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Upgrading under globalization in health-related industries in Tanzania: the case for dynamic industrial deepening

Samuel Wangwe^a, Roberto Simonetti ^b, Paula Tibandebage^a,
Maureen Mackintosh^b, Caroline Israel^c and Phares G. M. Mujinja^d

^aEconomic and Social Research Foundation (ESRF), Dar es Salaam, Tanzania; ^bFaculty of Arts and Social Sciences, School of Social Sciences and Global Studies, The Open University, Milton Keynes, UK; ^cUONGOZI Institute, Dar es Salaam, Tanzania; ^dMuhimbili University of Health and Allied Sciences, Dar es Salaam, Tanzania

ABSTRACT

Globalization of markets and production networks has made it progressively harder for low income countries to industrialize. This article addresses a conundrum facing industrial firms and industrial policy in a low-income African country: how to achieve upgrading necessary for sustained competitiveness. Using data from a study of manufacturers of health products in Tanzania, we document the double 'squeeze' on firms' profits exerted by sharp price competition alongside competitive pressure for rising product quality within globalized markets. Drawing on Sutton's model of competing on capabilities, and the sectoral systems of innovation and production framework, we argue that 'dynamic industrial deepening', strengthening domestic inter-firm linkages, is a key requirement for sustainable development of these health industries. We present evidence that sectoral industrial support for the health industries can promote sustainable technological upgrading, and reflect on the challenge of building developmental linkages where external investment to support upgrading is transforming existing business structures.

KEYWORDS

Upgrading; dynamic industrial deepening; capabilities; Tanzania; health industries; industrial policy

1. Introduction

The rise of East and South Asian manufactured exports, alongside global trade liberalization and the integration of global manufacturing networks, has made it increasingly hard for low income countries (LICs) to follow in emerging industrializers' footsteps, with Sub-Saharan Africa (SSA) facing particularly severe challenges (Sutton 2012; Newman et al. 2016). In this article, we analyse responses to this challenge from Tanzania's health industries, that is, manufacturers of pharmaceuticals and other health essentials. Manufacturers in health industries are important components of health innovation systems as they contribute to the creation and diffusion of new products and technologies through market and non-market linkages to a variety of private and public organizations

CONTACT Roberto Simonetti  roberto.simonetti@open.ac.uk

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(Natera, Tomassini, and Vera-Cruz 2019). Urias (2019) showed that competitive health industries, nurtured by appropriate industrial policy, can contribute to health policy and promote access to medicines.

Adopting an innovation system perspective, we investigate the following questions: what were the upgrading challenges and responses of manufacturers in Tanzania's health industries in the period 2012–2017? Are there any useful lessons for policy aimed at strengthening health industries in LICs facing international competition?

We show that, as Sutton (2012) indicated, all firms interviewed were trying to adapt to international competitive pressure through industrial upgrading, that is, by innovating to reduce costs by improving production processes, raise the quality of existing products and expand the product range to include more technologically complex product (Pietrobelli and Rabellotti 2006). We identify a key actual and potential route to sustaining competitiveness in the process of dynamic industrial deepening. Industrial deepening can be defined as 'the formation of local linkages and the creation of a robust local supplier base' (Kuroiwa 2015, 1), whilst the term dynamic indicates the centrality of learning to develop skills, knowledge, experience and adapted institutional linkages to generate and manage technical change throughout the supply chain.

We then explore how sectoral industrial support for the health industries can promote sustainable technological upgrading within locally owned business structures typical of LICs, and the scope for building domestic developmental industrial linkages as external investment required for major upgrading transforms those business structures. Having gained the status of lower-middle income country in 2020, at the time of the research Tanzania was a low-income economy which had undergone fluctuating economic fortunes and industrial policy regimes since Independence in 1960, including protected industrialization with price controls, import substitution, macroeconomic liberalization with export promotion and, most recently, openness coupled with newly active industrial policy (Wangwe 1995; Msami and Wangwe 2016; McMillan, Page, and Wangwe 2017). Pharmaceutical manufacturing has mirrored these fluctuations, and faced a sharp decline in the period from 2009 to 2013. The market share of local producers fell from 35% to under 20%, and a deteriorating international trade balance saw a fall in exports from US\$8 million in 2009 to US\$1.7 million in 2013 and a sharp rise in imports to US\$286 million, over half of it from India (Tibandebage et al. 2016; URT 2016; Wande et al. 2019).

This article presents evidence of the upgrading challenges (Section 3), and employs a framework drawn from the Sutton's (2007, 2012) model of competing on capabilities, and the sectoral systems of innovation and production framework (Malerba 2002; Malerba and Mani 2009), to demonstrate the importance of dynamic industrial deepening for sustained competitiveness, and the evolving constraints within current business structures (Sections 5–8). The discussion (Section 9) draws out industrial policy opportunities that may have wider resonance in LICs.

