



Ethiopia

SCIENCE, TECHNOLOGY & INNOVATION **POLICY REVIEW**





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Explanatory notes

References in the text to the United States are to the United States of America and those to the United Kingdom are to the United Kingdom of Great Britain and Northern Ireland.

The term “dollar” (\$) refers to United States dollars, unless otherwise stated.

The term “billion” signifies 1,000 million.

The term “tons” refers to metric tons.

The term “MT” refers to megatons.

The term “MW” signifies megawatts.

Annual rates of growth and change refer to compound rates.

Exports are valued FOB and imports CIF, unless otherwise specified.

Use of a dash (–) between dates representing years, such as 1988–1990, signifies the full period involved, including the initial and final years.

An oblique stroke (/) between two years, such as 2000/01, signifies a fiscal or crop year.

A dot (.) in a table indicates that the item is not applicable.

Two dots (..) in a table indicate that the data are not available, or are not separately reported.

A dash (–) or a zero (0) in a table indicates that the amount is nil or negligible.

Decimals and percentages do not necessarily add up to totals because of rounding.

Preface

UNCTAD Science, Technology and Innovation Policy Reviews (STIP Reviews) are an analytical and policy learning process for a country's science, technology and innovation (STI) stakeholders to reach a clearer understanding of the key strengths and weaknesses of their innovation systems and identify strategic priorities for its development. The result of this process is documented in the STIP Review document and considered at the United Nations Commission on Science and Technology for Development (CSTD).

The analysis is based on the Framework for Science, Technology and Innovation Policy Reviews (UNCTAD, 2019). STIP Reviews aim to assist countries to align STI policies with their development strategies while promoting sustainable development and the achievement of the Sustainable Development Goals (SDGs); build stronger national capacities in STI; assess the National Innovation System and priority sectors and industries; provide recommendations to improve technological capabilities; and encourage innovation. The reviews make a systematic effort to involve a broad range of stakeholders to build national consensus.

The STIP Review of Ethiopia was prepared at the request of the Government to assist the Ministry of Innovation and Technology in preparing a new STI policy. The primary objectives of this report are twofold: (1) to appraise the extent to which rapid economic growth in Ethiopia has contributed to local technological learning and upgrading, and created the necessary conditions for the development of a viable National Innovation System (NIS); and (2) to develop a national STI policy framework that the country needs to implement the SDGs and the national development vision, particularly the export-oriented and manufacturing sector-based industrialization strategy. At the request of the Government, the STIP Review provides a deep-dive analysis of two sectors that could serve as case studies for understanding the relationship between the national STI policy framework and technical learning and innovation at the sectoral level: apparel and textile for resource-based labour-intensive exports and pharmaceuticals for knowledge-intensive import substitution.

The STIP Review is based on fact-finding missions to Ethiopia, which included interviews with representatives of the Government, the private sector and specialized public institutions, conducted in December 2018 and March 2019, and current relevant data. The missions received the full support of the Ministry of Innovation and Technology and members of the Interministerial Committee established to assist with the STIP Review process, as well as other stakeholders.

Geneva, November 2019

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The Review benefited greatly from comments and suggestions provided by Angel Gonzalez-Sanz, Dimo Calovski, Ermias Biadgleng, Kiyoshi Adachi (UNCTAD) and Jicui Dong (WHO). Comments from stakeholders in Ethiopia were provided during a workshop held in Addis Ababa in October 2019.

Many people in Ethiopia, including government officials, university and research institute staff, private-sector representatives, development partners and staff from civil society organizations and others gave generously of their time and insight to the research team preparing the Review. All these contributions are gratefully acknowledged.

The Review would not have been possible without the support of Dr. Getahun Mekuria, Minister of Innovation and Technology, MInT; Mr. Sisay Tola, State Minister of Innovation and Technology, MInT; Mr. Jemal Beker, State Minister of Innovation and Technology, MInT; and Dr. Shumete Gizaw, Chief of Staff, Prime Minister's Office and formerly State Minister of Innovation and Technology, MInT.

Teams from the Ministry of Innovation and Technology were closely involved in the Review and deserve our sincere gratitude. In particular, we are grateful to Mr. Desta Abera, Director of Policy and Future Planning at MInT, and his team, in particular Mr. Walelign Mihretie and Mr. Tariku Gerba Boka, whose work and collaboration were instrumental for the preparation of the Review. The evaluations and conclusions expressed in the Review, however, are exclusively those of the UNCTAD secretariat.

Abbreviations

AGOA	African Growth and Opportunity Act 2000 (of the United States)
AHRI	Armauer Hanssen Research Institute
BMZ	Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung [Federal Ministry for Economic Cooperation and Development, Germany]
cGMP	current good manufacturing practice
CMT	cut, make and trim
DBE	Development Bank of Ethiopia
EAO	Ethiopian Accreditation Office
EBTI	Ethiopian Biotechnology Institute
EFDA	Ethiopian Food and Drug Administration (formerly EFMHACA)
EFMHACA	Ethiopian Food, Medicine, Health Care Administration and Control Authority
EHGCs	empty hard glycerin capsules
EIC	Ethiopian Investment Commission
EPHI	Ethiopian Public Health Institute
EPSA	Ethiopian Pharmaceutical Supply Agency
ESA	Ethiopian Standards Agency
ETGAMA	Ethiopian Textile and Garment Manufacturing Association
ETIDI	Ethiopia Textile Industry Development Institute
FBPIDI	Food, Beverage and Pharmaceuticals Industry Development Institute
FDI	foreign direct investment
FDRE	Federal Democratic Republic of Ethiopia
GDP	gross domestic product
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit [German Corporation for International Cooperation]
GMP	good manufacturing practice
GTP I	First Growth and Transformation Plan (2010–2015)
GTP II	Second Growth and Transformation Plan (2015–2020)
HSTP1	First Health Sector Transformation Plan (July 2015–June 2020)
IP	intellectual property
IPR	intellectual property rights
JSC	joint steering committee
KIP	Kilinto Industrial Park
LDC	least developed country
LPP	local pharmaceutical production
M&E	monitoring and evaluation
MInT	Ministry of Innovation and Technology (formerly MOST until 2018)
MOE	Ministry of Education

MOF	Ministry of Finance (formerly Ministry of Finance and Economic Cooperation and, prior to that, MOFED)
MOFEC	Ministry of Finance and Economic Cooperation (predecessor of MOF)
MOFED	Ministry of Finance and Economic Development (predecessor of Ministry of Finance and Economic Cooperation)
MOH	Ministry of Health
MOI	Ministry of Industry (now under MOTI)
MOSHE	Ministry of Science and Higher Education
MOST	Ministry of Science and Technology (predecessor of MInT)
MOTI	Ministry of Trade and Industry
NBE	National Bank of Ethiopia (the Central Bank)
NIS	National Innovation System
NMI	National Metrology Institute
NPL	non-performing loans
NQI	national quality infrastructure
NSO	National Standards Organization
NSPA-Pharma	National Strategy and Plan of Action for Pharmaceutical Manufacturing Development in Ethiopia (2015–2025)
NSTIC	National Science, Technology and Innovation Council
PMPA	Pharmaceutical Manufacturing Plan for Africa (of the African Union)
PMPA-BP	Business Plan for the accelerated implementation of the PMPA (of the African Union)
PMSMA	Ethiopian Pharmaceuticals and Medical Supplies Manufacturing Association
PTRM	Pharmaceutical Technology Roadmap (of Ethiopia)
R&D	research and development
RBEC	Regional Bioequivalence Center
RIF	Research and Innovation Fund
SDGs	Sustainable Development Goals
SMEs	small and medium-sized enterprises
STI	science, technology and innovation
STIP	science, technology and innovation policy
TRIPS	Agreement on Trade-Related Aspects of Intellectual Property Rights (of the WTO)
TVET	technical and vocational education and training
UNCTAD	United Nations Conference on Trade and Development
UNICEF	United Nations Children’s Fund
UNIDO	United Nations Industrial Development Organization
USAID	United States Agency for International Development
USP/PQM	United States Pharmacopeia/Promoting the Quality of Medicines
WHO	World Health Organization
WTO	World Trade Organization

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Key messages

- **High-level growth but low-level of technological learning.** Ethiopia has ambitious development plans and in the past two decades it has become a fast-growing African economy (achieving a double-digit growth rate for more than a decade) and a country where foreign direct investment (FDI) inflows have been expanding fast. However, despite rapid growth and increased FDI inflows, progress in structural transformation by shifting from low-value, low productivity and low-tech economic activities to higher-value, higher-productivity and high-tech activities has been limited. This has constrained the opportunities available for technological learning, skill formation and innovation. This STIP Review sheds light on the mismatch between high-level economic growth and FDI inflows and slow technological learning and the main factors that are hindering the development of local technological and innovative capabilities.
- **A mismatch between “policy formulation” and “policy implementation”.** On paper, Ethiopia has most of the policies, regulations, background studies and road maps necessary to kick-start a successful process of technological learning, innovation and technological upgrading. In reality, however, there is a serious implementation gap across public institutions either because of capacity constraints or misallocation of efforts and resources. The STIP Review has identified several areas where the hindrance to technological progress was largely due to implementation deficiencies rather than lack of policy and strategy or institutions. Advances should also be made on policy coordination and coherence.
- **Need to focus on entrepreneurial capacities and production linkages.** Ethiopia needs to build its productive capacities to add value, produce a wide range of products, diversify the economy and generate income. In Ethiopia, progress has been greatest in “productive resources”, particularly transport infrastructure and energy with significant improvements in road construction and railway networks. The next STI policy framework should build on this progress and advance on improving the entrepreneurial and technological capacities and production linkages.
- **Need to shift focus from technology transfer to innovation.** The current Ethiopian STI policy gives priority to technology transfer (mainly referring to the acquisition of technologies from abroad). Implicit in this approach is the assumption that acquired technologies will be automatically assimilated into the local economy through learning, linkages and demonstration effects. The next STI policy framework should shift the focus of the national STI policy to the dynamic process of “technological learning and innovation”. MInT has already recognized this need as reflected by the change in the name and structure of the Ministry. In this context, the objective of the STIP Review is to assess how this transition could be achieved and the role and effectiveness of industrial parks in promoting learning, capability-building and diffusion of technology through linkages.
- The STIP Review provides specific recommendations to assist the Government to build an effective National System of Innovation.



