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## Innovation and economic transformation in low-income countries: a new body of evidence

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February 2020

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## About DFID-ESRC Growth Research Programme

The DFID-ESRC Growth Research Programme (DEGRP) funds world-class scientific research on inclusive economic growth in low-income countries (LICs). The programme's principal aim is to generate policy-relevant research on four key areas: financial sector development and growth; agriculture and growth; innovation and growth; and China's engagement in sub-Saharan African countries.

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## Acknowledgements

This report synthesises research undertaken by the DFID-ESRC Growth Research Programme. It was discussed during a synthesis roundtable at the Overseas Development Institute (ODI) on 17 September 2019. Participants at the roundtable included Oliver Morrissey, John Piper, Richard Teuten and Njuguna N'dungu. We are grateful for the comments and suggestions received. We would like to thank DEGRP researchers for their excellent collaboration and comments. The authors would like to thank Margaret McMillan for her peer-review comments on earlier drafts.

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## Acronyms

<b>BER</b>	business environment reform
<b>DEGRP</b>	DFID-ESRC Growth Research Programme
<b>DFID</b>	UK Department for International Development
<b>ESRC</b>	UK Economic and Social Research Council
<b>ET</b>	economic transformation
<b>FDI</b>	foreign direct investment
<b>GDP</b>	gross domestic product
<b>GGDC</b>	Groningen Growth and Development Centre
<b>HIC</b>	high-income country
<b>IFPRI</b>	International Food Policy Research Institute
<b>IGC</b>	International Growth Centre
<b>IMF</b>	International Monetary Fund
<b>LIC</b>	low-income country
<b>MIC</b>	middle-income country
<b>ODI</b>	Overseas Development Institute
<b>PEDL</b>	Private Enterprise Development in Low-Income
<b>R&amp;D</b>	research and development
<b>SAIS CARI</b>	China Africa Research Initiative at the Johns Hopkins University School of Advanced International Studies
<b>SEZ</b>	special economic zone
<b>SME</b>	small and medium-sized enterprise
<b>SSA</b>	sub-Saharan African
<b>TFP</b>	total factor productivity
<b>UN</b>	United Nations

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## Summary

The Department for International Development (DFID) and Economic and Social Research Council (ESRC) Growth Research Programme (DEGRP) has carried out innovative, mainly empirical, research on the subject of innovation and economic transformation. This report synthesises this emerging evidence in the context of ongoing research in the wider literature.

Structural transformation theory dates to the times of Arthur Lewis (1950s and 1970s), who argued that development occurs when surplus resources shift from the agricultural subsistence (traditional) sector to the modern sector. Lack of data permitted only limited empirical long-term analysis. This analysis was until recently mainly on high-income countries, but over the past decade DEGRP research has been at the forefront of extending it to Latin America, Asia and particularly Africa. DEGRP research has also examined sector transformation (e.g. the African pharmaceutical industry) and within-sector productivity change focusing on firms (e.g. in the garments sector in Bangladesh).

### Patterns of transformation

Structural transformation (moving resources across sectors) has growth and productivity implications, but the precise impacts vary by country and period. While many 'developing' countries recorded strong growth leading to income levels converging with 'developed' countries, there have been very different patterns of transformation. African countries experienced structural change that reduced labour productivity in the 1990s (including moving out of manufacturing into activities with lower productivity), but the opposite after 2000. Latin America, however, has experienced growth coming from within-sector productivity improvements. Such new empirical research using new databases has had a major impact on the policy and academic debates around structural and economic transformation.

Innovation and adoption of new technology varies by country, sector and firm, and even within firms through production lines. Innovation is not always visible in economic measures, but changes, for example, in working practices can be very important, even if below the radar. Many firms may adopt new technology out of necessity. Those that do not may not survive competition with imports, but those that innovate thrive on competition. Even within large firms there can be major differences across production lines. This adds a new dimension to economic transformation and changes in production structures (more disaggregation of the within-sector component) and as such provides a new area of research on the factors behind this.

### Supporting economic transformation

Research has confirmed the importance of a range of general enabling policies such as research and development (R&D), openness (exporting and inward foreign direct investment (FDI)), education, and skills building for innovation and structural transformation. These results are perhaps not path-breaking, but it is still very important to have confirmation about the importance of general enabling policies using more recent data and other data collected specifically for the research in low- and middle-income countries (LICs and MICs). Research has also pointed to the importance of considering demand versus technology or supply explanations of structural change. This can have implications for those institutions and actors supporting transformation, but it is too soon to draw any specific policy suggestions given that research in this area is relatively new.

The policy literature has been clear that general enabling policies on their own are not sufficient to kick-start transformation. This synthesis makes the case that more targeted, sectoral and industrial policies also have an

important role to play. In particular, DEGRP research suggests that governments need a more targeted approach to building up local industrial capabilities. This involves more active support for local production, for example through using public procurement and better coordination between trade and industrial policies. This confirms findings in the literature elsewhere that strategic interventions when done well are vital for transformation.

Working at the micro level with businesses to enable their learning is important. There is much heterogeneity across firms, and it is crucial to bring them together, including in policy dialogue with governments, so that they can consider the causes and implications of the differences. Large garments firms in LICs should consider the importance of training for female supervisors and more attention needs to be focused on peer learning and mentoring, which has been shown to support firm performance. This indicates a collective action problem and lack of firm-level initiative, which need to be addressed.

This synthesis identifies a number of DEGRP findings and achievements. It also offers general and specific policy suggestions and includes new areas for research.

## Key achievements

DEGRP research on growth and economic transformation has resulted in at least five major achievements:

1. Reinvigoration of the empirical study of structural transformation in LICs, helping African countries to become more vocal and better informed during the last decade. This has also advanced the academic debate on structural transformation (McMillan and Rodrik, 2011; McMillan et al., 2014; Diao et al., 2017a).
2. Development of data on African countries, which has been cited and used frequently, and has many opportunities for future applications, such as the Africa Sector Database, a 10-sector database developed by the Groningen Growth and Development

Centre (GGDC) (de Vries et al., 2015; GGDC, n.d.).

3. Discovery of new sources of economic transformation at firm level (Bangladesh), which previously had not been examined in such a detailed way. These types of data are likely to be exploited much further in the future. It has also allowed for a better understanding of women's advancement through supervisor training in large garments firms (Macchiavello et al., 2015a).
4. Increased profile of the challenges and opportunities of the local pharmaceutical sector in Africa, especially in Kenya and Tanzania. This includes a better understanding of the coordinating role of industrial policies and other incentives for further action at the African level, bringing together industrialisation and the health sector (Mackintosh et al., 2016) and solving coordination failures for structural change.
5. Confirmation of general enabling and targeted policies behind innovation and transformation, which has global applications and new, specific implications for industry–university collaborations in countries such as Ghana (Fu et al., 2018).

## Policy suggestions

Specific policy suggestions require context-specific analysis. DEGRP research has led to specific policy insights summarised by DEGRP briefings and a series of briefings called Research in Context. Stepping back from the details, and focusing on general lessons, the research has helped to identify five policy shifts in support of economic transformation and innovation. Policy-makers should:

- **Pay more explicit attention to structural change (in addition to sector transformation).** While empirical evidence suggests that patterns of transformation differ over time and across countries, and the relative contribution of structural change (across sectors) and sector transformation on productivity change differs too, it is also clear that structural change plays a major role in driving (or limiting) aggregate

productivity growth. Policy support is often focused at sector transformation, but it should be broadened to promoting structural change, which is underemphasised.

- **Target support for the manufacturing sector in Africa.** The manufacturing sector plays a special role in economic transformation: it has greater (labour) productivity than most other sectors and it has traditionally supported large-scale job generation. However, the manufacturing sector now plays a different, albeit still important, role in development. It is harder to enter manufacturing now, as it has become more capital intensive. Africa has several other options for growth, but the share of the manufacturing sector in overall production is very low compared to other regions. It has significant scope for growth.
- **Provide targeted and coordinated measures for economic transformation.** General enabling market incentives are relevant, for example, in simulating greater openness to trade and investment, which is an important factor for productivity change. But strategic and targeted actions are also important. For example, efforts to industrialise and meet health needs require coordinated approaches across industrial policy and the health sector. This would suggest it is important to combine market incentives and strategic interventions while building up innovation systems involving a range of interconnected institutions that interact around innovation.
- **Work with firms to incentivise collaboration and learning.** Much progress in productivity within a sector happens at the firm level. Policy-makers sometimes assume firms are similar, but the evidence, including new evidence produced under DEGRP, suggests firms can have different levels of productivity (including within firms across production lines), which is a major source of economic transformation generally. The evidence on firm-level impact of access to credit is more developed than it is on the impact of training, and the evidence on the impact of coaching between firms is beginning to be significant. Policy-makers will need to work with firms

to understand how they can best foster collaboration and learning among firms.

- **Support the development of industrial capabilities for innovation.** Attention has only recently begun to focus on digital technologies, such as the impact of mobile phone technology, and generally this is posing interesting questions for future research. One specific policy suggestion for now, however, is that it is simply important to prepare for any type of innovation that is about doing things differently. Developing industrial capabilities is more important than ever, and this needs to go beyond market incentives that may only help to lock in digital divides.

## New areas of research

There are many research gaps, including:

- Extending and bringing together different types of data focusing on: (1) the structure of consumption, leading to better mapping between expenditure categories and productive sectors of the economy (Herrendorf et al., 2014); and (2) estimating sectoral productivity levels by combining sectoral value-added prices with information on wages and capital input prices to measure sectoral total factor productivity (TFP) using the dual approach to productivity measurement (Herrendorf and Valentinyi, 2012).
- Examining the demand versus supply or technology explanation of structural transformation and apply this to the experience of LICs (Sen, 2019).
- The lack of industrialisation in Africa is an important observation in this synthesis. Further attention on this matter is needed, as it is on the effectiveness of industrial policy. And how can industrial policies, market incentives and other transformation actions be best combined?
- Structural transformation is often couched in terms of sectors, which are directly measured in the national accounts. However, there is now much attention on global value chains, which do not follow traditional sectoral

upgrading paths. Instead, they combine different sectors. There is also evidence that modern and traditional activities co-exist within sectors, though Lewis (1954) suggests these differences were mainly between sectors.

- Automation and digitalisation are likely to have wide-ranging effects on types and pace of transformation. How can this be best

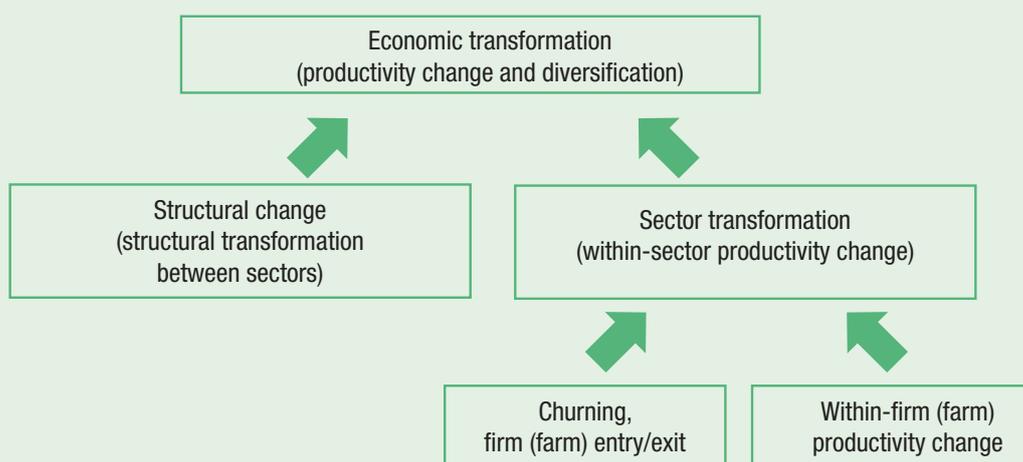
measured, what do empirical observations tell us, and what can be done? How do traditional suggestions on industrial capabilities need to be adapted for preparing countries for a digital economy?