2. Sources and methods

Evidence is drawn from analysis of interviews in Tanzania in 2012/2013 with multiple interviewees in the five main pharmaceutical firms producing human medicines at that date, and in six manufacturers of other health supplies such as specialized furniture,

hygiene and cleaning items, and packaging materials. Semi-structured interviews covered business history, strategy and constraints; production organization and technological level; and domestic and export market access. Eleven further interviews included public and private wholesalers, regulators and government officials, and a manufacturing association. The interviews formed part of a broader project on health-industry linkages in Tanzania and Kenya¹ that also included quantitative and qualitative health sector supply chain research (Mackintosh et al. 2016, 2018).

In 2017, follow-up interviews in Tanzania² were conducted with two pharmaceutical manufacturers and a new industrial investor; the public wholesaler; government officials responsible for regulation and policy making; and a pharmaceutical training institution. East African community officials and senior Global Fund managers were interviewed about pharmaceutical production and procurement in the region.

Data from the Learning to Compete (L2C)³ 2012 survey in Tanzania are used here for context and framing. Qualitative responses in the survey were coded to assist analysis. Useable responses were received from 49 firms, of which 14 were in sectors relevant to this article, including five firms interviewed for this study.

Ethical clearance was obtained from the Open University Human Research Ethics Committee in the UK (HREC/2011/#956/2), and the National Institute for Medical Research, Ethics Review Committee in Tanzania. All participants had consented to the research, having been assured that participation was voluntary and that their anonymity would be preserved in published research findings.

3. Analytical framework: capability development within a sectoral system of innovation and production

Sutton's (2007, 2012) model of the impact of globalized industrial competition on developing countries' manufacturing offers a useful framework to analyse the challenges and responses of business in the Tanzanian health industries. In Sutton's model, consumers will pay a premium for quality, and markets display a moving 'capability window' characterized by a rising quality/cost threshold below which firms will be unable to sell. Firms with capabilities that enable them to successfully distinguish themselves for high quality cannot be driven out of a market by firms selling cheap but low-quality products. Hence, low labour costs can compensate for low productivity but not for low quality.

Firms in LICs facing global import competition after market liberalization must therefore invest in learning to build their capabilities, in order to stay in business and compete with firms from high capabilities countries as quality thresholds rise. Sutton recognizes that 'the determinants of the speed and effectiveness of this process [of capability building] ... are only partially understood' (Sutton 2007, F471).

This study addresses this research gap for one LIC by drawing on the work of Malerba (2002) on sectoral systems of innovation and production (SSIP). An SSIP approach focusses on the key actors, networks, institutions and processes that drive innovative activity in a sector. It is intended as 'not a straitjacket, but a broad, flexible and adaptable tool. It points to some key variables and fundamental relationships. Only the goals of the analysis will decide which levels of aggregation should be used, depending on the purpose of the analysis' (Malerba and Mani 2009, 4).

The firms interviewed are heterogeneous, including higher-skilled pharmaceuticals manufacturing alongside some of the 'light manufacturing' often promoted for African industrial policy support (Dinh et al. 2012), and fall into different industrial sectors (as defined by standard industrial classifications). Nevertheless, the health industry businesses, as a sector, share common features that influence the ability of firms to upgrade: the nature of competition, driven by a rising price/quality threshold as described in Sutton's model; an institutional environment characterized by rising regulatory standards for health industries and tariff-induced cost disadvantage for local firms; a shallow industrial structure with significant gaps in supply chains; weak labour and financial markets with scarcity of skilled workers and finance that is limited and expensive; and market demand shaped by international philanthropic procurement, domestic wholesalers (public, faith-based, private), and low-income out-of-pocket purchasing, with strong exposure to international price competition.

In the evolutionary economics literature that underpins the SSIP framework, firms are key agents which, through learning, accumulate distinctive capabilities that enable them to upgrade by introducing new products and processes (Bell and Pavitt 1993). However, firms do not operate in a vacuum: they rely instead on a network of market and non-market relationships with suppliers, users, government agencies, labour and financial institutions and other organizations in order to accumulate their capabilities. Lall (1992) emphasized the importance of linkage capabilities, which are 'the skills needed to transmit information, skills and technology to, and receive them from, component or raw material suppliers, subcontractors, consultants, service firms, and technology institutions' (Lall 1992, 168), alongside production capabilities needed to successfully run and improve industrial processes, and investment capabilities needed to successfully expand production and set up new facilities.

Input-output relationships with buyers and with suppliers of inputs are the key linkages in the Tanzanian health industries innovation system. The process of upgrading through learning and the accumulation of capabilities within health industries, including strengthening of domestic industrial linkages over time, we call 'dynamic industrial deepening'. Dynamic industrial deepening refers to the development of a broad-based, resilient supply chain in which participants adapt and learn to develop new technological and linkage capabilities. Learning to generate and manage technical change, with its associated skills, knowledge, experience and adapted institutional linkages, is necessary to be competitive in a highly dynamic market environment characterized by rising price-quality thresholds over time.