Part I

Policy challenges: Looking ahead

I. The country's development trajectory

Ethiopia has been among the fastest-growing economies in Africa and globally since 2003.

From 2005 to 2015, the growth of real GDP averaged more than 10 per cent per year, enabling the country to double its per capita GDP (reaching \$720 in 2017) and reducing substantially extreme poverty from 37.2 per cent of the population in 2004 to 27.3 per cent in 2015.¹ This growth is the fastest that the country has experienced and is considerably above the average achieved by low-income and sub-Saharan African countries during this period.

The main drivers of this unprecedented growth rate include the Government's bold and ambitious economic development strategy.

This strategy has incorporated, among other things, a big push in public investment, particularly in agriculture and infrastructure development. Since 2001, the Government of Ethiopia has launched four consecutive five-year development plans – namely the Sustainable Development and Poverty Reduction Strategy Paper (SDPRP; 2001–2005), the Plan for Accelerated and Sustained Development to End Poverty (PASDEP; 2005–2010), the First Growth and Transformation Plan (GTP I; 2010–2015) and the Second Growth and Transformation Plan (GTP II; 2015–2020) – to guide the overall development of the country. The first three plans gave due priority to pro-poor economic sectors including agriculture, while the latest plan (GTP II) gives more emphasis to industrialization. Manufacturing is expected to play a leading role in job creation, technological learning and innovation, and in enhancing the export capacity of Ethiopia and redressing the current trade imbalance. GTP II foresees the strengthening of production and knowledge linkages between sectors, and the creation of value chains and improvements in the quality, productivity and competitiveness of the key economic sectors (FDRE, 2016). **Leveraging these achievements, in September 2019 Ethiopia launched a home-grown economic reform agenda aimed at boosting private investment, creating productive jobs and enhancing the role of the private sector in the economy.**

As a result of the investment promotion efforts of the Government, Ethiopia witnessed increasing

FDI in the past 10 years. FDI inflow to Ethiopia started to rise from 2013 and has surpassed all countries in the region (Figure 1). With \$3.3 billion worth of FDI inflow, Ethiopia has absorbed almost half of the FDI the East African region received in 2018. FDI inflow to Ethiopia in that year was about twice that of the second-ranked country in the group (Kenya).

The formation and expansion of industrial parks is a key strategy for achieving GTP II.

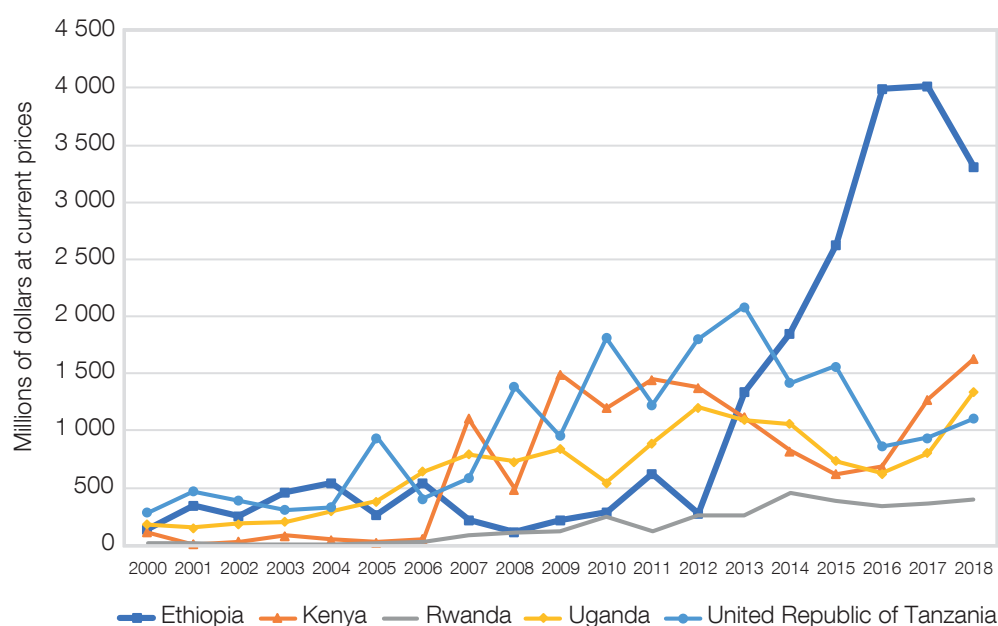
This scheme is envisaged to attract domestic and foreign direct investment, thereby upgrading industries and generating employment and exports. It is also seen as the best route for addressing environmental concerns. Accordingly, the Government set an ambitious plan to build about 14 public industrial parks in different parts of the country over the period 2015–2020. The Industrial Parks Development Corporation of Ethiopia (IPDC) was established in 2014 with the mandate of developing and operating a wide range of industrial parks. So far four public industrial parks (Bole Lemi, Hawassa, Kombolcha and Mekelle) have been inaugurated, while two others (Dire Dawa and Adama) are under construction. There are also a small number of private industrial parks such as the Chinese-owned park named the Eastern Zone located in Bisheftu about 45 km from Addis Ababa.

The sustained economic growth of Ethiopia was also supported by a conducive external environment.

Between 2000 and 2011, international trade was a dynamic force in the development of the economy with exports increasing more than threefold between 2005 and 2015, while volumes increased by a magnitude of more than two, reflecting a positive commodity price effect. Imports increased in value by a factor of four over the same period (Table 1).

However, the recent stagnation of exports is a major concern.

During GTP II, the Government was expecting to increase merchandise exports by 20 per cent per annum and sustain it well into the next decade. This pattern of export growth would enable Ethiopia to increase export earnings to \$14 billion from its 2013 level of \$3.1 billion. However, exports, in particular merchandise exports, have been stagnant in the last five years partly due to the end of the global commodity super-cycle and partly reflecting the limitations of domestic productive capacity and numerous production-related constraints. In contrast, the import needs of Ethiopia have increased rapidly,

Figure 1 FDI inflow, selected East Africa countries

Source: UNCTADstat. Available at: <https://unctadstat.unctad.org/EN/Index.html>.

Table 1 International trade

Indicators	2005	2010	2015	2017
Merchandise exports, millions of dollars	903	2 330	(e) 3 050	(e) 3 163
Merchandise imports, millions of dollars	4 095	8 602	(e) 16 914	(e) 16 008
Merchandise trade balance, millions of dollars	-3 192	-6 272	(e) -13 864	(e) -12 845
Volume index of exports	45.6	75.3	100.0	102.1
Volume index of imports	29.5	49.4	100.0	94.5

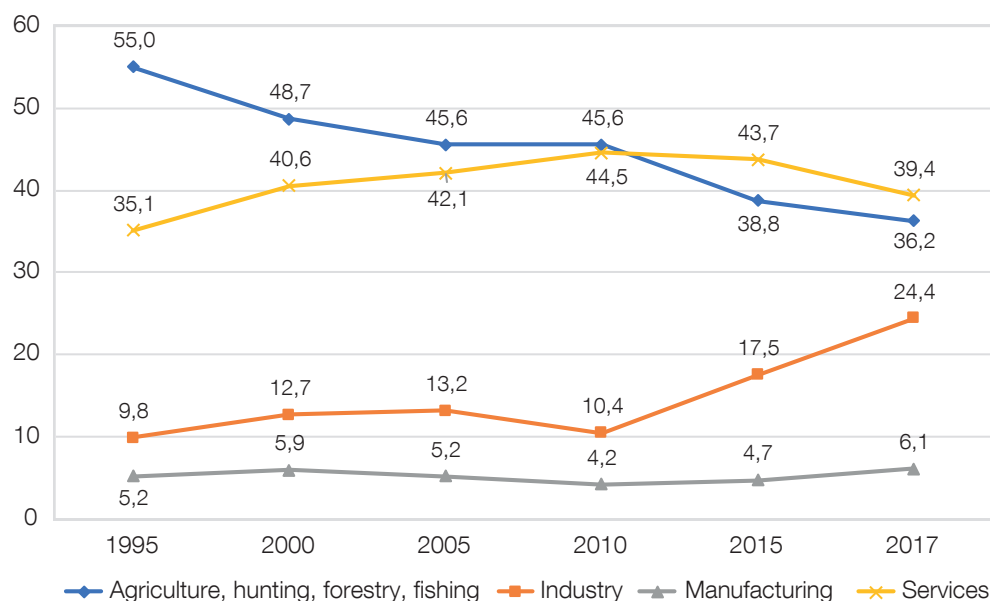
Source: UNCTADstat. Available at: <https://unctadstat.unctad.org/EN/Index.html>.

raising the total cost of imports to \$16 billion by 2017. This discrepancy between exports and imports has worsened the balance of payments more than fourfold between 2005 and 2017. The result is a trade deficit amounting to \$12.8 billion in 2017. Shortages of foreign exchange arising from the balance-of-payments problems have somewhat diminished the ability of enterprises, even export-oriented, to obtain the foreign currency they require to import technologies.