- Uncovering links between structural transformation and other non-economic variables, such as poverty and environment.

### Box 1 Economic transformation, structural change, productivity growth and innovation

This synthesis uses a range of terms, which we explain here briefly. The most comprehensive term we use is economic transformation, which is the process of broad-based aggregate productivity change and diversification (McMillan et al., 2017). This consists of: (1) structural change or structural transformation, indicating that moving factors of production between sectors affects productivity; and (2) sector transformation, describing within-sector productivity change. The latter comprises productivity change through churning or firm entry and exit, and firm-level productivity change or firm-level (and farm-level) upgrading, which can also involve reallocation of resources.

Innovation can happen at all levels but is most associated with sector and firm-level productivity change. It refers to product- and process-level innovation (OECD, 2005), which can be the implementation of new or adapted existing technology. Innovation can lead to productivity change, which is measured through the efficiency of factor use. Ideally, we use TFP to measure productivity, but at the macro and meso levels we often use labour productivity measures due to data constraints (such as lack of capital stock data).



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# 1. Introduction and overview

Policy-makers in LICs are increasingly aiming for a different and higher-quality type of growth. This growth should be more technology intensive, with a diversified production structure, be resilient to shocks, create jobs and be more inclusive. Growth should have greater depth (ACET, 2014), with more diversification, competitive exports, upgrading and improved human skills. Crucial for this is enhancing economic transformation (ET), defined as the movement of resources from low-productivity to high-productivity activities (McMillan et al., 2017). However, empirical evidence on how much is already happening and how to enhance this process is often scarce or lacking altogether in LICs. Research undertaken by the DEGRP over the past decade has led to exciting empirical work in this area, which has had wide-ranging consequences (McMillan et al., 2014; de Vries et al., 2015; Macchiavello et al., 2015a; Mackintosh et al., 2016; Fu et al., 2018). This report synthesises the most relevant evidence, putting it in context in terms of an emerging body of research on ET (see Box 1 on definition of key terms, Box 2 on DEGRP projects covered and Box 3 on other relevant research).

Structural change or structural transformation is a key component of wider ET. The literature on structural transformation has been evolving since the 1950s, with contributions from Kuznets (1966), Lewis (1954), Syrquin and Chenery (1989) and others. Building on these theoretical contributions, McMillan et al. (2017) define ET as the ongoing process of: (1) increasing aggregate productivity by moving labour and other factors of production from lower- to higher-productivity sectors (structural change); and (2) raising within-sector productivity through sector-wide improvements (moving resources from low-productivity activities to high-productivity activities within the same sector), for example skills training or clustering of firms, and firm-level innovations. ET is, therefore, a process that includes productivity change at the macro, meso and micro levels.

The shift of resources from less to more productive sectors and activities is often thought of as moving away from ‘traditional’ sectors – such as agriculture – into more productive ‘modern’ sectors – such as industry and ‘high-end’ services (Lewis, 1954; Kuznets, 1966; Syrquin and Chenery, 1989). Moving productive resources between economic sectors to fill productivity gaps can indeed be a significant driver of growth (McMillan and Rodrik, 2011; McMillan et al., 2014). However, even within sectors often considered to be less productive, such as agriculture, the promotion of more productive firms and activities will raise average productivity in the sector, and consequently nationally (Dercon and Gollin, 2014). Thus, ET can also be considered as productivity increases within sectors, value chains or within firms. Much has been written on firm-level productivity (Dutz et al., 2011) and its causes, such as capital, skills and mentoring. Woodruff (2018) provides a recent review.

Structural transformation links sectors with different levels of productivity and innovation with economic growth. The spread of innovation helps technical change and the ET process more generally. The Oslo Manual (OECD, 2005) defines innovation as the implementation of a new or significantly improved product (good or service) or process (a new marketing or organisational method in business practices, workplace organisation or external relations). In the case of LICs, we use a broader definition of innovation, encompassing the 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. Innovation encompasses the processes by which firms master and put into practice product designs and processes that are new to them. DEGRP has also examined innovation in household practices, which we do not cover in this synthesis.

## Box 2 DEGRP projects covered by this synthesis

The [Growth Research Programme](#) covers four broad areas: innovation, finance, agriculture and China-Africa. We have selected those projects that address ET directly or indirectly through sector or firm analysis. The innovation portfolio is highly relevant because it deals directly with questions around structural transformation, diffusion of innovation, industrial policy and worker productivity at macro or meso levels. But not all projects will be covered directly, as some projects are more focused on innovation at the household level. The China-Africa portfolio includes two projects related to structural transformation, innovation and employment. The finance portfolio includes projects on microfinance and macro-financial sector regulation and growth, and a recent survey (Beck and Tyson, 2019) covers the latter. Within the agriculture portfolio, studies examining productivity have focused on raising productivity on farms, often beginning by observing the gap between practices on farm and what is achievable using, what is by now, quite well-known technology. Just two studies look at productivity within the evolving agricultural supply chains and two look at the links between agriculture and the rural non-farm economy. Some of these studies have also been covered by other DEGRP synthesis products.

There are hundreds of outputs we could potentially examine, ranging from journal articles to book chapters, briefings and presentations, all available from the ESRC's Researchfish Research Impact Assessment Platform or the [DEGRP website](#). This synthesis focuses on DEGRP studies of the highest quality, which include peer-reviewed journals and selected papers or books that have had significant exposure and public discussion, in the context of other relevant analyses.

More specifically, this synthesis covers the findings of the following [DEGRP innovation](#) and [China-Africa projects](#) (listed by principal investigator):

- **Margaret McMillan, IFPRI and Tufts University:** *Structural Change and Productivity Growth in Africa*
- **Maureen Mackintosh, Open University:** *Industrial Productivity, Health Sector Performance and Policy Synergies for Inclusive Growth: A Study in Tanzania and Kenya*
- **Chris Woodruff, University of Warwick:** *Training, Productivity, and Upgrading: Evaluation of Female and Supervisor Training Programs in the Bangladesh Apparel Sector*
- **Xiaolan Fu, University of Oxford:** *The Diffusion of Innovation in Low-Income Countries*
- **Naufel Vilcassim, London Business School:** *Complementing Managerial Capital with Business Information: A Field Experiment on International Consulting for Entrepreneurs in Uganda and Rwanda.*
- **Deborah Bräutigam, SAIS CARI, Johns Hopkins University:** *Chinese FDI and Structural Transformation in Africa*
- **Carlos Oya, SOAS University of London:** *Industrial Development, Construction and Employment in Africa*
- **Other relevant innovation projects:** **Andrew Dillon, Michigan State University:** *Malaria, Productivity and Access to Treatment: Experimental Evidence from Nigeria*; **Sharon Buteau, Institute for Financial Management:** *Worker Sorting, Work Discipline and Development*; **Orazio Attanasio, Institute for Fiscal Studies:** *Improving Productivity in Developing Countries: Identifying Bottlenecks and Obstacles to Investments and Technology Adoption*; **Amalavoyal Chari, University of Sussex:** *Privatisation and Productivity Growth*
- **Relevant innovation in agriculture projects:** the agricultural projects listed on the [DEGRP Agriculture project page](#) will be treated briefly in this synthesis and will be the subject of a more detailed synthesis later in 2020.

This synthesis is structured as follows: Section 2 reviews the academic literature on the theory of structural transformation and discusses the renewed policy interest in innovation and ET in LICs. Why is structural transformation important for growth? What can be done to support it?

Section 3 presents and analyses new empirical evidence, contributed by DEGRP, on patterns of ET in LICs. This section distinguishes among patterns at the macro, meso and micro levels and asks where innovation, and structural and productivity change, are already happening and to what extent. How do country experiences compare? What is the role of sector transformation and value chain development in ET? What is the importance of firm-level performance in driving ET?

Section 4 discusses new evidence on policies and institutions that can stimulate ET and innovation.

ET is a long-term process, and policies and institutions play a role in shaping it. This section examines the incentive framework for countries and firms to acquire new technology, upgrade production processes, innovate and promote productivity change. It reviews the new DEGRP evidence on supporting transformation through general enabling policies, industrial policy and firm-level support.

Section 5 concludes by discussing the main findings from DEGRP research and proposes new areas of research. This synthesis aims to support public policy planners, high-level civil servants and private-sector associations in LICs, economic development officials in donor agencies and development finance institutions, and to inform the wider academic community interested in innovation for ET.

### **Box 3 DEGRP and other research programmes on innovation and economic transformation**

Several research programmes have examined aspects of growth and ET in LICs over the past decade:

- **DFID-ESRC Growth Research Programme** (DEGRP) funds world-class scientific research on inclusive economic growth in LICs. The programme's principal aim is to generate policy-relevant research on four key areas of growth: financial sector development, agriculture, innovation and China's engagement in sub-Saharan African (SSA) countries.
- **Private Enterprise Development in Low-Income Countries** (PEDL) is a joint research initiative of the Centre for Economic Policy Research (CEPR) and DFID focusing on private-sector development in LICs. The initiative aims to better understand what determines the strength of market forces driving efficiency in these countries.
- **Growth and Labour Markets in Low-Income Countries Programme** (GLM | LIC). Run by the Institute of Labor Economics (IZA) and DFID, the programme aims to improve knowledge on labour market issues in LICs and provide a solid basis for capacity building and development of future labour market policies. Since mid-2019, the programme now includes a focus on gender issues.
- **Enabling Innovation and Productivity Growth in Low-Income Countries** (EIP-LIC) is a research project at Tilburg University and Radboud University Nijmegen funded by DFID on innovation and productivity growth in LICs. It focuses on studying the factors, institutions and policies that increase business innovation and productivity growth, particularly in small and medium-sized enterprises (SMEs) engaged in manufacturing.
- **United Nations University World Institute for Development Economics Research** (UNU-WIDER) provides economic analysis and policy advice to promote sustainable and universal equitable development. From 2019–2023 UNU-WIDER research is focusing on the interlinked development challenges of transforming economies, states and societies

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## 2. Structural and economic transformation: concepts and policy questions

### 2.1 The academic literature on structural transformation

Economists have long searched for patterns that relate successful economic development to structure and policy (Syrquin and Chenery, 1989). This comparative approach in development economics was initiated by Kuznets and predicated on ‘the existence of common, transnational factors and a mechanism of interactions among nations that will produce some systematic order in the way modern economic growth can be expected to spread around the world’ (Kuznets, 1959).

One of the most striking findings of this comparative approach to economic development was the ‘universal inverse association of income and the share of agriculture in income and employment’ (Syrquin and Chenery, 1989: 172). As Kuznets argued, one of the key features of modern economic growth was the movement of workers from agriculture to manufacturing and services (Kuznets, 1966). The comparative approach identified the manufacturing sector as the engine of economic growth for most countries, and the rate at which industrialisation occurred differentiated successful countries from unsuccessful ones (McMillan et al., 2014; Haraguchi et al., 2017). However, at a certain stage of economic development, productivity growth in manufacturing exceeds productivity growth in agriculture and services, and demand for services expands. At this point, the service sector becomes the major provider of employment and the manufacturing sector becomes less important in terms of providing employment, though not in terms of output growth (Chenery and Syrquin, 1975; Syrquin, 1988; Syrquin and Chenery, 1989).

The movement of workers from agriculture to manufacturing, and then to services, is the path of structural transformation undergone in all the countries that comprise the high-income club as well as the successful growth examples in

East Asia. This path has received a great deal of attention among economists, and underpins most of the theoretical understanding of structural transformation all the way from scholars in classical economics, such as Kuznets, Lewis, Chenery and Syrquin, to more contemporary approaches that are rooted in the neoclassical tradition (Duarte and Restuccia, 2010; Dabla-Norris et al., 2013; Herrendorf et al., 2014; McMillan et al., 2014; Diao et al., 2017a). In this section, we review the theoretical literature on structural transformation, starting with the classical approach and followed by the neoclassical approach.