4. The challenge of the price-quality squeeze arising from international competition

In line with the scenario analysed in Sutton's model, over the period of this research, the health industries in Tanzania, pharmaceutical and other suppliers, were facing a severe competitive 'squeeze' between intensifying price competition from imports, and competitive pressure to invest to upgrade. Price competition in pharmaceuticals had intensified after 2009 when tariffs on finished formulations fell to zero. That policy, advocated by the WHO and international NGOs, aimed to reduce domestic medicines prices, an objective confirmed by Tanzanian tax authorities interviewed in 2014. Other

imports for health care such as hospital beds were also exempt from duty. However parallel removal of tariffs on imported inputs for domestic manufacturing, such as active pharmaceutical ingredients (APIs), had faced difficulties where inputs had wider use, such as highly refined sugar for pharmaceutical syrups or inputs for furniture production that could also be used for household goods. Domestic manufacturers therefore faced tariff-induced cost disadvantage against importers of finished essential health commodities.

All firms interviewed also reported continual pressure to meet rising quality standards by introducing improved and new products, which in turn require better industrial processes and improved organizational capabilities. The products of the health industries are necessarily highly regulated for quality, in terms of safety and efficacy. The Tanzanian Food and Drug Authority (TFDA, now the TMDA⁴), widely seen as one of the strongest African regulators, supports and requires local manufacturers to upgrade their production processes to Good Manufacturing Practice (GMP) standards. International donors, who set the procurement terms for funded HIV, TB and anti-malarial medication, require the more stringent WHO-prequalification certification for each pharmaceutical product, or approval by a stringent regulator such as USFDA. Quality, in the sense of documented meeting of regulatory quality and safety standards, is therefore an important aspect of competitive advantage in the health industries because it is key to market access. The manufacturers interviewed stated that external pressure for rising standards was also driven by quality-based external competition; by new data on dangers e.g. from cross-contamination; by rising regulatory standards in high income countries (HICs), and also incentives for established multinational exporters to raise quality-based barriers to entry. All the firms' business responses to the 'double squeeze' of intensifying price competition and rising quality assurance market entry barriers were upgrading- and quality-focused.

Similarly, firms interviewed for the L2C data set prioritized competitive upgrading within business strategies. Asked for four key success elements for the company, 62% identified product quality as key to success, a much larger proportion than any other single element, such as labour availability and skills (25%); customers and marketing (20%), and management competences (33%). These findings echo Sutton's (2012, 54) comment that 'quality is a constantly recurring theme' in conversations with Indian and Chinese manufacturers, productivity (unit labour cost) less so.

5. Business structure as strength and constraint

Firms are the key actors in a sectoral innovation system. Firms under competitive pressure must build capabilities to innovate and upgrade within their current business structures, or adapt those structures to enhance learning. The firms interviewed in Tanzania in 2013 and 2017 were business survivors and successful adaptors to extremely challenging business conditions. Some had survived the rapid import liberalization of the 1980s and early 1990s, which had wiped out much of manufacturing (Wangwe 1995); others had restarted or established from the late 1990s.

All firms grappled with poor and expensive infrastructure, as in many LICs: poor quality water, intermittent electricity, and poor road, rail and port infrastructure subject to institutionalized delays (Andreoni 2017; Sutton and Olomi 2012; Lall and

Wangwe 1997). In the L2C sample, 88% of firms, and 100% of chemical (including pharmaceutical), plastics and textile firms said they ‘often’ experienced insufficient electricity supply. Although recently the reliability of electricity supply has significantly improved, two thirds of firms interviewed in 2013 identified expensive and intermittent mains electricity as a major constraint and cost driver; the plastics, pharmaceutical and textile firms all required expensive power generation backup and machine protection.

The shallow industrial structure that emerged in Tanzania from the 1980s crisis and the loss of trade barriers (Wangwe 1995) was also beset by institutional voids, including scarce and expensive loan capital, shortages of skilled labour, and supply chain gaps resulting from weak or absent local suppliers of key inputs. Responding to these circumstances, businesses interviewed were mainly family firms, or businesses within diversified family owned conglomerates or business groups (Table 1). These large business groups dominate Tanzanian manufacturing, often having roots in East African trading activities; many are in East African Asian ownership (Sutton and Olomi 2012).

All had begun in family ownership except one pharmaceutical producer, set up initially as a state-owned enterprise which collapsed in the crisis years then was reopened as public-private joint ventures in 1995 by Tanzanian African family business owners. A large producer of long-lasting insecticidal bed nets (LLINs) was structured as a joint venture between a Japanese multinational and a Tanzanian partner which, in turn, was part of a family owned diversified textiles and plastics group. All other suppliers were family businesses of various sizes, ranging from small enterprises to a large family conglomerate (Table 1).

This business structure has strengths and weaknesses as part of a sectoral innovation system. Competitive advantages include the ability to move funds internally to economize on loan capital, and share skilled people within the group (Khannah and Yafeh 2007). Internal diversification spreads risk in uncertain market, contracting and political contexts (Carney 2007), and can fill supply chain gaps e.g. by building in-house logistics. Global reach helps business groups to control quality of inputs and reduce search and contracting costs, and can facilitate technology transfer in contexts with poor market intelligence (Sutton and Olomi 2012). However, family owners may also be risk-averse, undermining innovation by focusing on preserving family wealth (Carney 2007). Fears of loss of control may block external equity investment and cause resistance to managerial changes needed for growth in technologically complex industries.