Despite the economic growth, the progress made in structural transformation has been limited.² Essentially, Ethiopia is still an agrarian economy. More than 70 per cent of the population relies on farming and rural economic activities for employment, income and livelihood.³ As shown in

Figure 2, in 1995, the share of agriculture in GDP was at about 55 per cent, value added in services was on average 35 per cent and industry, consisting of construction, mining and manufacturing, contributed only 10 per cent of GDP. The share of manufacturing during this period was around 5 per cent, much lower than the African and low-income countries' average (16 per cent). At the beginning of 2000, the share of agriculture in GDP started to drop below 50 per cent for the first time while that of services increased by 5 percentage points to 40.6 per cent of GDP. In more recent years, agriculture has declined further to 36.2 per cent (in 2017), while industry increased its share to 24.4 per cent. The rise in the share of industry has been due largely to the rapid expansion of the construction

Figure 2 GDP by value added, by kind of economic activity
(Percentage of total GDP)



Source: UNCTADstat. Available at: <https://unctadstat.unctad.org/EN/Index.html>.

sector, while the increase in the contribution of the manufacturing sector remains modest. The share of manufacturing to GDP in 2017 reached 6.1 per cent mainly on account of the increased investment in export-oriented manufacturing activities.

The sectoral shift was largely from agriculture to services and construction activities bypassing manufacturing. However, service-sector productivity and technological development in African countries are not significantly different from traditional agriculture (Rodrik, 2014). The service sector in Ethiopia consists largely of non-tradable activities such as retail, hotels, restaurants, local transport and informal sector activities with the exception, of course, of tourism and the international transport service provided by Ethiopian Airlines. This suggests that rapid economic growth in Ethiopia did not promote structural transformation. As a result, the opportunities available for technological learning, innovation and skills formation by shifting resources into high-productivity and high-tech activities across and within sectors were limited.

As Ethiopia pursues the more ambitious export-led industrialization strategy, it may need to think outside the box in terms of the policies it would have to adapt to promote successful structural transformation. It may prove increasingly difficult to rely on the same policy mix that in the past enabled the country to achieve high-level growth

and a rapid sectoral shift. As well as overcoming existing finance, investment and skills-related constraints, success in export-led industrialization will require upgrading technological capability and building the productive capacity that the country needs to manufacture and export higher-value and technologically more sophisticated products. The importance of expanding the country's productive capacity cannot be emphasized enough as it is an essential prerequisite for moving up the value, technology and productivity ladder (UNCTAD, 2006). The home-grown reform agenda is aimed at creating a conducive policy environment for productive capacity-building and the strengthening of domestic private enterprises by correcting macroeconomic imbalances, easing structural constraints and creating new investment opportunities and sources of growth.

The new and more ambitious strategy depends on exports of more sophisticated manufactured goods. The comparison between Ethiopia and Bangladesh, another least developed country (LDC) focused on low-value light manufacturing exports, on the one hand, and Viet Nam, a country that Ethiopia aspires to catch up with, on the other, reveals an interesting scenario and an important lesson for Ethiopia. Between 2005 and 2018, high-tech exports from Ethiopia rose from zero to 2 per cent, while primary and resource-based exports

Table 2 Export composition by technological classification of products

Percentage of total exports	Ethiopia		Bangladesh		Viet Nam	
	2005	2018	2005	2018	2005	2018
High-tech	0	2	0	1	6	35
Low-tech	5	9	88	93	36	33
Medium-tech	1	5	3	1	6	10
Primary products and resource-based	88	76	8	5	52	22

Source: UNCTADstat. Available at: <https://unctadstat.unctad.org/EN/Index.html>.

(such as coffee, oilseed, live animals) fell only from 88 per cent to 76 per cent (see Table 2). Over the same period, increasing technological capabilities and expansion of productive capacity allowed Viet Nam to increase high-tech exports from 6 per cent to 35 per cent, while its primary and resource-based exports fell from 52 per cent to 22 per cent. In Bangladesh, continuing dependence on low-wage, low-value and low-productivity manufacturing activities in textile and garments for export led to the continued dominance of low-tech exports (rising from 88 per cent to 93 per cent) despite more than 30 years of diversification into the manufacturing sector. This reliance on low-tech exports reflects the failure of Bangladesh to intensify technological learning and deepen its innovation capability, which locked the country into a low-value and low-tech production trap, although in terms of volume of exports of light manufactured goods and export earnings, Bangladesh has outperformed most LDCs as well as many middle-income countries. The Bangladesh experience poses an important lesson for Ethiopia on the need to pay greater attention to technological learning and upgrading from an early stage of export-led industrialization strategy.

In this respect, Ethiopia faces fierce competition as a “late-latecomer” to industrialization, technological development and innovation. The country has recently adopted an export-oriented industrialization strategy as a development model to propel its growth and transformation agenda. However, it is embarking on this more ambitious strategy at a time when the export-driven industrialization model is becoming much harder to achieve than when other developing countries (for example, the newly industrializing countries in East Asia) were pursuing this development path five decades ago. The global economy in the twenty-first century is much more open and governed by more complex multilateral trade rules, and, as

UNCTAD notes, it is “crowded, with a multitude of countries simultaneously trying to realize the promise of export-led industrialization by exporting their manufactures, thereby increasing the global supply of less-skilled labour” (UNCTAD, 2016b: 97). In most cases, low-income countries are producing the same types of low-value and low-tech light manufacturing goods to export to the same international markets, which could lead to compression of price (and ultimately wage) growth.

A key element in accelerating economic transformation is the speed in which a country can upgrade its technological capability and build a strong productive capacity that enables it to produce an increasing range of higher value added and higher quality goods and services. Productive capacities are composed of three basic elements: (1) productive resources (factors of production, including natural resources, human resources, physical capital and financial capital); (2) entrepreneurial and technological capabilities (the skills base, the capability of local firms to learn, assimilate, adapt, upgrade and master technology, the competence to absorb management and technical know-how, the ability to innovate, add value and invest in new ideas, and the level of sophistication of supporting institutions at national and sectoral levels); and (3) production linkages (flows of goods and services in the form of backward and forward linkages, market-based information flows, inter-firm interactions, the development of local value chains, etc.). Together, these three elements determine a country’s overall capacity to produce goods and services, which goods it can produce, and at what quality and level of productivity.

Like other LDCs, the productive capacity of Ethiopia is low, but recent growth has enabled the country to initiate a process of productive capacity-building, driven largely by public-

sector investment in targeted areas. Public investment in Ethiopia became the third highest in the world, increasing from 5 per cent in the early 1990s to 18.6 per cent of GDP in 2011 (World Bank, 2013), reaching nearly a quarter of GDP by 2014 and accounting for nearly half of economic growth. The bulk of the public investment, supplemented by Official Development Assistance (ODA) and concessional loans, was devoted to infrastructure development to redress the neglect of infrastructure in previous decades.

Of the three key components of productive capacity, progress has been greatest in productive resources, particularly transport infrastructure and energy, with significant improvements in road construction and railway networks. Annual spending on road construction during GTP I reached 4 per cent of GDP, increasing the road network from 26,500 km in 1997 to 60,000 km in 2014, and connecting previously isolated rural areas (World Bank, 2013). A new railway line connecting landlocked Ethiopia to a seaport in Djibouti, through which 95 per cent of the country's trade transits, is expected to halve delivery times for its imports and exports. Public investment has also been deployed to develop agricultural infrastructure, in particular productivity-enhancing support services and water and sanitation. Similarly, major progress has been made in solving the country's energy constraints which is critical for strengthening productive capacity. Out of the \$11.4 billion public expenditure earmarked for infrastructure development during GTP I, energy accounted for 31.2 per cent of the total investment (Ali, 2019). Most of the investment was targeted at the construction of hydroelectric dams including the Great Ethiopian Renaissance Dam, the largest in Africa. The current five-year plan (GTP II) aims to increase the power generation capacity of the country from the present level of less than 4,000 MW to 10,000 MW by the end of 2020. The aim is to address domestic demand, both by households and industry, while exporting surplus power to neighbouring countries and beyond to generate the foreign exchange that the country needs badly to meet the import needs of export-oriented manufacturing enterprises.

In contrast, however, mixed results are shown in the development of “entrepreneurial and technological capabilities”. In this respect, government intervention has focused mainly on two areas: (1) public investment in research and development (R&D), and (2) human resource

development – both in terms of broadening the country's skills base and improving access to education.

Until recently, public expenditure by Ethiopia on R&D as a share of GDP was one of the lowest in Africa, but this trend has changed in recent years, particularly during GTP I. R&D spending increased sharply from 0.24 per cent of GDP in 2010 to 0.61 per cent in 2015.⁴ Similarly, the number of R&D personnel increased from 13,095 to 14,200 during the same period. That said, most R&D institutions in Ethiopia are not fully functional as research institutions. Most of the additional R&D spending was used to acquire scientific equipment and “there is poor cooperation and absence of R&D resource sharing among R&D units which result in duplication of expensive scientific equipment purchase” (MOST, 2015b: 3). There are limited local technical capabilities for equipment repairs. Consequently, capacity utilization and effectiveness in most R&D institutions is undermined by faulty or “malfunctioning” scientific equipment (MOST, 2015b). It seems, therefore, that without significant improvements, the contribution of R&D institutions to technology transfer and the generation of technologies that support the SDGs and the export-led industrialization strategy will clearly remain minimal.