#### Theoretical perspectives

In the 1950s, economists such as Chenery, Syrquin and Kuznets led a programme of research that sought to understand the features and preconditions of modern economic growth. The interest in understanding ‘the interrelated processes of structural change that accompany economic development ... jointly referred to as structural transformation’ was central to this programme (Syrquin, 1988: 206). One of the most robust findings from this programme of research was set out by Kuznets: ‘in the countries where per capita income grew significantly, the proportion of the labour force engaged in agriculture declined and that engaged in non-agriculture increased’ (1965: 24). Kuznets also noted that, in more advanced economies, ‘the shares of mining and manufacturing in the total labour force grew significantly, but the increases have ceased or slowed down in recent decades ... the shares of trade and other services have grown steadily and grown steadily in recent decades’ (ibid.: 25).

A more recent analysis of the pattern of structural transformation is provided by Duarte and Restuccia (2010), who use sectoral employment data for 29 high-income countries (HICs) and MICs that are obtained from the EU KLEMS data

and the Laborsta database of the International Labour Organization (ILO). They find that 'all countries in the sample follow a common process of structural transformation. First, all countries exhibit declining shares of hours in agriculture, even the most advanced countries in this process, such as the United Kingdom and the United States. Second, countries at an early stage of the process of structural transformation exhibit a hump-shaped share of hours in industry, whereas this share is decreasing for countries at a more advanced stage. Finally, all countries exhibit an increasing share of hours in services' (Duarte and Restuccia, 2010: 135). They go on to state that 'The processes of structural transformation observed in our sample suggest two additional observations. First, the lag in the structural transformation observed across countries is systematically related to the level of development: poor countries have the largest shares of hours in agriculture, while rich countries have the smallest shares. Second, our data suggest the basic tendency for countries that start the process of structural transformation later to accomplish a given amount of labour reallocation faster than those countries that initiated this process earlier' (ibid.).

### The classical approach to structural transformation

The classical approach to structural transformation is best exemplified by the Lewis model, which explicitly recognises the importance of structural change and intersectoral flows of labour in the process of economic development (Sumner, 2019). Lewis argued that the key driver of capital accumulation was a sectoral movement of labour, which was the factor of production abundant in low- and middle-income countries, from traditional sector to the modern sector. Here, the traditional sector could be taken to be the low-productivity subsistence agricultural sector, while the modern sector could be taken to be the manufacturing sector, which tended to be more productive than the agricultural sector, at least in the initial stages of economic development. The reason for this was the existence of surplus labour in the traditional sector.

The dual economy model that Lewis proposed to understand structural transformation in the context of economic development had three features: 'First, there are two sectors, hereinafter called "modern" and "traditional", such that the modern sector grows by recruiting labour from the traditional. Second, unskilled labour is paid more in the modern sector than in the traditional sector for the same quantity and quality of work. And thirdly, unskilled labour is initially abundant in the sense that at the current wage much more labour is offered to the modern sector than that sector wishes to hire' (Lewis, 1979: 211).

In the standard Lewisian framework, the increase in employment in the modern sector – the manufacturing sector – occurs due to an expansion in the demand-for-labour curve in that sector (Lewis, 1954). Due to a wage gap between the manufacturing and agricultural sectors (the subsistence sector, in Lewis's original framework), where the manufacturing wage rate is higher than the subsistence wage in the agricultural sector, surplus labour moves from the agricultural sector to the manufacturing sector (Basu, 1984). In Lewis's model, the wage rate in the manufacturing sector is institutionally set (Fields, 2004). The wage rate in the agricultural sector, on the other hand, is set in relation to the average productivity in that sector. As long as the real wage differential between the manufacturing and agricultural sectors is sufficiently large, firms in the manufacturing sector will face an unlimited supply of labour from the agricultural sector – that is, they can hire as many workers as they want without increasing the manufacturing wage rate. As the demand for labour in the manufacturing sector expands, the labour force in the agricultural sector diminishes, increasing the agricultural wage rate. This happens only after 'surplus labour' – that is, labour with a very low marginal physical product – has left the sector. This may take decades, as seen in China from 1978 onwards. The movement of labour from the agricultural to the manufacturing sector at the institutionally set, fixed manufacturing wage rate will come to an end when the agricultural wage rises to the level of the manufacturing wage rate (although in practice this may not occur often).



As Lewis argued: ‘The key to the process is the use which is made of the capitalist surplus. In so far as this is reinvested in creating new capital, the capitalist sector expands, taking more people into capitalist employment out of the subsistence sector. The surplus is then larger still, capital formation is still greater, and so the process continues until the surplus labour disappears’ (Lewis, 1954: 151–152). In this model, an increase in the demand for labour follows an increase in manufacturing output. This could occur through investment and accumulation as capitalists reinvest their profits (Lewis, 1954). As long as there is reinvestment of surplus in the modern sector, growth is sustained by structural transformation – that is, the transfer of workers from low-productivity to high-productivity sectors.

While Lewis provided an explanation of why – as there was surplus labour in the agricultural sector – the manufacturing sector could expand both in terms of output and employment, it was less clear from his model how the allocation

of workers could occur from manufacturing to services, especially as surplus labour was exhausted in the agricultural sector. As we have noted, the possibility that structural transformation at a later stage of economic development would involve a reallocation away from manufacturing to services was recognised in the classical economics literature, and some early insights on why this may be the case were provided by Clark (1940). He argued that the pattern of structural transformation could be related to differential productivity growth and Engel effects (which represent a reallocation of labour from manufacturing to services on the basis that the latter is more income elastic than the former), which according to Syrquin are ‘the two principal elements in the subsequent attempts to account for the transformation in the structure of production’ (Syrquin, 1988: 213). More theoretical development along these lines had to wait until the resurgence of interest in structural transformation among neoclassical economists from the 2000s onwards.

## The neoclassical approach to structural transformation

The main model of economic growth is the Solow–Swan model, which by its very nature abstracts from sectoral allocation issues in the process of economic development, focusing on the role of capital accumulation and technological change in the aggregate. As Herrendorf et al. (2014) note, ‘The one-sector growth model has become the workhorse of modern macroeconomics’. The popularity of the one-sector growth model is at least partly due to the fact that it captures in a minimalist fashion the essence of modern economic growth, which Kuznets (1973) in his Nobel prize lecture described as the sustained increase in productivity and living standards. By virtue of being a minimalist structure, the one-sector growth model necessarily abstracts from several features of the process of economic growth. One of these is the process of structural transformation – that is, the reallocation of economic activity across the broad sectors agriculture, manufacturing and services’ (Herrendorf et al., 2014: 855).

For a long time, there was limited interest in the question of structural transformation in the neoclassical school of economics. This changed in the 2000s with a series of path-breaking studies that developed multi-sector versions of the one-sector growth model that were consistent with the stylised facts of structural transformation, such as Rogerson (2007), Ngai and Pissarides (2007), Duarte and Restuccia (2010) and Herrendorf et al. (2014). Two different models were developed: one where the causal explanation was technological in nature and which attributed structural transformation to different rates of sectoral TFP growth; and the second being a utility-based explanation that required different income elasticities for different goods and could yield structural transformation even with equal TFP growth across all sectors.

While several authors attempted to provide a theoretical formulation of the process of

structural transformation within a growth model, the best-known formulation is provided by Duarte and Restuccia (2010). Their model captures the causal factors that drive the allocation of labour from agriculture to manufacturing and services. In their model, there are two forces that drive labour reallocation between sectors – technological (or supply) factors and demand-side factors. The technological explanation stresses the role of differential productivity growth in explaining structural transformation. The second explanation is the utility-based explanation, where there is a reallocation of labour from manufacturing to services as the latter is more income elastic than the former (the Engel effects mentioned previously).

Duarte and Restuccia (2010) provide a series of simulations of their model with real-world sectoral data drawn from the GGDC. These show that their model ‘mimics’ the pattern of structural transformation in HICs and MICs. However, Sen (2019) shows that their model does not do an adequate job of capturing the pattern of structural transformation in LICs. He suggests that there needs to be a rethinking of the theoretical premises behind much of the mainstream approach to structural transformation and the identification of alternate causal mechanisms that can explain the different types of structural transformation that we see in LICs and MICs. Clearly, more progress is needed on the theoretical front for understanding the complex patterns of structural transformation seen in LICs and MICs.

The literature on structural transformation emphasises the key role of the industrial sector. Because the structural transformation that typically accompanies economic development sees agriculture decline relatively, both as a contributor to gross domestic product (GDP) and as provider of employment, the temptation is to ignore or undervalue agriculture’s contributions to transformation. However, while agriculture may decline relatively, it must develop in absolute terms if it is not to stymie

transformation (Timmer, 2009).<sup>1</sup> Successful structural transformation implies first that farm output grows faster than increasing population and demand for food, and second that labour productivity rises to allow agriculture to release labour – and often capital as well – to other sectors.

Moreover, relatively rapid agricultural growth can drive down the cost of food, thereby reducing the cost of living for workers in other sectors. That in turn allows either higher rates of savings or expanded demand for non-agricultural goods and services that helps stimulate industrialisation. Reduced real cost of staple food was the major contribution of the agricultural Green Revolution that began in the mid-1960s across much of South and Southeast Asia (Evenson and Gollin, 2003). Furthermore,

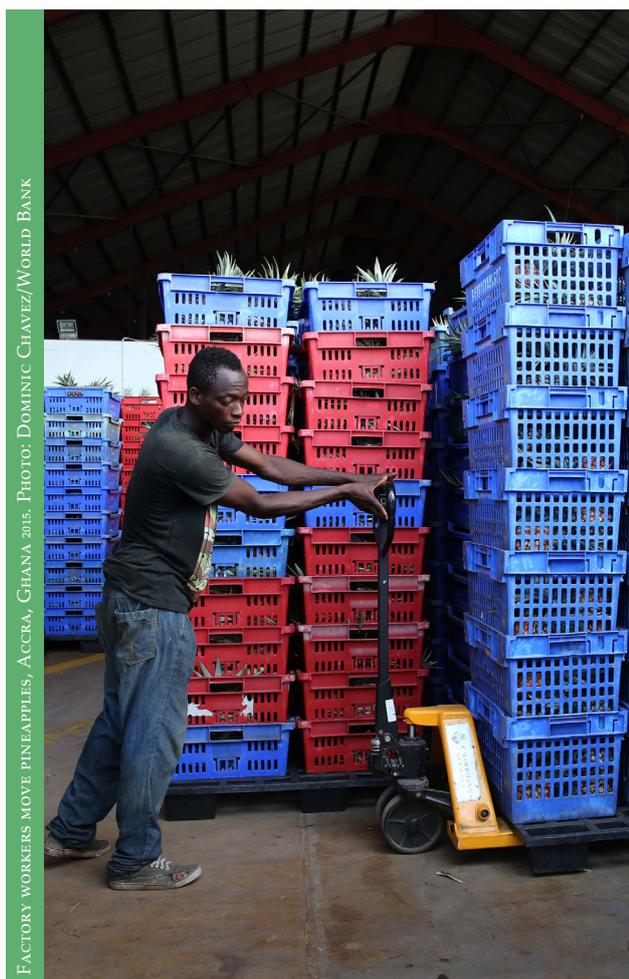
when agriculture is a major exporter, as usually applies in LICs, its development can earn more foreign exchange to allow nascent industry to import machinery and raw materials.

When these ideas about the role of economic development were first set out by Johnston and Mellor (1961), it was not clear that agriculture could develop sufficiently. Pessimism at that time was strongest about the prospects for Asia, which was then very poor, with fast-growing populations adding to the difficulties of what were already seen as overpopulated countries (Myrdal, 1968). The Green Revolution, however, put paid to Malthusian doubt. By the late 1970s it was clear that agriculture could grow and raise productivity to support Asia's industrialisation.