Table 1. Sub-sector and ownership in 2013 of health-related manufacturers interviewed.

Sub-sector	Number of firms	Ownership		
		Local* family firm / conglomerate	Public-private/ local* joint venture	Local*-MNC** joint venture
Pharmaceuticals	5	3	1	1
Plastics	1	1		
Mattresses and furniture	3	3		
Brushes, cleaning items	1	1		
Hygiene items	1	1		
Bed nets	1			1
Total	12	9	1	2

Note: *Local = Tanzanian, Kenyan or DRC ownership **MNC: Multinational corporation.

It is therefore notable that the exceptions to pure family ownership were in the technologically more complex fields of pharmaceuticals and long-lasting insecticide-treated bed nets (LLINs) (Table 1). Furthermore, by 2017, this pattern had been reinforced. The largest pharmaceutical firm in Tanzania had moved from joint local /overseas ownership to 100% ownership by Aspen, a South Africa-based multinational. Another pharmaceutical firm had been sold by family owners in 2016 to a Kenya-based private equity fund. As shown below, scope for innovation and upgrading was thereby strengthened (see also Portelli and Narula 2006).

6. Industrial deepening: local supplier networks as key for sustaining competitiveness

Robust supply chains with good quality relationships between suppliers and users are an important element of successful SSIPs. However, Tanzania's shallow manufacturing sector has few firms in each sub-sector, limiting the development of labour pools, narrowing markets, and creating large gaps in competencies and input suppliers. As Table 2 shows, the firms interviewed were strongly reliant on imported inputs including core intermediate items, and they identified this dependence on international supply chains as a sharp constraint on cost control and quality assurance. Pharmaceutical firms, for example, faced overseas exporters of finished formulations some of whom had the competitive advantage of vertical integration with API suppliers.

Table 2 suggests scope for strengthening local upstream supply chains in Tanzania, since many inputs from textiles and cotton to packaging could potentially be supplied locally without major technological upgrading. Other inputs however, such as APIs and polymer, would require a much larger jump in national technological level e.g. in chemicals.

Table 2. Country sources of main intermediate inputs, machinery and technology.

Main products	Country sources of main inputs	Country sources of machinery and technology
Pharmaceuticals	APIs: India and China. Starch, sugar, packaging, bottles: India and China. Secondary packaging, pyrethrum: Tanzania. Incidental inputs, packaging: Kenya.	Mainly India, some China. Older equipment Germany and UK.
Plastic goods	Polymer: India, China, Malaysia, Korea.	Injection machinery: Canada, Japan.
Furniture	Steel pipes, steel and metal parts, paint, plastic, textiles, packaging: Tanzania. Sheet steel: import (unspecified). Powder for coating: Dubai.	India. Some old UK equipment
Mattresses	Polyurethane, PVC fabric for mattresses: Korea: Other fabric: India Thread, incidental inputs: Kenya.	Foaming equipment: India
Cleaning and hygiene products	Recycled plastic, timber, packaging, low grade cotton, paper pulp: Tanzania. Brush fibres: China. Cotton: Pakistan.	Germany, Italy
Bed nets	Polymer and insecticide: Japan, Thailand	Machinery: China; insecticide proprietary technology: Japan.

Most of the health suppliers interviewed considered the local production of inputs an important strategy for cost control. Initiatives aiming to upgrade local suppliers in order to loosen bottlenecks and bridge gaps in local supply chains (Simonetti, Wuyts, and Fivawo-Wuyts 2007) are therefore important to strengthen health industries. The interviews identified ways in which industrial deepening through extending backward linkages had been used, or potentially could be used, to strengthen local supply chains and improve manufacturing competitiveness for the individual firms and the sector. Table 3 reports the challenges and potential and actual solutions in upgrading local suppliers and sourcing domestic inputs.

The following example of potential mutual benefit between local suppliers blocked by a contracting dilemma illustrates both a characteristic problem in shallow markets, and the scope for facilitative intervention. Local pharmaceutical firms produced bottled syrups for children's medication, such as antibiotic syrups. Production processes for the bottles must therefore meet pharmaceutical quality standards such as air handling and cleanliness. In 2013, pharmaceutical manufacturers imported glass bottles for this purpose from India. However, glass bottles are heavy, fragile and, inefficient to transport. So why not use plastic bottles made locally?

A plastics firm stated that they had the capability and technology to produce plastic bottles for this purpose. However to do so required substantial upgrading of the existing

Table 3. Upgrading challenges and potential solutions: strengthening supply chains.