Regarding human resource development, government expenditure on education grew by 8.3 per cent annually between 2000 and 2015, rising from 14 per cent of public expenditure to 27 per cent (MOE, 2017). Most of the expenditure has been directed mainly to the construction of elementary and secondary schools, universities and technical and vocational education and training (TVET) institutions. Primary education is now almost universal; the number of technical and vocational training institutes almost doubled to 900 between 2011 and 2015; and there are more than 35 universities, compared with only three at the end of the 1990s. However, while the massive investment in education has increased the opportunities for learning and skill formation, creating the relevant skills and knowledge base requires sufficient and suitably qualified teaching staff, the maintenance of higher educational standards and practically relevant training. These essential requirements are currently lacking (Shiferaw, 2017).

Of the three key elements of productive capacity, production linkages are the least developed, reflecting a weak private sector and limited technological and manufacturing

production capacity. The conclusions of various studies on production linkages in Ethiopia is that linkages among firms in the manufacturing sector and between the manufacturing sector and agriculture remain insignificant (Legese et al., 2014; Gebreeyesus, 2016). This partly explains the dependence of manufacturing firms on imports for inputs, both raw materials and intermediate goods. It also explains the growing balance-of-payments problem and foreign exchange shortages, which is singled out by most import-dependent producers as the most immediate binding constraint.

This context and the implications for technological development and innovation in Ethiopia set the backdrop for this STI policy review.

II Societal challenges: Alignment with the SDGs

The review of the Ethiopian STI policy by UNCTAD will contribute to better alignment of technology policy with the country's development strategy and the SDGs. In this respect, this STIP Review could not have come at a more opportune time. There is no doubt that the country is at a crossroads in

its economic and political development and policy direction. After more than two decades of State-led and public investment-driven growth and development, there are signs that the Government is rethinking its policy approach, particularly the role of the State in the economy. The Government has already announced its intention to privatize major State-owned enterprises and follow a more open approach in trade and investment policies. The review of the STI policy during this transitory period creates a unique opportunity for aligning the STI policy with the country's medium- to long-term vision and the national development strategy, particularly the export-led and manufacturing sector-driven industrialization strategy. It also enables the Government to align the STI policy with the 2030 Agenda and the SDGs.

In fact, in Ethiopia, the Second Growth and Transformation Plan (GTP II) is considered as the development strategy to implement the SDGs in the country (National Plan Commission of Ethiopia, 2017). Each of its priority areas is aligned with the implementation of several SDGs (see Table 3).

Therefore, aligning the STI Policy framework with GTP II will also enable Ethiopia to address the main societal, economic and environmental challenges and contribute to the achievement of the SDGs.

Table 3 Alignment between the priority areas of Ethiopia and the SDGs

Priority areas	SDGs
Agricultural sector development	
Structural transformation through the development of manufacturing	
Productivity, quality and competitiveness of the productive sectors	
Rebalance demand and supply by accelerating growth	
Construction industry policy and strategy framework	
Accelerate urbanization and structural change	
Transformation of domestic investors	
Development of human resources supported with technological capacity-building	
Build climate-resilient green economy	
Eliminate rent-seeking and ensure the predominance of a developmental frame of mind	

Source: UNCTAD based on National Plan Commission of Ethiopia (2017).

Notes

¹ UNCTADstat. Available at: <https://unctadstat.unctad.org/EN/Index.html>.

² However, according to UNCTAD, 2015, structural transformation is not only about labour and capital shifts to higher-productivity activities across sectors, but also within sectors. When viewed from this perspective, the successful development in Ethiopia of a modern and high-tech cut flower production capability can be considered as structural transformation within the agricultural sector.

³ ILOSTAT, the country profile of Ethiopia. Available at: <https://ilostat.ilo.org/data/country-profiles/>

⁴ The sudden increase in R&D expenditure was due to efforts by Ethiopia to meet the target set by the African Union for member countries to devote at least 1 per cent of their GDP to R&D (MOST, 2015b).



Part II

**Policy components:
Evaluating government action**

III. The National Innovation System of Ethiopia

The innovative activities that enable countries to move up the productivity, technology and value ladder typically take place at the firm level, but a firm usually does not innovate in isolation. Innovation depends upon a wider system comprising diverse actors and their interaction, as well as the policy framework covering various policy domains. At the national level, the National Innovation System (NIS) strongly shapes the country's technological development and innovation performance.

This chapter charts the NIS of Ethiopia, focusing mainly on the strengths, weaknesses and gaps in the key policies and institutions and actors that shape it. The chapter focuses on three broad sets of actors: (1) the State and other public-sector institutions; (2) private-sector institutions; and (3) learning and research institutions.

A. The State as a coordinator of the National Innovation System

The State is the glue that holds the innovation system together and ensures that all the key actors work cohesively and complement each other's needs. Government actors provide the conducive regulatory and STI policy environment that creates the incentives, skills and the infrastructure necessary to engage in innovative activities. Governments set appropriate policies and rules that provide the guarantee to firms that markets function well and that the returns on their investment in innovation are secured. These are the roles of the State, which also has the responsibility to ensure that the educational system is responsive to industry's needs and provides the finances required to build the national infrastructure for R&D and quality/standards control. Above all, the State oversees the formulation and implementation of STI policies and facilitates interactions between key actors and institutions in the National Innovation

Table 4 Major government actors and instruments of the Ethiopian NIS

Ministry of Innovation and Technology (MInT)	Formerly the Ministry of Science and Technology (MOST), MInT is the ministry responsible for technology upgrading and transfer. It is responsible for the formulation and the coordination of the implementation of the STI policy.
Ministry of Trade and Industry (MOTI)	MOTI is responsible for expanding industry and promoting trade (and specifically exports) in the country. This ministry has been divided into two, the trade ministry and industry ministry for a while, until recently again merged. MOTI has been given a new direction to focus on capacity-building of local firms while following up on foreign firms left to the Investment Commission.
Ethiopian Investment Commission (EIC)	EIC is the first window of entry at which investors first apply for an investment licence. In recent years, EIC has been given more responsibilities and power to promote investment, particularly FDI.
Education and training system	The education and training system comprise the formal education system and specialized training and on-the-job training. They comprise the lower education system, overseen by the Ministry of Education (MOE) and the higher education system, overseen by the Ministry of Science and Higher Education (MOSHE).
Quality infrastructure	Ethiopian Standards Agency (ESA) provides technical and capacity-building support to firms. The agency also facilitates the development of standards, mainly adopting international standards to the local context. It also provides information on science and technology information. ESA has changed the ministry to which it is accountable. It has recently come back under MOTI while it was under MOST for some years. Other actors that are part of the quality infrastructure include universities, the National Metrology Institute, and development institutes under MOTI.

Technology and Innovation Institute	The Technology and Innovation Institute is a general-purpose STI support body established in 2014 as the Science and Technology Information Center (STIC). Its main purpose is collecting and analysing STI indicators used for analysis to inform policy. This is an essential service for enabling an effective policy design and implementation process that is evidence based.
Ethiopian Intellectual Property Office (EIPO)	The main objectives of EIPO are to protect intellectual property (IP) and administer IP laws, to prepare laws and regulations on IP, to raise awareness on IP and to disseminate patent information to firms, universities etc. who might use the information for a source of technology transfer. Ethiopia is in the process of joining the Berne IP Convention and the Patent Cooperation Treaty (PCT).
Development Bank of Ethiopia (DBE)	DBE acts to promote development by lending to high-priority industries and activities. DBE offers reduced interest rate loans and tailored repayment periods for high-priority industries. It provides two types of financing: project financing and lease financing, particularly for SMEs. Project financing refers to projects with an estimated cost of 7.5 million Birr (approximately \$235,000) and above. The current credit policy is that local investors should contribute 25% of their project cost, while foreign companies contribute 50%. That means DBE can finance up to 75% and 50% of the local and foreign-owned projects respectively.
National Bank of Ethiopia (NBE)	NBE is the country's central bank. It is responsible for designing and implementing foreign exchange policies. It has established a quota system for the allocation of foreign exchange. Exporting manufacturers can retain 70% of foreign exchange proceeds for three months to use to buy imported inputs.
Industrial parks	Industrial parks are instruments of industrial development and technology transfer in Ethiopia. The first Government-sponsored industrial park was built at Hawassa city in 2015. Three additional parks have opened since, and at least 10 more are expected to be operational by 2025. The Ethiopian industrial parks are modern, environmentally friendly and contain all the provisions and services necessary to attract FDI and kick-start export-oriented manufacturing activities. They represent a new approach to the investment and technology development policies of Ethiopia, signalling the Government's determination to experiment with different policy instruments in implementing GTP II.

Source: UNCTAD.

System. Table 4 lists major government actors of the Ethiopian NIS.

For the last three decades, the State has been the main driver of the impressive economic growth of Ethiopia and the force behind the successful technological learning and export promotion in selected sectors such as the floriculture industry. The rapid development and impressive export performance of the Ethiopian floriculture industry would not have been possible without the direct intervention by the State, which spearheaded the process from the start by targeting the industry and potential investors and creating the “systemic” conditions needed for investment and technological learning (Oqubay and Tesfachew, 2019). Central to the country's State-led growth model have been the principles of “policy independence” and “developmental and activist

State”, which are features that are comparable to the State-driven growth model practised in the newly industrialized East Asian economies during their earlier stage of development.⁵ An activist state model, which has served the country well over the past decade, will continue to be essential for effective implementation of STI policies and the governance of the NIS.

Nevertheless, the governance of the NIS in Ethiopia is in its formative stage. Like most countries at an early stage of development, the economic governance system as a whole is still underdeveloped, the regulatory environment is cumbersome and non-transparent, and many inter-firm interactions are based on informal arrangements and personal contacts.⁶ However, unlike many other developing countries, Ethiopia has a Government that is focused on development

and that provides the strategic direction needed to position the country in a fast growth and economic transformation trajectory.