## 2.2 What are the policy questions?

Despite being a topic of analysis in the academic literature for a long time, as already noted, economic and structural transformation has received significantly more attention in LIC policy circles only in the last decade through the work of the African Union, the United Nations (UN) Economic Commission for Africa and the 2015 UN Sustainable Development Goals. Improved data, more detailed visions of industrialisation and transformation or five-year plans by African governments, and selectively supported by donors and think tanks, have also contributed to renewed interest.

Many LICs and MICs have experienced a remarkable period of economic development over several decades. In addition to India and China, which have registered very strong growth rates, countries in SSA and Latin America have managed in recent decades to match or exceed their performance of the 1960s and 1970s. Their experience differs greatly from the high-income or standard East Asian path already discussed. Countries such as the Republic of Korea, Taiwan and China have grown through rapid, export-oriented and labour-intensive manufacturing (Rodrik, 1995).



FACTORY WORKERS MOVE PINEAPPLES, ACCRA, GHANA 2015. PHOTO: DOMINIC CHAVEZ/WORLD BANK

<sup>1</sup> During the 20th century, almost all countries that successfully developed their industries did so accompanied by, and usually preceded by, an acceleration of agricultural development (Tiffin and Irz, 2006). The growth spurt in output from China smallholder farms seen from 1978 to 1983 is a good example (Montalvo and Ravallion, 2009).

By contrast, Latin American manufacturing as a percentage of GDP is now back to what it was in the 1960s, while the African manufacturing sector is not keeping pace with overall economic progress (and is declining as share of GDP). Thus, attention has shifted to the pattern, quality and resilience of that growth. Issues of concern include the sectoral and social distributions associated with the aggregate increases in GDP, the low-growth elasticity of extreme poverty in many countries and the weak capacity of the most dynamic sectors to generate sustained increases in productive employment. Much of the recent growth, especially in SSA, has been the result of high commodity prices generating higher incomes and demand (especially in the 2000s), or of increased public debt (more recently, in the 2010s) within an economic structure that retains many features and structural compositions established a long time ago. Other sources of recent growth include buoyant urbanisation and the expansion of a service economy serving new upper and middle classes, without any prior transformation of agriculture or the emergence of a sizeable manufacturing sector. Indeed, Diao et al. (2017a) suggest that African growth was based on declining labour shares in agricultural and rising in services. This pattern of growth is highly skewed and non-inclusive. As explained in the introduction, the African Centre for Economic Transformation argues that countries are getting economic growth but not ET or growth with depth (ACET, 2014).

Such observations have led to policy questions about the differences and commonalities in transformation patterns across countries, sectors and over time, as well as about what has driven these differences. To what extent is innovation and productivity change already happening in LICs? Why have some countries been able to raise productivity and diversify economic structures while others have not? What has been the role of innovation? How important is the structural change component of productivity change and do policy-makers sufficiently take into account this component of transformation?

During the past decade, African countries have begun to collectively put the spotlight on transformation through the African Union 2063 agenda (AUC, 2015). Industrialisation has now become a major objective in the development strategies of several African countries, leading sometimes to overly ambitious goals. While the aims of industrialisation may have become more visible, much less attention has been placed on how to achieve this in practical terms. Hence, there are important questions regarding the appropriate policy and institutional frameworks to support industrialisation and structural transformation. Would general enabling policies or regulatory reform be sufficient, or is a more targeted approach also required? How can the poor industrialisation records in Africa be reversed?

ET is not just a macro question involving structural change or a meso issue involving sector transformation through churning, it is also relevant at a micro level. Governments and organisations supporting ET realise the importance of working with firms. This is as much about the importance of supporting transformational deals (Pritchett et al., 2018) as it is about the importance of developing firms' capabilities to take part in value chains. Upgrading is not only about moving from one sector to the other, it is also about upgrading firms and functions within value chains that may cover several sectors (Gereffi, 1999). The role of public and private sector organisations in supporting learning and upgrading within firms, especially the smallest firms, is a further key policy issue.

In this policy context, DEGRP commissioned high-quality research on growth and ET in a range of areas: agriculture, innovation, financial sector development and the role of China in Africa. Some research began in the early 2010s whereas other research has become available more recently and in some instances has yet to pass the sometimes lengthy peer-review processes.

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### 3. Innovation and economic transformation: empirical patterns

A better understanding of empirical patterns of innovation and structural transformation is crucial for designing quality support to enhance economic and structural transformation. Herrendorf et al. (2014) argue that, while data are available for richer countries, much less is known in ‘today’s less developed countries’. The insights generated by Duarte and Restuccia (2010) were based on HICs and MICs, while there was very little empirical analysis on LICs (Sen, 2019). The literature uses different types of data sources to describe how productivity change and structural transformation happen, using production and consumption-based measures. We include three different pathways of transformation based on production-based measures:

1. **Structural change (or structural transformation):** moving labour and other factors of production across sectors with different productivity. McMillan and Rodrik (2011) highlight the potential for aggregate productivity change by enabling the shift of labour from agriculture to manufacturing.
2. **Firm entry and exit (or churning):** moving resources to higher-productivity firms within a sector. Several researchers have argued that productivity differentials are particularly large in LICs and MICs among firms rather than within firms within a sector or across sectors (Hsieh and Klenow, 2009; 2014).
3. **Improving firm-level productivity:** much aggregate productivity change in advanced countries happens within firms (Bartelsman et al., 2009), implying that innovation can be fostered through firm upgrading. For example, firm upgrading could occur through managerial changes (Bloom and Van Reenen, 2007).

This section discusses these three ways to describe transformation with economic data, putting the new DEGRP research in a wider context.

#### 3.1 Macro links between growth and transformation

DEGRP has contributed to the body of research analysing the link between growth and structural transformation, including McMillan and Rodrik (2011) and a range of subsequent studies. Using a sample of 38 countries (including 9 African countries, 9 Latin American countries, 10 low- and middle-income Asian countries, 1 Middle Eastern country and 9 HICs), McMillan et al. (2014) analyse global patterns of structural change and productivity growth to draw conclusions on how structural change and globalisation affected productivity growth. They divided the period between 1990 and 2005 into 1990–1999 and 2000 onwards. The results they obtained varied regionally and by income level, but had major implications on our understanding of structural transformation in LICs.

Due to a lack of pre-existing productivity differences between sectors, the HICs in the sample did not experience any positive or negative productivity differences explained by structural change. On the other hand, structural change made a significant impact on productivity in LICs and MICs. McMillan and Rodrik (2011) find, counterintuitively, that between 1990 and 1999, structural change had actually served to reduce rather than increase economic growth in those LICs and MICs, mostly due to the ‘industry rationalisation’ phenomenon – a situation whereby, due to import competition, the least productive firms exit the industry, and the firms that remain end up shedding excess labour. Thus, if the industry experiencing import competition was a high-productivity sector such as manufacturing, the only available industry to absorb labour would be lower-productivity sectors, such as agriculture or informal services. McMillan et al. (2014) observe this kind of reverse structural change in the Latin American and African countries of the sample. This movement from high- to low-productivity sectors

was found to reduce Africa's growth by 1.3 percentage points.

Disaggregating the data by time, however, it was found that structural change did indeed contribute positively to Africa's overall growth after 2000, accounting for nearly half of all growth and presenting a somewhat more positive outlook. For the same period, the manufacturing sectors of Ethiopia, Malawi, Nigeria and Zambia expanded, alongside a contraction in agriculture and services. Meanwhile, in Kenya and Senegal, structural change was mainly driven by an expansion in the services sector.

The initial analysis on the basis of labour productivity decompositions has led to further insights. For example, de Vries et al. (2015) find that labour productivity growth in Africa was the result of static gains, by moving resources to higher-productivity services (and out of manufacturing), but with dynamic losses, as such sectors have much lower (or negative) productivity growth compared to manufacturing. Diao et al. (2017a) provide more recent insights through comparing continents. They find that recent growth accelerations (e.g. in the 2000s) were due to rapid within-sector labour

#### **Box 4 The role of DEGRP in improving data for economic transformation analysis**

Deficiencies in the quality of economic statistics for LICs are well known, but there have not been many attempts to address these challenges. For an overview of economic statistics, see Turnbull et al. (2015). For a discussion on data quality, especially in relation to GDP, see Devarajan (2013) and Jerven (2013). There are challenges in measuring GDP and major revisions in GDP levels of more than 60% when revising the base year of GDP. In addition, some labour force statistics include informal jobs, while others only account for formal jobs. In their study, de Vries et al. (2015) discuss data quality and include several examples. For example, the World Development Indicators included data for Ethiopian agriculture for 1994 and then again in 2004–2006, with the number in employment varying from 3 million to 28 million and back to 3 million.

The analysis of ET in Africa has similarly been hampered by the reliability and availability of data on output and productivity trends by sector. Each rebasing of the national accounts also involves a change in the structure of the economy. However, the Africa Sector Database that was constructed as part of DEGRP-funded research is a major step forward and provides a consistent database across countries and sectors. The database consists of data for the period 1960–2010 for 11 SSA countries, which together account for about 70% of SSA's GDP (excluding South Africa). It covers countries from East Africa (Ethiopia, Kenya and Tanzania), West Africa (Ghana, Nigeria and Senegal) and Central and Southern Africa (Botswana, Malawi, Mauritius, South Africa and Zambia). It includes annual data on gross value added at current and constant prices from 1960 to 2010. It also includes data on persons engaged, which allows the computation of labour productivity (value added per worker) trends. The database covers 10 sectors, which together cover the total economy. Data and detailed documentation of sources and methods are publicly and freely available from the University of Groningen's GGDC (GGDC, n.d.).

The database is being used in several follow-up publications that use measures of sector labour productivity for the period 1960–2010. The study by de Vries et al. (2015) describes the data and has already been cited over 200 times. Other studies that use the database are Rodrik (2016) on premature deindustrialisation and Diao et al. (2017a) on recent growth. Other DEGRP grants operate at different levels. For example, research by Macchiavello et al. (2015a) examines the efficiency of trainees at production lines inside the factory. Databases like this are instrumental in comparing efficiencies across product lines inside a factory, across factories, and within and between countries.

productivity growth in Latin America, and due to structural change in Africa (at the same time as slow or negative within-sector productivity change). This was in contrast to Asian countries, which had rapid industrialisation and both structural change and within-sector productivity change. Diao et al. (2017a) argue this was because Africa's changes depended on demand-side factors such as remittances, external transfers and agricultural incomes (rather than rapid industrialisation).

Productivity decompositions have been used by other researchers using complementary data sets and for different countries. Table 1 summarises these attempts and confirms a lack of within-sector productivity change in Africa compared to Asia. A further point is that, while within-sector productivity growth in Africa is second to Asia, the GGDC data show relatively

strong productivity growth in agriculture, but productivity growth in the other 'modern' sectors in Africa has been very poor.

Diao et al. (2017b) chart differences in productivity across sectors in an original way (see Figure 1). The figure suggests there is large potential for growth through structural transformation. Moving resources from low-productivity sectors (such as agriculture) to higher-productivity sectors (such as manufacturing) would lead to an increase in aggregate productivity and economic growth. In Africa, low growth in manufacturing sector employment has restricted increases in aggregate productivity growth.