Products	Capability upgrading challenges	Main constraints	Actual and potential solutions
Plastics	Technological capability to produce bottles to higher pharmaceutical standards	Lack of assured demand to incentivise investment in new plant	Agreed longer contracts from buyers and government de-risking /guarantees to make investment viable
Furniture	Powder coating equipment to prevent rust	Investment cost of machinery and procurement dominated by price	Public sector support for upgrading through enforcement of quality standards in tenders and longer contracts to support investment
Furniture	Technological capability to work with stainless steel.	High cost of upgrade to handle stainless steel.	Public sector support for upgrading through enforcement of quality standards in tenders and longer contracts to support investment
Cleaning equipment	Cost cutting by switching to local recycled plastic	Low quality of local recycled plastic suppliers.	Buying contracts with quality specification and support to suppliers Public support for local recycling industry: technology, supplies, upgrading.
Pharmaceuticals	Cost cutting by switching from glass to plastic bottles and greater automation	Lack of reliable local source of plastic bottles.	Upgrading and long-term contracting with local suppliers
Pharmaceuticals	Continuing move to blisters packaging; improved packaging for quality and brand acceptance. Automating secondary packing	Lack of quality local packaging suppliers. Installing and operating new machinery; investment finance	In-house upgrading and long-term contracting with local suppliers; in-house and loan finance
Bed nets	Logistics for cost-effective delivery in a large geographical market.	Expensive and unreliable local logistic providers.	In-house logistics: lower cost and reliability in delivery.
Mattresses	Improved foaming equipment	Skill levels of production employees	Public investment in vocational training

plastics plant, since at the time the plant was producing, for pharmaceuticals, only external packaging for bulk tablets already plastic-packed in the pharmaceutical plant, not requiring them to meet pharmaceutical primary packaging standards. The upgrading installation would make commercial sense only if the plastics firm had a long enough supply contract from a pharmaceutical firm to ensure a return on the investment.

Conversely, a pharmaceutical firm pointed out that they would need to invest in new equipment to handle the plastic bottles, without a guarantee of the quality of the locally produced bottles. Because of quality doubts, they would not give a contract in advance to the plastics firm, so continued to use imported glass bottles.

This dilemma is generated by the small number of both local buyers (pharmaceutical firms producing syrups) and local producers (plastics firms with the capability to produce the bottles). Demand and supply sides are 'shallow', so for each firm to move first risked finding themselves with a product with no buyer / a production line with no local supplier. The mutual dilemma has the form of an 'assurance game': the two firms are stuck in a low-level equilibrium trap. Both prefer a higher-level equilibrium where both invest. But they cannot reach their preferred position because of lack of assurance about how the other will respond. Scope for intervention to resolve the dilemma is discussed below.

Conversely however, a brush and cleaning equipment supplier of health facilities had earlier managed to overcome directly a comparable supply chain problem through collaboration between firms to upgrade a local supplier. Faced with severe Chinese price-based import competition in its domestic market, the local firm had fought back with cost cutting and quality improvement. The key to business survival, according to the firm's owner, had been a switch from imported plastic to locally recycled plastic for brush handles. The cleaning products firm had worked with a local plastics recycler to sharply improve the recycler's product quality to their specified level. They had then given the recycler a large supply contract, and the switch had sharply reduced costs. The firm had also learned from competitors and trade fairs to develop a more attractive, better coloured product range. The firm's large market share was retained, and the quality of local recycled plastic on the market rose. The firm was stimulating further improvements in local recycled plastic, to further reduce costs.

In some cases, firms managed to compensate for the lack of local suppliers by developing alternative in-house solutions. Two furniture makers interviewed mostly used local recycled steel. They both faced severe lower-price, lower-quality competition from China and India, in public tenders to supply hospital and health center furniture, and also quality-based competition from imports using stainless steel. As it could not fund the upgraded machinery needed to handle stainless steel, one of the firms responded by improving powder coating technology and strengthening other aspects of quality including durability and appropriate product design such as mechanical bed adjustment not reliant on – always intermittent – power supplies.

Conversely, a high-volume producer of long-lasting insecticide-treated bed nets had responded to problems with local logistics firms by building up an in-house logistics arm to achieve more reliable and lower cost East African regional distribution: an example of internal vertical integration to deal with a lack of industrial depth.

Problems with local inputs could also sink local manufacturers. A previously successful manufacturer of hygiene products never recovered after it lost its cheap supply of raw cotton from waste of local weaving firms when the Tanzanian textile industry largely collapsed. More expensive, poorer quality cotton wool undermined market access.

7. Sustaining technology access and upgrading over time: international networks

For incremental upgrades, developing local suppliers and relying on internal resources within diversified business groups remained effective. Many firms interviewed had funded these repeated upgrading investments from other family businesses. Finance for incremental upgrading was not seen as their central investment problem, and the L2C survey data supports this finding.