There is an urgent need to think “outside the box” and design – including through learning from successful countries – a governance system that matches the new vision and aspirations, and the demands of innovation-driven industrialization in the twenty-first century. While there is no “one-size-fits-all” approach to good governance and each country has to mould its system to match its needs, there are ample possibilities for learning from the experiences of successful countries, particularly the principles and institutional mechanisms that helped to create effective governance of the NIS. While each country differs from others in many ways, identifying the “how” aspect from other countries’ experiences (for example, how successful countries organized their STI policies) allows generic operational principles to be learned.

Ethiopia has proven that it is willing to learn from other countries as well as through learning by doing and experimentation. The introduction of the kaizen system in Ethiopia in 2011 to assist with productivity improvements and quality and waste management at production level is an excellent indicator that Ethiopia is open to new ideas and prepared to learn from others and to experiment with innovative institutional mechanisms in its determined efforts to pursue the export-led industrialization agenda. The kaizen system was borrowed from Japan, which is an advanced economy with institutions and a skills base much higher and more sophisticated than those found in Ethiopia. Thus, in adapting the principles of kaizen, Ethiopia had to adjust and tailor the system to its specific needs and conditions.

This Review identifies four important lessons from the East Asian experience that Ethiopia can adapt and apply in the management of its STI policies and the governance of its NIS.

1. The intensity of “efforts” and “learning”

Formulating STI policies is only the beginning of the technological development process. Successful implementation of STI policies depended on “intensity of efforts” (Kim, 1998), meaning the amount of resources and energy expended by governments in developing domestic

absorptive capacity, encouraging local actors to apply new technologies and the sense of urgency attached by firms and governments to speeding up technological learning and creating an ideal environment for innovation. Such efforts creating “intensity of learning” (Oqubay and Tesfachew, 2019) are an important precondition for successful implementation of STI policies and for accelerating the process of technological and innovation capability-building and catch-up.

The development of the floriculture industry in Ethiopia is an excellent example of what can be achieved through “intensity of learning”. The Government of Ethiopia was able to develop, in a short period, a successful and internationally competitive floriculture industry and catch up (in less than a decade) with countries in the East African region that have been exporters of cut flowers for more than five decades (Oqubay and Tesfachew, 2019). A modern and export-oriented floriculture industry is a high-productivity and technology-intensive activity that displays many features of manufacturing. There is no reason why this successful learning experience cannot be replicated in other areas such as supporting technological development in local enterprises and the strengthening of the NIS.

The new administration, with the change of leadership in the ruling party governing Ethiopia since June 2018, has introduced several reforms that have signalled “intensity of efforts” and the determination to accelerate technological learning and innovation-driven development. A good indicator of the renewed and intensive focus on innovation is the streamlining of the mandates of the former Ministry of Science and Technology (MOST) from the broader science, technology and innovation-related activities to only innovation and technology. The “science” aspect of the Ministry’s responsibility has been moved to the Ministry of Higher Education and the former MOST has now been renamed the Ministry of Innovation and Technology (MInT). The main mandate of the new Ministry is to promote innovation among new and existing enterprises, including by establishing a new Innovation Fund aimed at financing start-up enterprises that are engaged in innovation.⁷

Another indicator of intensive efforts is the sense of urgency, dynamism and ambition to create a new technology policy environment that encourages innovation and technological learning observed during interviews with

Box 1 The 2222 strategy

MInT announced its Start-up Strategy centred on the “2222 plan” in late 2018, to seed 2,000 new technology-based start-ups in two years that provides 20,000 jobs and \$2 billion in extra GDP. These are ambitious targets. The strategy includes the creation of incubators (called incubation centres) for new technology-based firms. The start-ups are expected to come from universities and TVETs, among others. MInT is building an innovation hub to house incubation centres on the outskirts of Addis Ababa. They also plan to use the nine regional science and technology bureaux to establish an incubation centre in each region of Ethiopia. The details of the strategy, including the Innovation Fund, were being designed in late 2018 when the UNCTAD Mission to Ethiopia took place, and had not yet started to function. These are promising initiatives that indicate a welcome shift from a heavy focus on technology transfer at MOST to a balanced focus on technology and innovation, with a desire to fuse the two together, at MInT. The Start-up Strategy presents a point of contact with the National Entrepreneurship Strategy (NES) that is currently being developed under MOTI.

Source: UNCTAD based on information from MInT.

officials at the new Ministry of Innovation and Technology. In line with the renewed dynamism, the Ministry is launching the highly ambitious 2222 strategy aimed at intensifying efforts in the coming two years to encourage the establishment of 2,000 enterprises (mainly SMEs), which are expected to create 20,000 skilled jobs and generate \$2 billion to the economy (see Box 1).⁸ Whether this goal will be achieved within the specified time frame will be seen. However, it indicates the intensity of efforts by the new administration to push an innovation-driven development programme and bring technology into the forefront of the national development agenda.

2. Learn to walk before running or leapfrogging

Successful economies keep up with new technologies while mastering the technologies and innovations that are essential for improving productivity and competitiveness at the current level of development. In Ethiopia there is now a high level of enthusiasm and an intense desire to acquire and apply new technologies, particularly digital technologies, software development and artificial intelligence. This is fine and to be encouraged, but it is also important to realize the critical need to master the technologies and innovations needed to boost the development of the agricultural and manufacturing sectors, where the country’s current needs and potential for dynamic comparative advantage lie. Nearly three quarters of the Ethiopian population lives and works in rural

areas, mainly engaged in farming-related activities. The unemployment rate in 2018 was about 19 per cent and it is estimated that 2 million people join the labour market every year, nearly 70 per cent of them below 25 years of age. This scenario highlights the challenges facing Ethiopia as it embarks on an export-led industrialization drive in the twenty-first century and the importance of its NIS to build a strategy for innovation in agriculture and manufacturing, applying innovations that have already transformed economies elsewhere.

3. Don’t confuse “action plan” with “action”

Successful economies translate STI policies into detailed operational policy actions mapping out who does what in the innovation system and the rules of engagement in terms of interactions among key actors. A good example of an effective policy delivery system is the PEMANDU (Performance Management and Delivery Unit) initiative in Malaysia, which was established in 2009 by the Prime Minister of Malaysia, Mr. Mahathir bin Mohamad, to translate the five-year plan into specific lines of action. This was done through extensive consultation among key stakeholders and by agreeing on the timeline for implementation and the roles and responsibilities of different actors in the implementation process (World Bank, 2013). The PEMANDU scheme was created because of the realization that policies or strategies tend to remain aspirational statements with little impact on the economy, unless a road map

of policy implementation is created outlining what is to be done, how it is to be done and who will do it.

This aspect of consultation and planning during the implementation stage is currently missing in Ethiopia. One of the findings of the fieldwork conducted for this study is the serious mismatch that exists between policy formulation and policy implementation. On paper, Ethiopia has most of the policies, regulations, background studies and road maps necessary to kick-start a successful process of technological learning, innovation and technological upgrading. However, there is a grave implementation gap across public institutions either because of capacity constraints or misallocation of efforts and resources.

For example, the Government has established sectoral institutions to support targeted priority sectors but, to date, none of them has acquired the technical know-how and resources required to provide the full technical support needed by local enterprises.⁹ A total of 14 sectoral institutions have been established modelled on the East Asian sectoral support institutions style. All of them are expected to provide training and advisory services, conduct research on the sector, develop R&D capacity and facilitate technology transfer by working closely with enterprises in the sector. Government officials are often proud to point to the establishment of such institutions as an indicator of the Government's determined efforts to encourage technology transfer and support local technological learning and upgrading. However, interviews with potential beneficiaries show that although they are aware that the newly established support institutions exist, the range of technical support they can provide is limited. Some of those interviewed highlighted that most of these institutions suffer from resource constraints; they have difficulties finding skilled personnel; they do not have the right types of equipment and machinery necessary for conducting R&D; and the diversity of their activities (for example, the Food, Beverage and Pharmaceuticals Industry Development Institute; FBPIDI) makes it difficult to acquire all the skills, expertise and specialization needed to provide effective service/support to enterprises across different sectors.

Another example is the impressive research and analysis work on "technology road maps" but the lack of implementation plans. The preparation of the technological road maps was carried out by MInT covering a wide range of

sectors and aimed at expediting the execution of the technology mandates of the current five-year plan – GTP II (2015/16–2020). To date, MInT has prepared 22 sectoral road maps involving experts from academia and other public institutions. The objective is to establish a detailed mapping of the range of technological activities expected, the technology needs of sectors and the channels through which technological learning can be accelerated in each of the sectoral areas. The preparation of the 22 technology road maps has taken nearly three years and the next stage is to prepare the implementation protocol for each sector. It is anticipated that by the time MInT completes the preparation of the implementation protocols, the five years in the current plan period will be over, making the efforts somewhat redundant for the current plan. It is feasible that the implementation protocols may be ready by the time the next five-year plan (GTP III; 2020/21–2025) is operational in 2021. However, by then the Ministry would have spent more than five years preparing technology road maps and the baseline data used to prepare them (2014/15) will be out of date. Thus, while the work on technology road maps undertaken by MInT is admirable, necessary and to be commended, the fact that it has taken so long and that more emphasis has been given to the formulation of road maps rather than the actual implementation suggests a misguided prioritization in policymaking and policy implementation.

In short, there is a tendency to confuse "policy plans/actions" with "action". Establishing institutions and defining goals and operational guidelines are only the first steps in creating effective institutions and should not be confused with implementation.