Other research confirms the presence of productivity gaps. For 30 SSA countries, Dercon and Gollin (2014) find that agricultural labour

**Table 1** Productivity decompositions by region

Study	Period	Region	Labour productivity growth (annual %)		
			Total	Within sectors	Between sectors
McMillan and Rodrik (2011)	1990–2005	Africa	0.9	2.1	-1.3
		Latin America	1.4	2.2	-0.9
		Asia	3.9	3.3	0.6
		Developed	1.5	1.5	-0.1
Diao et al. (2017a)	2000–2010	Africa	2.7	2.0	0.7
		Asia	3.4	2.8	0.6
		Latin America	1.0	0.9	0.1
		High-income	0.7	1.0	-0.3
McMillan and Harttgen (2014)	2000–2010	Africa (unweighted)	2.2	1.3	0.9
		Africa (weighted)	2.9	2.1	0.7
Timmer et al. (2014)	1990–2010	Africa	1.9	1.7	0.1
		Asia	3.6	3.1	0.6
		Latin America	0.9	1.1	-0.1
Kucera and Roncolato (2012)	1991–2008	Sub-Saharan Africa	3.0	2.4	0.5
		Asia	3.8	2.9	1.0
		Latin America	1.2	1.1	0.0
		Developed	1.1	1.2	0.0
Martins (2015)	2002–2013	Africa	1.9	1.1	0.8
		Asia	5.8	4.1	1.6
		Latin America	1.2	0.7	0.5
		Developed	0.9	0.7	0.2

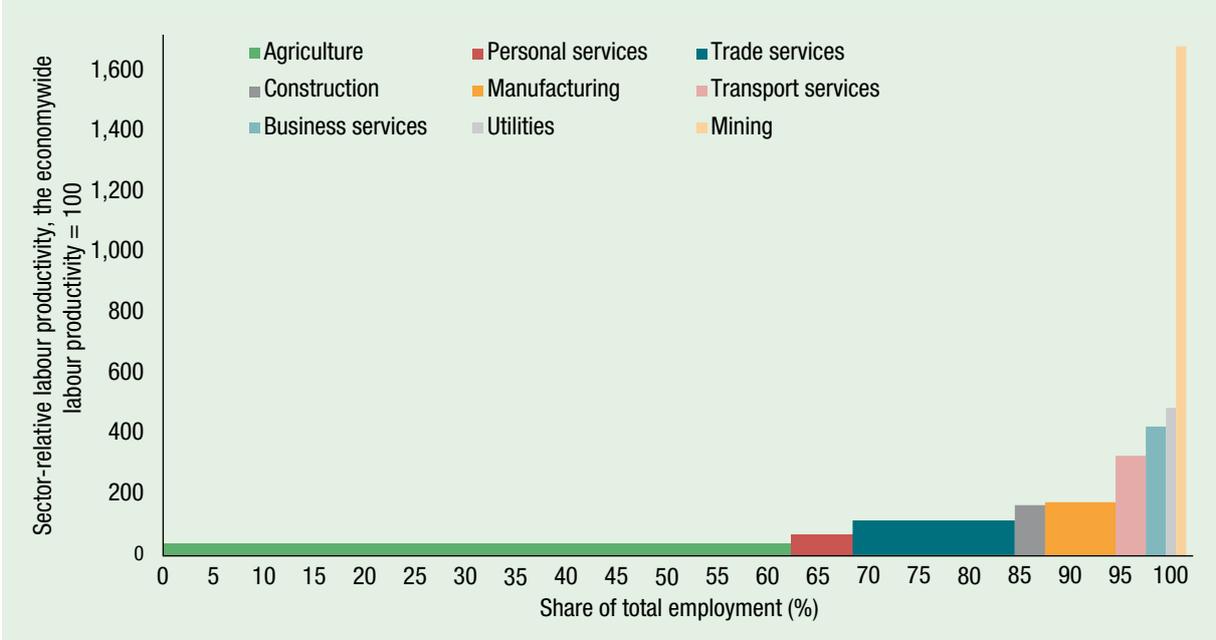
SOURCE: McMILLAN ET AL. (2017) AND MARTINS (2015) FOR FURTHER DETAILS.

productivity is 28% of non-agricultural labour productivity.<sup>2</sup> Structural transformation entails the movement of workers from low-productivity to higher-productivity activities, which involves a movement from agriculture towards the industrial sector. In DEGRP research, Oya (2019a) examines labour surplus transfer from agriculture to more productive activities in Ethiopia, where there is still limited evidence of this transfer. Unfortunately, a large pool of workers and low labour costs is no guarantee that labour will flow towards higher-productivity activities. For Ethiopia, key challenges to this movement include the presence of sociocultural barriers and the problem of ‘work cultures’ and work ethic; resource costs and frictions of labour transfers, especially related to living costs near working sites, and housing provision; the existence of large skills gaps; and contrasting expectations from employers and new industrial workers, and the conflicts that can arise from these.

### 3.2 Sector transformation

The macro analysis by McMillan and Rodrik (2011), McMillan et al. (2014) and Diao et al. (2017a; 2017b) suggests that within-sector productivity change will continue to be an important growth driver in LICs. Research over the last decade allows us to unpack the within-sector component. One observation is that there are large productivity differentials across firms within a sector, which indicates further opportunities for structural transformation within a sector. Hsieh and Klenow (2009) found that the misallocation of resources within sectors often results in a reduction in overall productivity. Thus, if there was more efficient redistribution by the firms (or farms) within different sectors, TFP could be improved significantly. Such misallocations were larger in LICs and MICs (India) than HICs (US). In addition, Balchin et al. (2019) suggest that many transformation successes and failures depend on sectoral conditions, such as targeted coordination of actors around a sector.

**Figure 1** Labour productivity gaps in Africa



SOURCE: DIAO ET AL. (2017B)

NOTE FROM ORIGINAL: THE SECTOR-RELATIVE LABOUR PRODUCTIVITY AND SECTOR SHARE OF EMPLOYMENT ARE CALCULATED USING THE WEIGHTED AVERAGE FOR THE REGION; THE COUNTRY DATA IS IN 2005 PURCHASING POWER PARITY DOLLARS. THE TOTAL EMPLOYMENT CONSIDERS ONLY THE EMPLOYMENT IN THE PRIVATE SECTOR.

2 Part of this may arise, however, from an overestimation of the amount of labour employed in agriculture. Much farming is seasonal and episodic: workers who declare their main occupation to be agriculture may be working fewer than 500 hours a year on their farms. Once labour productivity is recomputed as earnings per hour, the differences between agriculture and other sectors become much less marked – as McCullough (2015) found in Ethiopia, Malawi, Tanzania and Uganda.

DEGRP researchers have undertaken a range of sector studies around innovation and transformation, including the pharmaceutical and other manufacturing industries (especially in the context of China-Africa), and the financial sector and agriculture. We first cover the pharmaceutical sector in East Africa (discussed at length in the collection edited by Mackintosh et al. (2016), which examines the pharmaceutical sector in the wider context of linking manufacturing performance to health sector performance and structural change more generally). Lack of access to essential medicines is a major concern for SSA countries. There has been a considerable shortage of good-quality medicines and other essential healthcare commodities. Policy-makers are increasingly concerned about an overreliance on imports and are keen to investigate whether domestic pharmaceutical production can be improved instead. Indeed, many African countries consider the lack of local medicine supply a national security issue (*ibid.*).

Given the highly skilled and technology-intensive nature of pharmaceutical production, countries such as Tanzania and Kenya cannot meet the needs and demands of their populations without building up the financial, technological and regulatory capabilities associated with competent pharmaceutical production. African healthcare firms' ability to learn and adopt appropriate technologies has become the key to improving local industry competitiveness. The supply chain in Africa's health sector is a complex framework that requires continuous interaction and communication among stakeholders, with domestic medical manufacturers in Tanzania producing mainly basic commodities, while medical equipment and technological complex supplies are imported.

An important part of the research, such as that by Mackintosh et al. (2016; 2018), argues for linking industrialisation to a large health sector, examining manufacturing sector transformation in its wider context, suggesting that manufacturing performance should not only be seen within the separate silo of health, but in more general productive transformation terms. They argue that the recent wave of investment in

the pharmaceutical industry in Africa offers an opportunity to link industrialisation to improved access to medicines, better health sector performance and wider structural change.

The research includes a range of relevant findings for how to address sector transformation. Mujinja et al. (2014) show that it is important to examine sectoral transformation, looking much deeper into a sector. They examine local production of medicines by the pharmaceutical industry in Tanzania. Using data, statistical techniques and graphical presentations from a collaborative project between the World Health Organization and Health Action International, they analyse the role of locally produced medicines in African markets as opposed to imported brands. Rural populations were found to be heavily dependent on locally manufactured medicines, while import distribution systems skewed supply towards urban and more affluent regions. The relatively low level of technological capability among domestic manufacturers was found to be a severe constraint to their production capacity and efficiency, as well as a key barrier to domestic industrial development in general. If local firms were upgraded, this would support rural and urban consumers, but spending resources on imports would service urban consumers and fail to upgrade local supply capacity.

Such sector analysis fits within a wider research body that examines sector performance, for example on light manufacturing in Africa (Dinh et al., 2012) and UNU-WIDER research on learning to compete in industry (Newman et al., 2016), and on services, or 'industries without smokestacks' (Newfarmer et al., 2018). As noted, manufacturing in Africa is particularly poorly developed. The last decade has seen much new investment by China into the manufacturing sector in Africa, and one of the questions addressed (perhaps not always explicitly) in the China-Africa portfolio of DEGRP is whether China has helped Africa's manufacturing and transformation. For example, Tang (2018) analyses how Chinese investments have influenced Ghana's manufacturing sector to establish if there has been a 'flying geese' effect – a development pattern in which low- and middle-income countries first import a

particular product (such as automobiles), then begin to assemble and produce parts of the product, and finally move to becoming exporters of the product. Tang finds that the clustering of similar industries and the creation of industrial zones have helped Chinese manufacturers grow in Ghana, but beyond that they have also facilitated the building of linkages between Chinese projects and the local economy. On the negative side, the research also finds that these desirable spillover effects are slowed by a weak macroeconomic set-up and a lack of industrial support infrastructure and institutions. Further research will need to examine whether the Chinese experience is different to that of other foreign firms in Africa.

Oya (2019b) and Oya and Schaefer (2019) focus on the labour market impact of Chinese employers in Angola and Ethiopia. Through a selective survey of the available literature on labour practices in Chinese firms in Africa, Oya (2019b) finds that Chinese firms have generally high localisation rates (the share of local workers to total workforce). In terms of structural transformation, this indicates a movement towards higher-productivity sectors (especially construction and manufacturing).

However, some of the literature surveyed also reports that Chinese firms are characterised by limited skill development for their workers, which could signal lower within-sector productivity increases.

The agenda around agricultural transformation as a sector can be divided into two overall objectives. The first is support for farmers to innovate and invest. The large majority of farms in LICs and MICs are small-scale family farms. For most of these farms and the diverse crop and livestock enterprises they operate, technical innovations exist that can greatly raise productivity. There has been much research on why productivity gaps exist between what is technically feasible and what is observed in practice, including lower financial returns to innovation than expected, hence risks of adoption may be too high; markets for inputs, credit and insurance work imperfectly; insecure rights to land deter investment; knowledge of technical innovations does not reach farmers. None of these potential explanations excludes others: on the contrary, it is likely that limitations apply in combinations, with differing factors being more or less important depending on farming systems and individual farmers.



FACTORY WORKERS PRODUCE SHIRTS, ACCRA, GHANA, 2015. PHOTO: DOMINIC CHAVEZ/  
WORLD BANK

The second aim is facilitating reallocation of factors of production – land, labour and capital. Structural transformation should see some farmers reducing the time they spend farming, as they switch to non-agricultural occupations in industry and services. Land should then move from those farming less to those who remain as specialist farmers. Capital may also move, as savings generated from farming end up being invested in other sectors. Improved agricultural production can affect the national economy by causing a reduction in the prices of food and raw materials for industry, thereby raising the real wages of the urban poor (Thirtle et al., 2003). Savings in manufacturing production costs may also be passed on to the consumers. This rise in real wages could improve the general savings level and thus lead to further investment in the non-farm sector, thereby creating more jobs (Dorosh and Sahn, 2000). The foreign exchange earnings from agriculture could allow for more importation of capital goods, leading to further production. Finally, following the Lewis model, the release of labour from the agriculture sector could fuel even further non-farm or manufacturing production (Bhandari and Ghimire (2016) in DEGRP research).