Malerba and Mani recognize that ‘the dimensions of sectoral systems are not necessarily national’ (2009, 3). The health industries, for example, have an important international dimension in access to technology. To keep up to date, and import improved technology efficiently, global linkage capabilities were key to business survival and development. In the diversified family businesses, these networks were frequently internal to the group, and supplemented by industrial fairs and associated networking. Two pharmaceutical firms were within East African Asian business groups with associated enterprises in India. Technology access challenges included equipment purchase, for process upgrading or new product mixes, and also ongoing maintenance, repair and adaptation, for which staff training was key. Working relationships with external suppliers of technology were frequently long term, supporting both maintenance and upgrading. Equipment supply packages characteristically included machinery installation, skills transfer and training, financial support for technology purchase, spare part supply and maintenance, and ongoing organizational advice.

Most firms interviewed were using Indian or Chinese machinery (Table 2) mainly for cost reasons. Indian and Chinese suppliers installed machinery and trained operators, while after-sales service was described as reasonable, though spare parts could take 2–3 weeks. The use of Chinese and Indian equipment, as elsewhere in the region, had lowered barriers to entry to manufacturing, with lower cost if less robust equipment (Hanlin and Kaplinsky 2016). However, Germany, Italy and Japan had responded to Chinese and Indian competition by developing lower cost packages adapted to lower income markets. In one case, a German company had put together a competitive technologically ‘stripped-down’ equipment package, plus a training presence locally for six months to a year. The local firm stated this was slightly more expensive than Chinese competitors’ offers, but was believed to be a more robust product: ‘we are thinking medium term’.

Building long-term external supplier relationships was a key linkage capability for development in a context with low local technological industrial capability. A firm using German suppliers since the 1960s received parts ‘on the basis of trust’, not waiting for pre-payment, and received training in new technology by sending the son of the owner to work at the German supplier’s plant.

Developing new linkage capabilities through international trade fairs was also important to source new technology. A processor of recycled plastic found an Italian supplier which arranged installation, training, and parts supply, and was considering US technology embodied in Taiwanese-made injection moulding machinery for a future investment.

8. Upgrading capabilities to meet globalizing market challenges: requirements for a technological ‘leap’

While much of the upgrading described so far could be done incrementally, and largely with internal business finance, four of the larger higher technology firms, the three largest pharmaceutical firms and the firm producing insecticide-treated bed nets, faced a greater upgrading challenge in responding to the double squeeze.

The demand for their products was increasingly dominated by external donor funding and associated stringent and rising regulatory standards. In pharmaceuticals, expanded funding for anti-malarial, HIV and TB medication had become dominated by international tenders (Mackintosh et al. 2018). The bed nets firm stated that their market was almost entirely donor-funded through international tendering, and they had achieved the WHO prequalification required for market entry. International price competition in bed nets tenders was described as ‘cut-throat’. The pharmaceutical firms had been losing domestic market share because of inability to meet WHO prequalification and because of large scale and price-based competition in the tender markets. The pharmaceutical firms reported increasing price competition from imports with some evidence of dumping of antibiotics from India at around local API import costs and adverse institutional changes, such as the loss of tariff protection on health products in 2009.

This severe double squeeze led to the closure of product lines. The largest pharmaceutical firm by 2014 had closed its entire antibiotic output including children’s antibiotic syrups and also dropped many other low-margin basics such as mebendazole. They were aiming to move into more complex higher-margin formulations including combination tablets, and new branded basics such as oral rehydration salts with zinc. A second firm continued to run its penicillins plant selling at cost, to ‘use the assets’, but they would consider closing the lines if they lost money. This CEO argued that 10% tariff protection on final products would have been sufficient to sustain profitability.

These larger firms, in pharmaceuticals and textiles, needed to increase their product quality and range, improved processes and invest in new plant and equipment to serve their globalizing markets more competitively. They needed major technology upgrades which required more complex investment capabilities, including sourcing and licensing new technology, procuring equipment, automating processes, training and recruitment of skilled personnel and carry out some research and development (Lall 1992) (Table 4).

In pharmaceuticals, the process innovations required to cut costs and expand product range included moving into higher value products. The required capabilities included identifying, funding, accessing, installing and using improved technology effectively; improving plant, production machinery, air and waste handling and laboratory equipment; finding or training more skilled labour; and sharply improving process documentation. The bed nets firm was exploring new uses for its netting technology.

Table 4. Upgrading challenges and potential solutions: investment in complex technology.

Products	Capability upgrading challenges	Main constraints	Actual and potential solutions
Bed nets	Acquire technological capabilities to produce long-lasting insecticidal nets (LLIN) with WHO pre-qualification. Break dependence on one donor-dominated market through application of net technology to new markets, e.g. agriculture.	Requires partner with technological capabilities to produce LLIN inputs and funding. Need for R&D for alternative markets entry.	MNC partner with insecticide and spinning technology. MNC and other support for local R&D for net quality and new market applications
Bed nets	Gain a price premium from selling higher quality longer life nets.	Donor 'ceiling' quality requirements	Revised donor tendering rules.
Pharmaceuticals	Compete in markets for higher quality products, including combination tablets and intravenous products requiring sterile production conditions.	Access to technology for new higher quality products; cost of machinery and plant upgrades; staff and technology for new plant; new production culture.	External finance and partners: buyout by MNC with access to in-house technology; support from global PPP; private equity investors; joint ventures.
Pharmaceuticals	Better process technologies: e.g. air handling, reduced dust levels, and economies of scale (longer runs; higher levels of automation)	Investment finance for upgrading plants; skills and technology to install and operate a new plant; new production culture.	External finance and partners. Training from machinery suppliers; in-house and external training.
Pharmaceuticals	Better QA and GMP documentation and more complex laboratory testing	Supervisory and management skills and culture; hiring and training; production culture; lack of laboratory (industrial chemists) staff	Overseas GMP production culture work experience; training more industrial chemist and pharmacists
Pharmaceuticals	Improving marketing and brand recognition	Business culture with limited marketing focus.	Investment in in-house marketing and logistics; brand promotion.