4. Listen to practitioners: Effective Government–business relationship

The governance system in successful countries is often founded on a close working relationship between the Government and the private sector. This enables the formulation and implementation of policies that supports the needs of the enterprises while, at the same time, contributing to national development objectives. The most important lesson is that this relationship is not based on formality or formal links where government officials communicate with the business sector through formal letters and ad hoc

discussions with representatives of the business community. As Evans notes, in successful countries, “[e]ffective Government–business relations depended on large volumes of high-quality information flowing between Government and enterprises and on mutual confidence that predictions and commitments were credible. Neither could be generated by exchanging position papers and publicity releases” (1998: 76). A variety of institutional mechanisms enable effective information flows between Government and business. However, there is no single model that applies in all countries; each country has to either create its mechanism or learn from other countries and adapt it to local conditions and cultural specificity.

In Ethiopia, the public–private sector relationship has improved greatly over the years. This improvement has occurred even though in a “developmental state” model, the private sector is regarded as the second player in the policymaking process and when consultations take place, they tend to be ad hoc and based on formal interactions. However, with the recent changes in policy orientation and leadership, it is expected that the Government–private sector relationship will improve.

Recommendations

During the fact-finding mission, it became clear that slow progress in the implementation of STI policies and technology transfer was largely due to implementation deficiencies rather than lack of policy or institutions. Implementation appears to be incomplete due to various challenges. This may be partly related to the policy design process, where policies under the purview of a specific ministry or agency are to a large extent designed within one or a small number of ministries/agencies. It is certainly also due to limitations in implementation capacity across different agencies. Without sponsorship, oversight, policy direction and coordination at the executive (or ministerial) level, it is difficult to imagine how STI policies, which by their nature are cross-cutting and involve cross-sectoral interactions, could be successfully implemented. Against this backdrop, the Government could consider the following recommendations:

Short term

- Finalize the preparation of the implementation protocols of the 22 technology road maps

prepared by MInT and focus on the road-map implementation.

Medium term

- Replicate in other priority sectors the intensity of learning used in the development of a successful and internationally competitive floriculture industry, through supporting technological development in local enterprises and the strengthening of the NIS.
- Develop a strategy to keep up with new technologies in the productive sectors of the economy, and at the same time build a strategy for innovation in agriculture and manufacturing, applying innovations that have already transformed economies elsewhere.
- Assess, in partnership with representatives of the private sector, the range of technical support provided by the sectoral institutions of priority sectors and ensure that they attend to the technical demands of the firms in those sectors.
- Ensure the proper level of resources for sectoral institutions of priority sectors, including skilled personnel needed to provide effective service/support to enterprises, and right types of equipment and machinery necessary for conducting R&D.

B. Firm-level innovation

To succeed in the twenty-first-century international trade dominated by global value chains, Ethiopian firms need to build their technology and innovation capabilities. Rapid technological changes and their introduction and diffusion across enterprises and countries are hallmarks of the new global economic environment. Leading global corporations control the global value chains, involving complex relationships and governance structures and demanding high-quality products from all suppliers in the chain (OECD et al., 2013). This trend has made it essential that countries, regardless of their level of development, keep up with the latest technologies and pay greater attention to technological learning and innovation at the firm level (Mytelka and Tesfachew, 1998).

The following sections rely on the 2015 national innovation survey (see Box 2) as well as evidence from interviews conducted for this study and other studies on innovation activities in Ethiopia.¹⁰

Box 2 National innovation survey of Ethiopia

In 2015, the Science and Technology Information Center (STIC) conducted the first national innovation survey of Ethiopia following the 2005 *Oslo Manual*, which provides unprecedented insights into the types of innovative activities undertaken by Ethiopian enterprises and the transmission mechanisms for technological learning, the barriers to technological diffusion and the space for innovation policy.^a The parameters used to measure whether innovation is taking place at the level of the firm are: product innovation, process innovation and non-technological innovations such as marketing and organizational changes. Product innovation refers to the introduction of “new or significantly improved” products or services by enterprises. The term “new or significantly improved” refers to the characteristics or intended use of the product or service. Examples include improvements in the technical specification of products or the types of raw material used, or an upgrade in their application, user-friendliness, etc. Similarly, process innovation refers to the introduction of “new or significantly improved” methods of manufacturing. Thus, innovative enterprises are those that “introduced at least one type of innovation” in “product, process, marketing and organizational efficiency”,^b while “innovation active” enterprises are those in the process of introducing such new technologies during the survey period (2012–2014). The survey included 1,200 locally owned enterprises with 10 or more employees and covered four subsectors: manufacturing (40 per cent of the sample firms), construction, services and mining (MOST, 2015a). The STIC plans to conduct regular surveys of innovation among Ethiopian enterprises, however, the follow-up survey was still pending when this report was written, which made it difficult to assess trends in innovation patterns.

Source: UNCTAD, based on MOST (2015a) and interviews in Ethiopia.

Notes:

^a The manual, which was developed by the Organisation for Economic Co-operation and Development (OECD), is a standardized format used by many countries to collect information on firm-level innovative activities. The *Oslo Manual* defines innovation broadly as “the implementation of a new or significantly improved product (good and service), a new marketing method, or a new organizational method in business practices, workplace organization or external relations” (OECD and Eurostat, 2005: 46).

^b See MOST, 2015a: xviii. Technological innovation affecting products and processes is distinguished from non-technological innovation aimed at improvements in marketing and organizational efficiency.

1. The drivers and types of innovation¹¹

In Ethiopia, firms in the manufacturing sector recorded the highest level of technological innovations among the country’s firms. This fact reflects the sector’s predisposition towards productivity improvements and technological upgrading. Nearly 93 per cent of manufacturing enterprises gave their main source of technological innovation as acquisition of machinery, equipment and know-how from abroad, highlighting the critical roles of trade and access to foreign exchange as the main drivers of technology transfer and innovation in Ethiopia. As already noted, Ethiopia depends on imports for technologies. Nearly 70 per cent of the capital goods imports of Ethiopia consists of machinery and equipment, of which transport-related equipment accounts for 29.4 per cent. The survey result shows that only 15 per cent of the respondent firms, all large manufacturing firms,

reported using in-house R&D to enhance their innovative capacity. Over the years, private-sector R&D spending has declined and by 2015, it was only 1.2 per cent of total R&D spending (Kuriakose et al., 2016).

2. Product and process innovation

The number of firms undertaking both technological and non-technological activities is limited. While nearly 60 per cent of firms included in the survey had introduced new technologies impacting on product, processes, marketing and/or organization, only 8.2 per cent had introduced technologies or innovations affecting all four areas. Product and process innovations appear the most difficult, with only 0.7 per cent of firms introducing new or significantly modified products, and only 1 per cent introducing new technologies that significantly changed production methods or processes.

Furthermore, many of the product and process innovations are new to the firm but not new to the market. Only 15 per cent of innovations that are identified as “product innovations” introduced products that are new to the market, the remainder being new only to the firm concerned. This result partly reflects the fact that many enterprises in Ethiopia use generic technologies, mainly industrial, textile, agroprocessing and construction machineries and equipment that are familiar to many other enterprises in Ethiopia. Similar results are found by another firm-level study of the cement, textile and leather sectors in Ethiopia (Wakeford et al., 2017). While focusing on “green innovation”, the study confirms that the “extent of product and process innovation is generally low, and green innovation is even less common” (2017: 1). Among the firms surveyed by Wakeford and colleagues (2017), less than 20 per cent reported undertaking product and process innovation. Although the share of product innovation in the leather sector is higher (65 per cent) because of the variety of finished leather goods produced, the rate of process innovation is lower (28 per cent). Interestingly, both the national innovation survey and the sectoral studies reveal that firms that introduced product and process innovations showed higher sales growth than those that had not, underscoring the importance of product and process innovations for growth, profitability and competitiveness.

3. Innovation across sectors and in non-technology areas

In contrast to product and process innovation, non-technology innovation is much more common and widespread across sectors. Nearly 50 per cent of the firms that responded claimed that they had introduced new activities that improved their marketing capabilities, and 34 per cent stated that they were engaged in “organizational innovation”. It is fair to deduce from these results that Ethiopian enterprises are introducing new marketing and organizational technologies that will help them improve their trading capacity and competitiveness. However, in the longer term, the dividends from competitiveness will be realized only if there is steady progress in product and process innovations.

The scale of operation makes a difference on whether enterprises will engage in innovative activities or not. The likelihood of engagement in innovation is greater as the size of enterprises increases. For the purposes of the survey, large-

scale enterprises were those with 250 or more employees, while medium-scale enterprises included those with 50–249 employees and small-scale enterprises those employing 10–49 persons. Nearly 77 per cent of the large-scale enterprises covered by the survey were engaged in one or more of the four areas of innovation, while the proportion for medium-sized and small-scale enterprises was 65.9 per cent and 56.5 per cent respectively.

The likelihood of engagement in innovation differs greatly by sectors or areas of activities. Product and process innovation were greatest among manufacturing enterprises (68 per cent), and non-technological (particularly marketing) innovation was more common in the services sector (54.4 per cent). This suggests that manufacturing firms may be responding to the recent shift towards a manufacturing-driven and export-led industrialization strategy by acquiring new technologies to improve product quality, production processes, marketing and organizational efficiency. Services have been the fastest-growing sector in the last two decades, now accounting for 47 per cent of the GDP of Ethiopia. As both these sectors tend to be knowledge-intensive, their engagement in innovative activities is a positive trend.