### 3.3 Firm-level transformation

A closer examination of the private sector in LICs suggests that there are very few large firms and many small firms. This has led to policy questions as to why large firms are small in number, whether they can become more productive and whether small firms can grow. Unfortunately, evidence suggests it is hard for small enterprises to grow, and the evidence on formalisation is not clear cut.

In a joint International Growth Centre (IGC) and Aspen Network of Development Entrepreneurs (ANDE) working paper, Woodruff (2018) sets out the relevant evidence. Many small firms in low- and middle-income countries are not interested in or prepared for growth, or face major constraints to their growth. For example, Hsieh and Klenow (2014) and Eslava and Haltiwanger (2017) suggest that small firms in poorer countries (e.g. Colombia, India, Mexico) grow three to four times slower than

in the US. John Sutton's enterprise maps for African countries suggest that very few of the largest African firms were once small. Instead, the largest firms started as public enterprises, foreign-owned firms or simply large firms.

Benhassine et al. (2018) examine whether efforts to formalise informal firms are worthwhile, both in terms of firm efficiency and revenue to government. They used a randomised experiment with about 3,600 informal businesses in Benin and econometric techniques to make their analysis. The results show that firms who were encouraged to formalise did not necessarily experience higher sales or business profits. Furthermore, they find that the government costs of encouraging formalisation at a general level may exceed any added tax revenue that may be expected. The implication of this is that specific programmes to promote formalisation of small businesses should be considered carefully on the balance of the expected benefits. Benhassine et al. (2018) do suggest that the best firms to target for formalisation are those that are already close to being formal anyway, since the costs of formalisation efforts in these cases would be relatively cheap.

DEGRP research (Fu et al., 2018) examines the role of innovation in productivity of the formal and informal sectors in Ghana. They analyse data from a survey of 501 manufacturing firms. They find that at a base level, though formal firms were not inherently more productive than informal ones, technological innovation occurred more frequently in formal than in informal firms (whereas non-technological innovation diffused evenly among firms). From the statistical analysis, technological innovation was found, in general, to affect firms' productivity, while the role of innovation on productivity tended to be greater for formal firms.

If it is a challenge to transform small into large firms (Newman et al., 2016; Woodruff, 2018), and formalisation is not necessarily associated with transformational results, there are two further opportunities for firm-level based ET: (1) to attract new investment by high-productivity small and large firms (transformation through firm-level entry and exit); or (2) improve the

productivity of large firms. In this context, it is significant that a range of projects supported by DEGRP, GLM, PEDL and IGC over a number of years have uncovered some important features of large firms, such as those in Bangladesh's garment sector. The evidence suggests that there are important opportunities for firm-level based structural transformation.

Macchiavello et al. (2015b) explore Bangladesh's garment industry as part of a larger set of studies that use detailed worker-level surveys within factories. The studies analyse a range of variables, including production efficiency, at different production lines in garment factories. A key finding is that there is a large productivity dispersion within a factory, which is worth exploring. Woodruff (2014) finds there is a great deal of persistent variance in productive efficiency across production lines within the same garment factory. In a typical production unit with 10 production lines, the most efficient line is two-thirds more productive than the least efficient line. He argues that 'reducing the dispersion within factories by increasing the productivity of the least efficient lines is unlikely to be sufficient to ensure that the Bangladeshi garment sector remains competitive as wages increase. But it would be an excellent start'. He also points to the importance of the development of management capacity in Bangladesh. This analysis follows the seminal work of Macchiavello et al. (2015b) that suggests there is a demand for training services to improve production processes and quality, but evidence is lacking on the merits of such training programmes.

DEGRP's China-Africa portfolio has also used firm-level evidence to examine productivity change and learning across firms. Chen and Landry (2016) examine firms in Madagascar and find evidence of limited technology transfer from Chinese to local Madagascan firms. They find that the major factor that limits the effectiveness of Chinese investments on growth in the agricultural and manufacturing sectors are institutional. This includes factors such as confusing or inadequate government policy environment, lack of political stability,

poor labour relations and poor infrastructure and economic conditions.

Tang (2019a) focuses on knowledge transfer between Chinese companies and Ethiopian firms, institutions and individuals in the manufacturing sector in Ethiopia. The research finds that workers acquire skills on the job within firms, but that these are limited to 'shop floor' skills, and there is limited evidence of larger and more established skill-building initiatives. Tang also finds evidence of intra-firm learning through competition, forward and backward linkages, and joint ventures. Furthermore, there was evidence of improved institutional management of the industrialisation process, with the Ethiopian government's policies and capacities increasingly supporting sectors, learning the demands and characteristics of enterprises. Looking specifically at the leather sector in Ethiopia, Tang (2019b) finds that Chinese investments have contributed to both exports and employment. The study stresses how, beyond technology, one important contribution brought by foreign investors is in building upstream and downstream supply connections between Chinese and Ethiopian enterprises, which helps production and the creation of markets.

### 3.4 Conclusions

The conclusion emerging from this chapter is that there are significant productivity gaps at various levels, between sectors, among firms and within firms. Key findings are that productivity gaps between sectors are large in LICs (especially in Africa), that productive and less productive firms co-exist and that there are large differences in productivity within large garment firms. The presence of productivity gaps indicates there is large potential for growth-enhancing structural transformation. DEGRP research has not only examined transformation between sectors (or structural change) and provided exciting new evidence using new data, but has also examined sector transformation, in both the industrial and agricultural sectors, and has moved into firm-level details, yielding new insights.

## 4. Innovation and economic transformation: policies, institutions and firm-level actions

Innovation and technological change can drive ET, especially when it coincides with closing productivity gaps. However, there is still little knowledge on exactly how these processes can be supported. The relevant literature has traditionally examined the role of structural transformation in describing growth differentials between countries, without much consideration for the causal role of innovation and technical change, either theoretically (Duarte and Restuccia, 2010; Herrendorf et al., 2014) or empirically (McMillan et al., 2014; de Vries et al., 2015). Hence, we still know little about the drivers of ET, through encouraging structural change (or reallocations across and between sectors) or encouraging innovation, technical adoption and productivity change within sectors.

The adoption of technology and the promotion of innovation are central to the more recent growth literature. The endogenous growth literature highlights the importance of specialising in technology and knowledge-intensive sectors for encouraging productivity growth (Lucas, 1988; Grossman and Helpman, 1991; Aghion and Howitt, 1998; Herrendorf et al., 2014). Economic

growth is driven by structural change deriving from sectoral differences in technological opportunities, which in turn affects the potential for productivity growth at the sectoral level. The possibility of closing sectoral productivity gaps thus links structural change, technical progress and aggregate economic growth, suggesting how shifts in the sectoral composition of output frame patterns of economic growth.

### 4.1 General policies and institutional policies

As discussed in Box 5, there is a major debate on whether the best policy framework is to provide a good business climate, without too much strategic planning, or whether some combination of targeted actions and general enabling policies is better in supporting transformation. McMillan et al. (2017) classify a range of public policies for ET, summarised in Table 2. They argue that it is important to consider complementarity between policies when implementing business environment reform (BER) with an intended ET outcome. For example, Rodrik (2013) calls for complementary policies that improve both

**Table 2** Typologies of public actions used to promote innovation and economic transformation

	General enabling interventions	Targeted interventions
Public actions to support structural change	<ul style="list-style-type: none"> <li>• business environment reforms (e.g. registration, land, tax, contracts)</li> <li>• financial sector development</li> <li>• strengthening state business relations</li> </ul>	<ul style="list-style-type: none"> <li>• export push policies</li> <li>• exchange rate and tariff protection</li> <li>• selective industrial policies</li> <li>• spatial industrial policies</li> <li>• national development banks</li> </ul>
Public actions to support within-sector productivity growth	<ul style="list-style-type: none"> <li>• building fundamentals (e.g. infrastructure, education)</li> <li>• investments in basic production knowledge</li> <li>• managerial good practices as public goods</li> <li>• innovations</li> <li>• promoting competition</li> </ul>	<ul style="list-style-type: none"> <li>• management training</li> <li>• attracting foreign direct investment</li> <li>• export diversification</li> <li>• developing global value chains</li> <li>• increasing agricultural productivity</li> </ul>

SOURCE: McMILLAN ET AL. (2017)

## Box 5 Incentivising economic transformation: the policy debates

Policy debates on factors behind structural transformation have changed in recent decades. In the early 2000s, there was a belief that all that governments needed to do was to set an appropriate regulatory framework and investment would flow. Donors wanted to support governments in these efforts. The 2005 World Development Report (World Bank, 2005) on investment climate contained a long list of regulatory reforms around doing business, cross-border trading and competition. Unfortunately, countries that followed these policies (several Latin American countries) grew unsatisfactorily, whereas those that did not (China, Viet Nam) grew rapidly. Nor did the policy prescriptions reflect the recent experience of Ethiopia, which has seen fast increases in garment exports despite weak investment climate indicators, owing to a very strong targeted approach to industrial development, including the use of industrial parks (although exports overall are still well below expectations).

The 2008 Commission on Growth and Development report (World Bank, 2008) highlighted the role of leadership in promoting economic growth, along with other key ingredients such as savings and export orientation. Hausmann et al. (2008) provided a step into a more targeted approach, providing a procedure to identify the most binding constraints, and arguing that binding constraints were country specific. Page (2012) also emphasised the importance of going beyond investment climate reform alone and advocates the phrase ‘investment climate plus’ (i.e. which includes actions that are complementary to the investment climate). For example, there is increased attention to linking micro-level data on firms and households to ET issues, and on learning for competitiveness at the level of firms and clusters of firms (Newman et al., 2016).

Lin et al. (2011) and Lin and Monga (2017) re-emphasise the role of the state in ET. Governments can kick-start transformative change even in the absence of ideal regulatory frameworks or other fundamentals. McMillan et al. (2017) and Balchin et al. (2019) argue that successful development in history has always involved recognising opportunities, taking targeted actions, making the most of an enabling environment and engaging in second-best policies. Progress can be made in certain sectors and in aspects of economic governance without waiting for substantial overall improvement.

Donors have also begun to follow a more targeted, sectoral approach informed by political economy analysis. For example, DFID and Gatsby have started to work with economic sectors and to promote industrialisation. Gelb et al. (2019) and Ripley and Shamchiyeva (2019) consider donors’ business environment reform (BER) and market systems approaches and bring them together in the context of supporting ET. Thus, the search is on for combinations of generally enabling and more targeted approaches (including sector approaches) that might best fit the political economy of specific countries. DEGRP research is providing new high-level insights.

‘fundamentals’ such as education, infrastructure or regulatory BER policies – and policies that target growth in high-productivity sectors. Support for education and improving access to export markets, infrastructure, the institutional environment and the regulatory environment has resulted in improved product quality, shifting resources to more productive activities and diversification (IMF, 2012). The effects of these reforms become stronger when partnered with

structural reforms such as financial deepening and trade liberalisation.

Much of the existing DEGRP and other research provide useful insights into these factors. For example, Fu et al. (2018) suggest that certain conditions encourage the adoption and development of innovation in LICs, leading to productivity change. They found that innovation (the introduction of new products and processes)

is a key determinant of labour productivity in LICs. It is important that innovation be encouraged and barriers be removed. First, policies that are aimed at rendering financial support to firms should be encouraged. This is because the more money firms have, the more resources can potentially be allocated to research. Second, an overall strategy should include the designing and implementation of platforms where potential employees can acquire and develop skills and firms can assimilate technological progress, as well as contribute back to the system. Fu et al. (2018) argue that a competitive environment can be important for frontier innovation, suggesting that policies which improve the macroeconomy and cause it to be more competitive should be encouraged. This would include protection against monopolies.<sup>3</sup> Furthermore, non-technological innovation, such as managerial innovation should be supported. Finally, the development of targeted industry clusters would help provide fertile ground for the cross-pollination of ideas, knowledge spillovers and information exchange.