In each case, a major leap in capabilities required firms to link technology transfer to substantial associated funding. The interlinked needs for technology and finance reveal the constraints on radical upgrading from the previous local business group structure, loosened by changing ownership structures. Three of these four firms had turned to overseas partners and changed their business structure to facilitate this leap; the fourth was struggling to find an appropriate partner.

The largest pharmaceutical firm had been bought out by Aspen, one of the largest global generics multinationals, in 2017. The acquisition enabled the Tanzanian subsidiary to access technology from elsewhere in the group. Local formulation and development (F&D) for a new product, for example, could take two years, whereas they could start the production and licensing processes immediately. They also gained access to R&D, auditing of suppliers of inputs such as APIs with regulatory paperwork ready for national authorities, and investment in automation in processing and packaging while reducing labour force numbers to cut costs.

A second pharmaceutical firm funded installation of new machinery partly with in-house funding, but largely through a grant associated with technology transfer by an international PPP. This firm was then bought by an East African private equity fund whose vision was to develop a regional group of pharmaceutical companies that could gain economies of scale e.g. through pooled API purchasing. Joint ventures were a further way to link technology transfer to finance. The bed nets firm's joint venture structure, between an established local textile company and a Japanese MNC had brought the

insecticide technology to the new plant, alongside the quality control system that was the basis for WHO prequalification, while the local firm brought the spinning and weaving experience, and also built up the logistics for a regional distribution operation.

The changes in ownership structure also helped improve organizational culture. Upgrading is a learning process, not only in equipment and skills improvement, but also in adapting firms' routines to create a culture of quality and upgrading in order to improve processes, documentation, product quality and product range. By 2017, one of the larger pharmaceutical firms had instituted extensive upgrading of quality control and quality assurance systems, aiming to change the 'temperament' of the factory. Another CEO commented that the firm would benefit strongly from being able to send supervisory staff to work in a GMP environment for a period, to learn by experience what GMP involved.

The third pharmaceutical firm, which had failed to find a new investor, was conversely struggling to fund investment in higher value products and upgraded machinery. The firm was also constrained in its efforts to increase capacity utilization by a lack of available skilled and supervisory staff to manage increased shifts per day to deliver a large public contract.

There is however a danger, as firms move into ownership by or joint ventures with MNCs, that they become more detached from local industrial linkages, increasingly relying on overseas' partners supply chains and services, rather than stimulating domestic innovation and industrial deepening.

9. Concluding discussion: developing and sustaining industrial upgrading in LIC health industries

The evidence presented shows that, in facing the double squeeze of rising quality and decreasing price, the firms in the Tanzanian health industries have substantial entrepreneurial and organizational capabilities but also face significant challenges consistent across the sector. There are feasible 'policy levers' that could help LIC firms to build competitive capabilities for survival in liberalized markets. We draw three key policy-relevant conclusions from our findings.

First, to support sustained learning and upgrading in the health industries, it is imperative to develop sector-specific policies that address the specific weaknesses of the SSIP. On the demand side, given the importance of the quality and price barriers to accessing donor-funded tenders, procurement design is a key tool for governments and donors to support market access and incentivise upgrading and industrial entry (Chataway et al. 2016). Both the bed nets and the furniture producers commented that donors' quality specifications in tenders could operate as a ceiling as well as a floor on quality, disincentivising improvement. The bed nets firm had developed the capability to produce longer lasting nets than specified, but would then lose tenders on price. Similarly, a furniture firm stated that local tendering favoured lower quality, lower price imports, with buyers not willing to pay a premium for e.g. durability. Firms will not be incentivised to upgrade if quality premiums are not paid in practice.

Institutional design can also contribute to the development of the sector, for example by eliminating the tariff-induced competitive disadvantage that actively disadvantages local manufacturers and introducing selective protection of imports to incentivise

sectoral investment in this ‘infant industry’. Incentives and support may include a quite low but stable level of industrial protection for final goods, to guard against dumping and to partially compensate for local infrastructural failures (Section 5) that need medium and long term amelioration, while incentivising continuing local supply of e.g. basic essential medicines (Tibandebage et al. 2016). Import duties can be designed to encourage equipment upgrade.