4. Innovation does not necessarily mean enhanced competitiveness

Engaging in innovative activities does not necessarily mean improvement in export capacity or competitiveness. Only 3 per cent of the enterprises that are “innovative” are engaged in export trade – either within the region or in European markets – suggesting that the introduction of new products or processes or initiating non-technological innovation has not increased the competitiveness of innovative enterprises or their technological competence to produce goods that can be sold in international markets. The number of Ethiopian enterprises that can register patents is another indicator of the fact that such innovations involve mainly adaptations of existing technologies or products rather than the generation of new products or technologies resulting from R&D activities. The results of the innovation survey show that only 4 per cent of innovative manufacturing enterprises filed patent rights within Ethiopia, and less than 0.5 per cent outside Ethiopia. Therefore, while the innovative activities observed may have increased opportunities for technological learning, they do not yet appear to have transformed firms’ technological capabilities.

5. Low level of inter-firm interactions and R&D spending

The innovation survey reveals low-level of spending on R&D by Ethiopian enterprises. This fact is not surprising in a low-income and technologically less developed country like Ethiopia where most product and process innovation involves mainly acquiring new technology or production processes from abroad or adapting existing technology and method of production without engaging in R&D activities. This pattern of product and process innovation also explains another finding of the survey, which is weak interaction among firms, and between firms and R&D centres and support institutions.¹² Normally, firms engaging in product and process innovation seek technical inputs or advice from other firms, R&D centres or specialized technology support institutions. Such interactions are considered critical to technical innovation, through the exchange of ideas and experiences. It seems that firm-level innovative activities in Ethiopia take place in isolation rather than in interaction with other firms or key actors in the NIS.

However, the survey reveals collaborative partnerships between local enterprises and machinery/equipment, and software suppliers abroad. Some of the innovative enterprises also indicated that if they interact with other enterprises, it is more likely to be with enterprises producing the same products or using similar production processes, but not with firms from other sectors or R&D institutions. Similar findings emerged from a study of innovation in a cluster of footwear manufacturers in Addis Ababa, Ethiopia (Gebreeyesus and Mohnen, 2011). In contrast to the widely held view that clustering strengthens inter-firm interactions and knowledge flows within the cluster, the study concludes that “interactions with buyers, suppliers and other producers (i.e. outside the cluster) were the major channels through which firms acquire knowledge” (2011: 24). The weak inter-firm interaction or lack of collaboration could be a reflection of weak domestic absorptive capacity and the informal nature of the clustering found in LDCs like Ethiopia. Nevertheless, such underdeveloped inter-firm linkages and interactions could be a major impediment to the country’s vision of developing a dynamic and internationally competitive enterprise sector and becoming a leading manufacturing hub in Africa.

6. Binding constraints to innovation

The most widely cited constraint on innovation is the cost of acquiring new technologies, closely followed by a lack of qualified workers, particularly technically competent personnel. Predictably, the cost of new technologies and access to credit were concerns for SMEs. Lack of information on technology within the country was also a critical constraint, highlighting the early stage of development of the technology support system and the lack of relevant knowledge and skills within firms. Another study of innovation barriers in SMEs in Addis Ababa reveals additional barriers to innovation including “unfavourable government policy and regulation”, such as the tax system and lack of patent protection, and “organizational culture”, particularly “low employee empowerment, low synergies of resources, insignificant role of managers and/or owner to promote innovation” (Talegeta, 2014: 98).

Recommendations

Both the innovation survey and sectoral and firm-level studies highlight the key role of imported capital goods as the principal channel of technology transfer, while exposing the weakness of domestic absorptive capacity, especially in terms of skilled personnel, technology support services and the limited capacity of specialized R&D institutions. They also signal the need for policy efforts to increase local firms’ capabilities to undertake product and process innovation, and to create an environment conducive to accelerated technological learning and innovation. Firms need policy support to convert product and process innovation outcomes into productivity gains. However, a major constraint and firm-level limitation in Ethiopia is information failures and asymmetries, where firms lack the capacity and the understanding to gather the required information, the resources and know-how to innovate. Moving forward, the following policy recommendations are worth implementing:

Short term

- In view of the importance of imported technologies as sources of technological learning and innovation in Ethiopia, monitor technology flows into the country by strengthening the capacity of EIC and MInT to screen and track the types of technologies entering the country and their applications.

- Establish within MInT and support institutions such as the Ethiopia Textile Industry Development Institute (ETIDI), the capacity to provide information to SMEs on new technologies. As already noted, at present, firm-level innovative activities in Ethiopia take place in isolation.

Medium term

- Establish within MInT support programmes that provide extension services on innovation and productivity improvements to targeted SMEs. Such services could also provide information on new technologies, and how to adopt them, in order to increase productivity and competitiveness.
- In the absence of R&D activities at the firm level, support from the Government is likely to be required to encourage R&D activities at the firm level and boost knowledge investments. MInT should explore how the newly established Innovation Fund could support R&D activities in local enterprises that have the potential to build in-house R&D capability.
- Introduce tax incentives for innovations and technological upgrading that take place through inter-firm collaboration and introduce new products and/or processes that contribute to productive capacity-building. This will help address the lack of inter-firm interactions observed from the innovation survey.
- At a national level, improve through targeted public expenditure and fiscal incentives, the quality of the physical and human capital infrastructure, including by establishing laboratories for testing and quality control, as a means of improving the availability and quality of innovation services for firms.

C. Learning and research institutions

Human capital is a fundamental determinant of the NIS and the ability to benefit from technology transfer and technological learning. The East Asian experience highlights the importance of optimizing the use of human capital, especially when skills are limited. In discussing the factors that differentiate successful from less successful catch-up countries, Keun Lee concludes that “only those countries that have invested heavily in the

formation of skills seem to be capable of catching up, and those that have not made such investment are falling further behind” (2013: 25).

While investment in human capital development and education in general is essential, more important is the quality of education and the strengthening of the essential basic technical skills needed for the operation and maintenance of technology. This requires a three-pronged approach: an inclusive national education system; building the capacity for TVETs; and prioritizing advanced human capital development at the tertiary level, with the emphasis on science- and engineering-related skills. Since the early 2000s, Ethiopia has taken measures in these three areas with mixed results as discussed below.

1. Human capital development in Ethiopia: Quantity versus quality

Ethiopia has made great progress in improving access to education up to university level. Since the early 2000s, the number of public universities has increased from four to more than 40, while enrolments in higher education have grown by 25 per cent per year since 2003/04, taking undergraduate-level enrolments to more than 800,000. Progress in narrowing the gender gap has been equally impressive, with female students accounting for 35 per cent of tertiary enrolment in 2015/16. Of the 51,521 students on postgraduate programmes, 23 per cent were female compared with 13 per cent in 2010/11 (MOE, 2017). In the TVET system, 54 per cent of graduates from short-term TVET training in 2015/16 were female, with rough gender parity across almost all regions (MOE, 2018: 177). The Government intends to develop competent local technicians, engineers and scientists through national education and training systems. Around 70 per cent of undergraduate students are reading science- and technology-related subjects.

Despite huge strides in expanding the Ethiopian higher educational system, there are signs that the system is being stretched to its limit with adverse effects on quality and sustainability. There are concerns, particularly in the business community, that the expansion has been achieved at the expense of quality and standards. Many believe that the 70:30 (STEM (science, technology, engineering and mathematics) versus social science) scheme was implemented hastily and without the necessary preparation, including technology infrastructure and

staff development. The poor quality of education contributes to a large percentage of unemployed graduates. According to the interviews with representatives of textile and garment companies in Ethiopia, it is estimated that about 30 per cent of the engineering graduates do not get employment.

To address constraints in technical skills, the Ethiopian Government has launched a massive TVET programme. Based on the German apprenticeship model, the TVET scheme aimed to provide the technical skills that young people need to work in productive sectors or start their businesses. The programme provides TVET in diverse areas, involving one to three years of study to provide students with the vocational skills and qualifications needed to build a career in their chosen field. TVETs are also expected to play a critical role in technology accumulation and transfer, which is one of the objectives of the Industry Extension Service (IES) that the Government established to support the diffusion of technology (Assefa et al., 2014).

The Government seeks to strengthen university–industry linkages. The objective is to facilitate technology diffusion from learning institutions, particularly universities. Technology centres were established in selected universities and linkage officers were appointed to encourage university–industry linkages and facilitate the diffusion of knowledge and technology. Technology and business incubation centres were also established in some universities, although to date their impact has been limited. Different guidelines on linkages were prepared jointly by relevant ministries, and annual conferences on university–industry linkage have been conducted since 2014.

The Government has also made concerted efforts to reform the national quality infrastructure systems. This resulted in the design and implementation of a new national quality infrastructure, accompanied by the introduction of product standards in most industries and the restructuring of the former Ethiopian Quality and Standards Authority (EQSA) into separate independent agencies, namely, the Ethiopian Standards Agency (ESA), the Ethiopian Conformity Assessment Enterprises, the National Metrology Institute (NMI), and the Ethiopian Accreditation Office (EAO). Until 2018, these agencies operated under the former MOST, but following the Government restructuring in 2018, the various quality and standards agencies are now organized under MOTI.

The university and TVET reform programme addresses the key constraints in the system needed to accelerate technological learning and catch-up. The Government is moving in the right direction and there are some signs that the efforts are bearing fruit. There are now many university-level graduates in engineering and technology fields, and this has eased the high-level technical skill constraints faced in the past. There are more than 500,000 students in higher education, which will help to boost economic dynamism. Similarly, since the launch of a TVET programme and strategy in 2003, it has expanded rapidly in terms of both enrolment (which tripled from 106,336 to 352,144 between 2004/05 and 2014/15) and the number of entities providing training (MOE, 2017).

At the same time, the quality of university and technical and vocational education is not at the desired level yet. There is a major gap in linking it with demand from industry in terms of skills, and the content of courses and supply of graduates. This finding came out clearly during interviews with enterprises in different sectors and economic activities. Almost all of those interviewed indicated that the teachers at university and technical school level lack practical industrial experience and that the exposure of students to the reality of the industry is weak. Another challenge has been the mismatch between the number of teachers available and the number required to catch up with the rate of expansion of the universities and technical and vocational colleges.