Using a cross-country panel data set for the period of 1992–2006 in LICs, Zhu (2013) shows that the sources of innovation are often external to the country (R&D in LICs is mostly needed to adopt and adapt, rather than develop frontier technologies). Export sophistication of countries is enhanced by a range of factors including capital deepening, engagement in knowledge creation, transfers via investment in education, R&D, and FDI and imports. Importing Chinese products has significant positive impact on firm-level TFP. This finding relates to past, recent and current analysis on the role of openness in productivity change (Bernard and Jensen, 2004; Dutz et al., 2011; Burstein and Melitz, 2013; Newman et al., 2016).

DEGRP research has not examined in detail the returns to R&D in agriculture, but it is important to highlight the high returns to public agricultural research (mirroring the importance of R&D in manufacturing). Studies that assess the impacts of agricultural research almost

always report high returns to agricultural research: ‘hundreds of cost-benefit studies have reported that investments in agricultural R&D have yielded high returns. Such studies have indicated that the world has persistently under-invested in agricultural R&D and have been cited by economists to justify an increased rate of growth in agricultural R&D spending’ (Alston et al., 2009). For example, the returns to public agricultural research in 32 countries in sub-Saharan Africa from 1977 to 2005 were estimated to yield an internal rate of return of 29% and a benefit–cost ratio of 3:1 for all 32 countries. For 21 countries, rates of return exceeded 20% (Fuglie and Rada, 2011). Doubts have recently been cast on the magnitude of these positive returns, querying the methods and assumptions by which these were arrived at (Nin-Pratt and Magalhaes, 2018). Modifying the analysis, the average rate of return to agricultural research in LICs and MICs has been re-estimated at 6%. This would still, however, be more than the discount rate for those countries. Some 60% of these countries would still have benefit–cost ratios of 2 to 1, suggesting that they underinvest in agricultural research.

DEGRP research shows that much of Africa’s recent growth and poverty reduction can be traced to a substantive decline in the share of the labour force engaged in agriculture, which has also been accompanied by a systematic move from low-productivity agriculture to higher-productivity manufacturing and services. Using regression analysis, McMillan et al. (2014) further discuss what factors determine why structural change influences growth differently between countries. These enabling factors can be summarised as follows:

1. Countries with competitive advantages in primary products are disadvantaged. This is because, although mining and other natural resource industries are higher-productivity sectors, they cannot absorb all (or most) of the labour leaving agriculture (and proceeds from primary products are often not used satisfactorily).

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3 Of course, much innovation has also occurred in monopolistic settings (see e.g. the emergence of the World Wide Web), so a competitive environment alone is not sufficient, and in some cases too much competition may hamper innovation.

2. Countries with competitive or undervalued currencies tend to experience more growth-enhancing structural change. This is because the exchange rate tends to act as a subsidy on industry (through cheaper exports and more expensive imports), allowing labour to move more freely across sectors and firms and in turn leading to growth-enhancing structural change.
3. Countries with more flexible labour markets experience more growth-enhancing structural change.
4. Institutional factors (such as corruption and rule of law) are also important.

Thus, DEGRP research is consistent with, and provides new evidence to support, the importance of certain general enabling policies and incentives. But this is often not enough to kick-start or sustain transformation.

## 4.2 Targeted policies

The literature suggests that a targeted approach to ET is also important, although there is debate around what to target and how to do this. For example, Lewis (1954) suggested that technological progress in the manufacturing sector is the major driver of structural change, as it raises productivity and sector wages and pulls

resources into the sector from agriculture. Others argued that technical change in agriculture raises productivity, freeing up resources to be used in manufacturing (Nurkse, 1953; Rostow, 1960; Gollin et al., 2002). More recently, Sen (2019) has argued that labour is moving from agriculture to services in LICs, and many researchers have begun to argue that services are fundamental for ET (see Balchin et al., 2016) and have pointed to the importance of ‘industries without smokestacks’.

Recent attention has also shifted towards the effectiveness of a sectoral and more targeted approach to supporting structural transformation (see Box 5). The DEGRP-supported book volume edited by Mackintosh (2016) argues that innovation and private-sector expansion are key to job creation and economic development. However, industrial policies in many low- and middle-income countries fail to support local innovation. An overreliance on foreign imports (appropriate imports of capital goods are not included here), for example, and too little investment in local alternatives can stunt the growth of domestic economies, which can have negative dynamic effects on industrial development and productivity (even when cheap imports benefit consumers in the short-run). The project found that, with the help of industrial and health policies, local pharmaceutical



AN EMPLOYEE FERRIES OUT OF THE MANUFACTURING PLANT WAREHOUSE COOKING OIL FOR LOADING AND SHIPPING, 2015. PHOTO: BIDCO AFRICA LTD

manufacturing was both financially viable and capable of improving access to medicine in many SSA countries. It suggests that it is important to consider coordinated and targeted actions across manufacturing and health sectors to make the most of the recent wave of pharmaceutical investment (Mackintosh et al., 2018), which will help sector transformation as well as structural change.

In this section, we first discuss building industrial capabilities in the pharmaceutical industry in Tanzania and Ethiopia based on the DEGRP studies we reviewed. Tibandebage et al. (2016) examine the factors that led to the rise and subsequent fall in the pharmaceutical sector of Tanzania. By 2009, 35% of local medicines were supplied by domestic production in a market worth approximately \$140 million overall. However, between 2009 and 2013, this relative success suffered a rapid reverse (Wangwe et al., 2014), with just five pharmaceutical firms still operating.

Drawing from extensive interviews, Tibandebage et al. (2016) explain why events played out the way they did. First, the family-run diversification could not make up for the lack of complexity in the industrial structure in Tanzania, and logistical and quality-control problems began to show. Second, there was a struggle to keep up with constantly changing regulations and technology, including international regulations. Third, there was an increase in price competition from cheap foreign imports.

Tibandebage et al. (2016: 54) suggest that selective intervention is an essential element of industrial policy. There needs to be a change from a situation where government strategy only focuses on policies to influence the general business environment without addressing the specific sectoral needs (Wangwe et al., 2014). An example of this is the imposition of taxes and duties on imported inputs, which specifically disadvantages local pharmaceutical manufacturers by raising their costs of production. In addition to a careful consideration of the specific tax rates, the certainty and stability in any tax and duty regime should also be ensured.

Gebre-Mariam et al. (2016) emphasise the need for governments to encourage partnership of local firms with foreign participation for the purposes of positive spillovers and transfer of capabilities and technology. Through a mix of government initiatives, a conducive business environment was created for foreign investment in the pharmaceutical sector, thereby engendering sectoral growth. There is a need to integrate health with industrial policies in order to encourage the local production of medicines and overall improvement in the productivity of the local industry.

Apart from the general policy reforms involving investment and manufacturing incentive packages, a major thrust in the revival of the pharmaceutical sector in Ethiopia was the encouragement for joint ventures to thrive. The advantage for the foreign joint-venture investors was that they would gain access to both local and regional markets, Ethiopia's cheap labour force and the varied investment incentives. This kind of partnership was key to eventual growth because it became a platform for the exchange of raw materials, positive spillovers in terms of technological and managerial know-how, as well as the development of mutually beneficial networks. Despite some of the progress made over the past few years, it should be noted that the development and local production of medicines in Ethiopia is still marginal, and greater success could be achieved if the limitations to foreign involvement are noted.

Targeted policies are also crucial for building vertical linkages between multinationals and local industry, offering much potential for knowledge and productivity spillovers (te Velde, 2019a). Policies include local capability building, linkage and information programmes, access to credit and targeting the attraction of specific types of FDI. Recent research supported by PEDL in Ethiopia (Abebe et al., 2018), discusses linkages between foreign and local firms. One-third of Ethiopian plants are linked to foreign-owned plants through vertical linkages, competition and labour sharing. This leads to knowledge spillovers such that local firms have an 11% productivity mark-up when they are linked to foreign firms. This suggests that

building linkages will help productivity in local firms.

DEGRP research further supports the view that an approach that is more targeted and focused on innovation systems can support innovation, either through building value chains or by creating industry–university linkages. Fu et al. (2018) argue that innovation depends on participation in value chains and the formation of national or regional (if not global) production networks. In addition, survey data on Ghanaian innovation activity suggest a lack of significant linkages between innovators and universities in Ghana.

There is also attention in the DEGRP research portfolio on whether and how African governments can work more strategically with China to enhance ET in Africa. Chinese firms, and Chinese investment more broadly, have facilitated knowledge transfer, thus promoting ET. Policies to support this investment include setting up special economic zones (SEZs). However, there is still limited evidence of the success of SEZs in driving structural change and industrialisation in African countries.

Bräutigam and Tang (2014) examine the impact and effectiveness of six investment projects undertaken by China in Africa under the ‘overseas special economic zones’. These are: Tianjin Economic-Technological Development Area in Egypt, Chambish in Zambia, Lekki in Nigeria, Jinfei in Mauritius, Ogun in Nigeria and Eastern in Ethiopia. The ambitious goals set by these SEZs have not been achieved so far. The main reasons for this are that the Chinese and African governments had different views and conflicting interests regarding what the projects were meant to achieve and there were insufficient and weak connections with local enterprises. They suggest the co-location of complementary industries and the local provision of basic infrastructure as ways in which positive manufacturing growth and productivity results could be obtained.

The DEGRP finance portfolio is synthesised elsewhere (Beck and Tyson, 2019) and deals with financial regulations and other general enabling

policies. However, an additional key finding relevant for this section, and also discussed in a Research in Context briefing (te Velde, 2019b) is that targeted actions, such as the deployment of public development banks, can support the process of structural transformation through, for example, channelling more and better finance to infrastructure and SMEs (and large firms when they are also constrained by capital). The research led by Griffith-Jones found that, while LIC banks are generally well capitalised and very profitable, they are charging their clients excessive interest rate spreads (Griffith-Jones and Gottschalk, 2016). Expensive credit is problematic for entrepreneurs who want to invest in high-productivity activities but lack capital. A further challenge noted in the research is that bank credit is available mainly to those seeking short-term loans (consumer credit and working capital) or to the government, rather than to SMEs or for long-term finance to fund infrastructure needed for ET and for development more broadly.

Griffith-Jones and Gottschalk (2016) argue for countercyclical mechanisms that could be used to dampen credit growth when this becomes excessive, while raising credit growth in bad times. There is a role for ‘good’ development banks: national development banks, which can co-finance with commercial banks to fund priority sectors and projects. These banks play a critical role in finance by guiding the market. They can help steer investment in underserved segments of the economy that are important for transformation and job creation.

The DEGRP agriculture portfolio also provides insights into the sectoral or targeted policies that are required for sector transformation. DEGRP researchers have studied several aspects of agricultural innovation:

- Exploring yield gaps for maize in Ghana and Ethiopia reveals that the gaps between what farmers achieve and what is possible are very large, with farmers typically harvesting around one-quarter of their potential crop. One key factor is simply the failure to use better seeds, fertiliser and other inputs (Assefa et al., 2019; van Loon et al., 2019).