The second conclusion is the importance of supporting and incentivising dynamic industrial deepening. The findings in Section 6 make a case for strategic sectoral intervention to strengthen and deepen local supply chains and to break supply chain bottlenecks. Increased access to good quality local inputs would support cost-effective quality improvement, and offers the potential for combining cost reduction with process and product improvements, for example by targeted support for upgrading in the large and competitive local recycling industry or in sectors such as card- and plastic -based packaging, where local suppliers could feasibly replace imports. Business services, including IT, technology services and equipment maintenance are other domestic input sectors whose support would strengthen local supply chains. More ambitiously, Tanzania could invest in R&D to enhance input supplies to pharmaceuticals, for example by developing and producing local excipients, as is being tried in Ethiopia (Gebre-Mariam, Tahir, and Gebre-Amanual 2016).

Skills policies are also needed, to support both the health industries and their upstream suppliers, by filling skills gaps such as industrial pharmacists and industrial laboratory technicians.

Capability building takes time, so procurement, sectoral support and skills building all require a long-term perspective, to generate cumulative sectoral improvement. That longer term contracts in procurement can incentivise investment and linkage development is now recognized by the main health procurement body in Tanzania (Mackintosh et al. 2017) and could be expanded further. Domestic procurement rules requiring increased local content over time could provide an incentive to invest within supply chains, and could help to break the kind of ‘assurance’ dilemma described in Section 6. Donors too could seek to bridge upstream supply chain gaps, for example through value chain lending of the type practised within the agricultural sector (Simonetti, Wuyts, and Fivawo-Wuyts 2007). These approaches require a shift in national procurement thinking, away from automatic recourse to international tenders, toward a mix that includes active support for capability building in local ‘lead firms’ (Sutton 2014), combining funding, contracts and advice to support firms’ development. Among large international actors such as the Global Fund, a shift to more developmental procurement thinking is visible, for example, using concepts of ‘total landed cost’ to recognize the benefits of suppliers’ proximity, and avoiding winner-takes-all tendering frameworks (Mackintosh et al. 2017).

Third, upgrading to access new markets, and to lower costs through a jump to much larger scale, can require a change in business structure to access the combination of technology, learning and finance required for the jump (Section 8). Several firms had achieved major upgrades through international MNC buyout, joint venture development or international PPP support. When tackling international tender markets, active government support can help an ambitious local firm to gain important first-mover advantages. The bed nets producer, for example, gained WHO-prequalification early in the

development of the donor-dominated market for long lasting insecticide-impregnated nets. Winning an initial large tender, with allowance for rapid depreciation of the initial investment, made the firm more competitive over time as more competitors came in. Capable firms can be assisted to climb market-access barriers early through active support to upgrade to meet market entry barriers, e.g. support for focused skill development, or linking local firms to technology institutes and universities. Location in export processing zones can also be helpful in these circumstances.

Policy levers could further influence both choice of institutional route and the impact on industrial deepening. Joint ventures, where a local partner is an active player, may be better placed to generate local linkages that a 100% MNC buyout which may produce a more 'enclave' company relying largely on external linkages within the parent MNC. Governments can shape joint venture development, through information, business development guidance, and by actively hosting meetings to encourage and support local suppliers. Government can also identify, for potential donor-support, investments seen as locally strategic, and encourage greater transfer of technological and organizational capability over time to both lead companies and upstream suppliers. Regulatory bodies such as the TFDA (now TMDA) already provide advice for upgrading, and could perhaps play a more active role in generating external support.

Finally, one of the attractions for policy makers of a focus on dynamic industrial deepening is its support for broader development agendas. Local production of essential medical supplies is increasingly seen by African governments as a strategic security concern (Mackintosh et al. 2017; URT 2016; EAC 2017) justifying active government intervention, a focus strengthened by the coronavirus pandemic. The strengthening of upstream linkages, for example in packaging and recycled plastics, also has positive spill-over effects for firms in other sectors using these inputs.

The concept of dynamic industrial deepening, introduced and developed in this article, thus has intellectual parallels with a strand of the economic development literature rooted in work by Hirschman's that is increasingly revisited (Hirschman 1977; Sai-Wing Ho 2019). Hirschman defined linkages as 'investment-generating forces that are set in motion, through input-output relations, when productive facilities that supply inputs to that line or utilize its outputs are inadequate or non-existent' (Hirschman 1977, 72). His 'generalised linkage approach' to economic development was therefore inherently dynamic, since 'linkages effects need time to unfold' (Hirschman 1977, 70–71). Srinivas (2016) further notes that Hirschman's policy approach, arising from the focus on linkage development, was one of problem-solving to support developmental investment. Sutton (2014, 1) makes a closely related point in arguing for the policy importance of a Local Content Unit to generate linkages to primary production in Tanzania, with the purpose of expanding and deepening the domestic business sector as a spin-off from the offshore gas industry. While most of the applications in this literature focus on creating backwards linkages from primary products, this article's findings suggest that the framework has much wider application including in the health industries.

Notes

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ORCID

Roberto Simonetti  <http://orcid.org/0000-0001-5880-3058>

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