- In Ghana, the effects of farmers having more access to agricultural insurance, better seed and agricultural extension have been assessed. Typically, farmers respond to the treatments offered, although it is not always the case that they end up harvesting more or earning more from their fields than other farmers who did not get access (van Asselt et al., 2018).
- In western Kenya, trials were run with farmers to see how much they were able to learn about the effectiveness of seed, fertiliser and other inputs, in a situation where a wide choice of inputs – not all of them appropriate to local conditions – was on offer. Farmers learned from their trials, but enhanced knowledge alone did not necessarily lead them to use more of the inputs found to be effective. Other limits apply to intensification (Laajaj and Macours, 2016).
- Experiments with increased extension for beans in eastern Democratic Republic of the Congo showed that farmers welcomed technical improvements for their crops, even in a war-ravaged part of the country. Existing social networks within communities can help spread new ideas, but agricultural extension needs sustained engagement with farmers, not fleeting contact. Painstaking work by civil society to build the capacity of ordinary farm households to engage with the rest of the community and the outside world pays off. Empowered farmers can more readily appreciate and take up innovations (Kendzior et al., 2015; Hofman et al., 2017a; 2017b; Leuveld et al., 2017; Ross, 2017; Ross et al., 2017).
- Experiments with farmers in eastern Uganda showed that they were risk averse and hence reluctant to grow cash crops using more fertiliser, seed and other inputs. They also showed how much the perception of risk changed with experience of taking risks and when interacting with others: intriguingly, the smallholders were less willing to take risks when this might harm others working with them (D'Exelle and Verschoor, 2015).
- In northern Kenya, farmers who were offered insurance when buying certified seeds were

then willing to intensify their production, using more inputs and working longer in their fields. After learning about insurance, they were more willing to consider paying for it (Bulte et al., 2019).

Insights from these studies will be discussed in more detail in a forthcoming DEGRP synthesis. For the purpose of this present synthesis, however, it is important to note that targeted policies are likely to be very important for innovation and agricultural transformation. Such policies include enhancing seeds, fertiliser and other inputs; improving access to agricultural insurance, and agricultural extension; building existing social networks within communities to help spread new ideas; improving risk perception and knowledge generation about innovation in agriculture.

### 4.3 Incentivising firm-level innovation

In advanced countries, much aggregate productivity change happens *within* firms. Bartelsman et al. (2009) imply that innovation and transformation can be fostered through firm upgrading, and Bloom and Van Reenen (2007) argue that the latter can occur through managerial changes. The past decade has also involved a better understanding of the microeconomic foundations of innovation in LICs, MICs and HICs (Hsieh and Klenow, 2009; 2014); better research on entrepreneurship (Bosma et al., 2009; Klapper et al., 2010); increased knowledge on the links between trade, foreign ownership, innovation and productivity (Melitz, 2003); between R&D, skills, innovation and productivity (Dutz et al., 2011; Saliola and Seker, 2011); between innovation, productivity and employment growth (Ugur et al., 2012; Katz and Margo, 2013).

Firm-level industrial capabilities lie at the heart of innovation, productivity change and hence ET. Industrial capabilities allow firms to innovate. While DEGRP focused on traditional innovation, the UN Industrial Development Organization shows the importance of industrial capabilities for adopting the latest technology, such as digital technology in the fourth industrial revolution (UNIDO, 2020). Banga and te Velde (2018)



INSTRUCTORS CHECK A NEWLY MADE SHIRT, MADE BY YOUNG WOMEN BEING TRAINED, DHAKA, BANGLADESH, 2016. PHOTO: DOMINIC CHAVEZ/WORLD BANK

suggest a two-pronged approach to industrialisation in a digital economy: supporting firms in building industrial capabilities and targeted participation in the digital economy. Supporting firm-level innovation plays a vital role in both. DEGRP research has argued that it can be important to target high-growth firms, which help sectoral transformation overall through churning. Diao et al. (2018) discuss targeting high-potential firms in the case of Tanzania.

Woodruff (2018) summarises the literature on incentivising firm-level innovation as follows: providing capital to small firms, if done in the right way, works. McKenzie and Woodruff (2008) find average returns of grants of 20%–30% per month in Mexico, and de Mel et al. (2008) find 6% per month in Sri Lanka. On the other hand, the training analysed does not seem to have worked well (McKenzie and Woodruff, 2013). The evidence on mentoring is thinner. However, Woodruff (2018) argues that individual or group mentoring is effective but, ideally, more evidence is needed about when mentoring works best.

DEGRP research has also contributed to this area of firm-level innovation in LICs. A body of work has emerged over the past decade through studies such as Macchiavello et al. (2015a; 2015b) and Naem and Woodruff (2014), which highlight the importance of improving

management skills to enhance productivity in the garment sector in Bangladesh. Mid-level management skills (especially in female supervisors) are underdeveloped in the garment sector in Bangladesh. This suggests that training can be an important way to help garment firms, especially female workers. The industry has over 4,000 firms, but while women accounted for 75%–80% of workers in the sewing operations, men accounted for approximately 95% of supervisors and higher-level managers.

There are some interesting findings relating to the impact of training on female empowerment and productivity in the garment sector in Bangladesh. Preliminary findings suggest an important role for the training of women, even if the effects are indirect. The initial analysis suggests that women are not being promoted to supervisor positions because of the perception that they lack technical and supervisory skills (even though in reality they may have them). Since they are not tried in such positions, women cannot signal to employers whether their ability is equal to that of their male counterparts. An outside intervention (such as the project's supervisor training programme) could break that vicious cycle and ensure higher returns to human capital investment (such as going to school) by appointing women to higher-earning management positions.

Macchiavello et al. (2015a) discuss links between female advancement, management and firm performance. Improving women's advancement entails some costs, but also involves major benefits. They first point to the possible cost of an initial level of underperformance as women are introduced into management. This initial underperformance is not because women are less capable, but because there is normally a period of adjustment for the workforce to change its attitudes towards women supervisors. This involves a change in the prevailing social construct. Finally, the cost of training is not only to the workers, but also to the firm's management on gender sensitivity. Macchiavello et al. (2015a) argue that, while there are costs, these changes are critical to achieving an improvement in the labour productivity of women in supervisory roles.

Other emerging DEGRP research (Anderson et al., 2019) attempts to go beyond microfinance and training and examines the effectiveness of a model of remote volunteer coaching (using Skype) on the sales performance of growth-oriented micro-entrepreneurs in Uganda. Based on the results of a randomised controlled field experiment with 930 such entrepreneurs, they provide evidence that remote volunteer coaching raises sales in recipients' firms by 28%. They are also 63% more likely to shift to a different marketing strategy and transform their value proposition to customers. Additionally, firms that appear less strategic in their orientation (ex ante) benefit more from the remote coaching intervention.

This relates well to other work. Brooks et al. (2018) show that mentoring of female-owned small enterprises in Kenya raises short-term profits by 20%. Missing information and localised knowledge are the main barriers to be overcome. Cai and Szeidl (2018) examine 2,820 firms in China and find that taking part in peer meetings increased scale and profitability by 8%–10%. The importance of coaching touches on a wider issue of peer-review learning. Several studies funded under DEGRP, GLM, PEDL and IGC (2017) find that firms learn from each other. Fostering collaboration and mentoring among firms around certain themes can help transformation. Collaboration could be enhanced by the provision of information on what business models work and why. Such information has public-good aspects, and hence a role for the state. Woodruff (2018) argues that the potential for peer learning is greatest when firms share some characteristics in the use of suppliers and production technology but are not competitors.

#### 4.4 Conclusions

DEGRP research has confirmed the importance of a range of general enabling policies such as R&D, openness (exporting and inward FDI), education and skills building for innovation and structural transformation. However, more targeted, sectoral and industrial policies also have an important role to play in both manufacturing and agriculture. Finally, working with firms to enable their learning is important. This can be in the form of information exchange on what models work and why.

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## 5. Conclusions and policy and research implications

ET is a crucial theme in the pursuit of quality growth. Research commissioned under DEGRP has led to relevant and path-breaking analysis. It has:

1. Reinvigorated the empirical study of structural transformation and helped African countries to become more focal and better informed in the past decade. This has also advanced the academic debate on structural transformation.
2. Developed a unique data set on African countries which has been used and cited 200 times, with many opportunities for future applications.
3. Pointed to new sources of structural transformation at firm level (Bangladesh), which previously had not been examined in such a way. This is likely to be exploited much further in the future, with one key area being women's advancement.
4. Raised the profile of the pharmaceutical sector in Africa, especially in Kenya and Tanzania, and incentivised further action at African level.
5. Confirmed general enabling and targeted policies behind innovation and transformation, which has global applications and implications for countries such as Ghana.

The research has major implications for growth-policy support. We discuss five major areas for policy-makers and donor agencies supporting them. The evidence suggests policy-makers should:

- **Pay more explicit attention to structural change.** While empirical evidence suggests patterns of transformation differ over time and across countries, and the relative contribution of structural change (across sectors) and sector transformation to productivity change differs, it is also clear that structural change plays a major role in driving (or limiting) aggregate productivity growth. Policy support is often focused at sector transformation, but it should be broadened to promoting structural change, which is underemphasised.
- **Target support for the manufacturing sector.** The manufacturing sector plays a special role in the process of ET, and DEGRP evidence suggests the manufacturing tends to be more productive than many other sectors; the sector has traditionally supported large-scale job generation. Africa has other options for growth, but the share of the manufacturing sector in overall production is very low compared to other regions. This means there is significant scope for growth in Africa, but the impact and role played by the manufacturing sector will also be an increasingly different one. For example, it will be increasingly difficult to enter manufacturing now as it has become more capital intensive, so a more targeted approach will be crucial.
- **Provide targeted and coordinated measures for economic transformation.** Market incentives are relevant; for example, simulating greater openness to trade and investment is an important factor for productivity change. But strategic and targeted actions are also very important. For example, efforts to industrialise and meet health needs require coordinated approaches across industrial policy and health. This would suggest it is important to combine market incentives and strategic interventions, and build up innovation systems.
- **Work with firms to incentivise collaboration and learning.** Much progress in productivity within a sector happens at the firm level. Policy-makers sometimes assume firms are similar, but the evidence suggests that firms can have different levels of productivity, which is a major source of ET generally. The evidence on firm-level impact of access to credit is more developed than on the impact of training, but the evidence on the impact of coaching between firms is beginning to be significant. Policy-makers will need to work with firms to understand how they can best foster collaboration and learning among them.



FACTORY WORKERS PRODUCE FRESH FRUIT DRINKS IN NSAWAN DISTRICT, GHANA, 2015.  
PHOTO: DOMINIC CHAVEZ/WORLD BANK

- **Support the development of industrial capabilities for innovation.** Attention has only recently begun to focus on digital technologies, such as the impact of mobile phone technology, and this is posing interesting questions for future research. One specific policy suggestion for now, however, is that it is simply important to prepare for any type of innovation that is about doing things differently. Developing industrial capabilities is more important than ever and this needs to go beyond market incentives that lock in digital divides.

There are still many research gaps, however, including:

- New research is required to extend and bring together different types of data. This could focus on a better mapping between expenditure categories and productive sectors of the economy (Herrendorf et al., 2014). It could also provide new sectoral productivity measures levels by combining sectoral value-added prices with information on wages and capital input prices to measure sectoral multifactor productivity using the so-called dual approach to productivity measurement (Herrendorf and Valentinyi, 2012).
- Examining the demand versus technology explanation of structural transformation
- (McMillan and Rodrik, 2011; Diao et al., 2017a) and applying this to the experience of LICs (Sen, 2019).
- The lack of industrialisation in Africa is one of the most notable observations in this synthesis. Further attention on this is needed, and on the effectiveness of industrial policy.
- Structural transformation is often couched in terms of sectors, which are directly measured in the national accounts. However, there is now much attention to global value chains, and these do not follow traditional transformation paths from agriculture to manufacturing and then services. Instead, they involve a range of activities from different sectors. In addition, traditional and modern activities now co-exist even within agriculture, manufacturing and services sectors.
- Automation and digitalisation are likely to have wide-ranging effects on transformation. How can this be best measured, what do empirical observations tell us, and what can be done? How do traditional suggestions on industrial capabilities need to be adapted for preparing countries for a digital economy?
- Uncovering links between structural transformation and other non-economic variables such as poverty and environment.

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Research jointly supported by the ESRC and DFID