A major contributing factor to the weak quality is the inability to resolve the inherent conflict between quality and quantity. According to private enterprises – who are, after all, the main employers of the new graduates – the quality of education in technical schools is very low due to lack of exposure to practical training and an industry-level operational environment. Some of the enterprises even indicated that they are reluctant to take students as apprentices because of the time taken on supervision and the fear that they may damage machines because of their poor training. Despite the Government's efforts, the linkage between university and industry is still weak and the participation of industry in guiding higher education on the types of skills required is almost non-existent. This is perhaps a fundamental failure of the current system that requires a significant shift in policy approach.

2. R&D institutions

R&D institutions are among the key actors in the NIS. The rationale for promoting R&D activities is evident. They are essential for generating new ideas, technologies and processes, and for advancing the frontiers of technical knowledge. They are also essential for transferring technology and for improving productivity either by increasing firms' capacities to absorb the acquired technologies or through direct effects on innovation (Kinoshita, 2000). R&D in areas such as agriculture and health can also be immensely beneficial for low-income countries such as Ethiopia where most of the population depends on agriculture and the rural economy. Research exploring appropriate solutions on health, nutrition, sanitation, alternative sources of energy, cost-effective housing and so on, also contributes towards the objectives of meeting the United Nations 2030 Agenda for Sustainable Development and the SDGs.

This section presents a summary of the main findings on the sectoral dispersion of R&D activities in Ethiopia, capacity utilization, linkages with other actors in the innovation system and the role of R&D institutions in the NIS of Ethiopia. The analysis is based on evidence obtained from two sources: interviews with technical personnel, managers and administrators who are directly engaged in R&D activities in Ethiopia and conducted specifically for the purpose of this study; and the results of a survey of R&D institutions in Ethiopia undertaken by MOST in 2014 and published in 2015 (MOST, 2015a). The survey was comprehensive and included practically all important institutions in the country that perform R&D activities either as specialized R&D centres or attached to other institutions such as universities.¹³

R&D in Ethiopia is uneven in terms of regional dispersion and sectoral priorities. The country's R&D institutions are concentrated in three geographical locations, the Oromia subregion, Addis Ababa city and the Amhara subregion. Nearly three quarters (73 per cent, to be accurate) of R&D institutions in the country are found in these three locations accounting for 30 per cent, 26 per cent and 17 per cent respectively. Two other regional States, namely the Southern Nations and Nationalities and Tigray, account for 14 per cent and 6 per cent respectively. Ethiopia is a federation of nine regional States and two administrative cities. While it is understandable that some locations may be the natural places to establish R&D activities

– for example, because of high-level economic activities, resource endowments and the presence of higher education institutions – it is evident that the regional dispersion of R&D institutions in Ethiopia is highly uneven. Furthermore, the country's strength in research is confined to two areas: agriculture and health-related research. The R&D activities outside these two broad areas, particularly in productive sectors, are generally limited.

The three main sources of finance for R&D activities in Ethiopia are the Federal Government, regional States and foreign donors. Private-sector financing of R&D activities is generally small and has been confined to certain enterprises – such as pharmaceutical companies that have small R&D units to formulate generic medicines. For the purchase of scientific equipment and expansion of R&D facilities, the main source of finance is the Federal Government, with 67 per cent of higher education institutions relying on the Federal Government for funding. Similarly, up to 53 per cent of agricultural research institutions and 23 per cent of government agencies that carry out research depend on the Federal Government for financing. Donor financial support is also important for some agricultural research institutions. As many as 47 per cent of agricultural research institutions in Ethiopia rely on donor support for their financial needs. Interestingly, some regional States in Ethiopia also support research institutions in their region, particularly for the purchase of scientific equipment.

The share of public expenditure on R&D as a proportion of GDP has increased sharply in recent years. Until 2010, in Ethiopia the share was less than 0.2 per cent of GDP, making it one of the lowest among the competitor and comparator countries. Since then, however, it has increased rapidly reaching 0.6 per cent of GDP by 2014.¹⁴ The main motivation was the expansion in the number of universities and the need to equip them with laboratories and R&D facilities. According to the information provided by the STI Center, the proportion of R&D-related expenditure allocated to higher education, consisting mainly of universities, increased from 42.3 per cent in 2010 to 74.1 per cent in 2014, a significant increase within a short period.

The total number of R&D personnel in the country increased considerably during this period. This number includes researchers and technical staff as well as managers, administrators and service providers working in R&D institutions.

In 2010, the total number of staff working in R&D-related institutions was 13,095. By 2013, the number had increased to 18,435, a rise of 41 per cent within three years. It is worth noting, however, that the sharp increase in R&D personnel was on account of expansion in non-technical and administrative staff rather than an increase in the number of researchers or scientists. During the three years from 2010 to 2013, the number of researchers increased from 7,283 to 8,218, a 13 per cent increase as compared with a 52 per cent increase in the number of administrators, managers and other non-technical staff.

Cooperation among R&D institutions is not uncommon, but it is not a regular feature of the operations of R&D institutions. Most R&D institutions recognize that in situations where the sectoral focus and the types of R&D activities performed are similar, exchanging information and sharing scientific equipment is beneficial and would reduce costs. Many R&D institutions claimed that they do collaborate, particularly when they need to use equipment or better facilities are available in other institutions. However, the overall conclusion of the survey is that there is “poor cooperation”, resulting in the “absence of R&D resource sharing among R&D institutions and duplication of expensive scientific equipment purchase. Moreover, the existence of certain facilities and scientific equipment in different research units is not known by other potentially interested parties, stakeholders and customers of research outputs in other organizations, and to a certain degree by those in other units within the same large organization” (MOST, 2015a: 3). This finding was confirmed during interviews with managers and technical personnel from pharmaceutical enterprises that have in-house R&D activities. A more detailed discussion on the experiences of the pharmaceutical enterprises is presented in Chapter IV of this Review.

Capacity utilization among R&D institutions in Ethiopia is very low. In some cases, capacity utilization has remained below 50 per cent since the establishment of the R&D institutions. The reasons for low capacity utilization vary between institutions and sectors. However, two factors were identified across the board as the main binding constraints of R&D activities in Ethiopia: foreign exchange constraints and limited technical skills and capabilities to repair equipment.

Excessive reliance on imports makes R&D institutions vulnerable to fluctuations in the country’s export performance and availability of sufficient foreign currency to import essential inputs. Practically all R&D institutions in Ethiopia rely on imports for the supply of machinery, equipment, raw materials and intermediate inputs. For example, all “active ingredients” that pharmaceutical enterprises require to produce medicines or experiment with alternative formulations of generic medicines are imported from major suppliers abroad. This is to be expected, given that Ethiopia is an LDC with limited capability to produce the scientific equipment and machinery required to carry out modern R&D activities. However, shortage of foreign currency, as well as the time it takes to obtain it, has been identified as the most immediate and pressing constraint facing R&D institutions and enterprises in general that rely on imported inputs for production.

Most R&D institutions have scientific equipment and/or instruments that are non-functional. Among agricultural research institutions, which have the highest share of the scientific equipment found in R&D institutions, 83 per cent were non-operational at the time of the survey (MOST, 2015a: 57). The figure for government agencies with R&D capacities was 77 per cent, and among educational institutions and health-research centres was 76 per cent and 60 per cent respectively. This, in effect, means that the additional resources made available for R&D (which were partly used to acquire essential scientific equipment and instruments from abroad) remain idle, creating underutilization of R&D capacities available in the country.

Lack of skilled or professional technicians is the main culprit. The reasons given as to why the scientific equipment in many R&D institutions remained non-functional and idle varied between sectors but 86 per cent of the total R&D institutions in the survey responded that lack of skilled or professional technicians – both within their institution and the country as a whole – to repair or provide maintenance was the main explanation for non-functional scientific equipment. The shortage of skills has affected not only the maintenance and repair of the scientific equipment but also the operation of the equipment. About 68 per cent of R&D institutions in the survey claimed that obtaining skilled technicians who can operate the equipment was also a major constraint. Another explanation given for non-functional equipment was lack of foreign exchange to import spare parts.

Recommendations

Ethiopia has made great efforts to advance its human capital development through both technical and university-level training. These efforts are beginning to ease the constraints in skill supply. However, the poor quality of education was repeatedly raised by the enterprise sector as a major limitation. An underdeveloped skills base can hold back the abilities of countries and their enterprises to promote learning and catch-up, and to foster a strong and dynamic National Innovation System.

The rapid expansion of public expenditure on R&D activities as a share of GDP is encouraging and indicates that the Government of Ethiopia recognizes the importance of broadening R&D capacities and capabilities if the country is to develop further its NIS. However, the limitations observed signal that Ethiopia is a long way from acquiring the R&D capacity needed to generate new technologies and facilitate successful technology transfer. These limitations are related to the lack of technical skills to operate R&D and scientific equipment, lack of capability to repair and maintain imported equipment, a shortage of foreign exchange to import spare parts and other inputs, and the lack of cooperation among R&D institutions and between these institutions and local enterprises. All of these gaps limit the effectiveness of the NIS.

In light of this, the Government could consider the following recommendations.

Short term

- Use the formulation of a new national STI policy as an opportunity for aligning the education and training strategy of the country with the skills required to build a strong NIS.

Medium term

- Focus on raising the quality of education in the next stage of educational reforms.
- Assess the right balance between the training of highly skilled specialists that a modern industrial sector needs (which is costly, often concentrated in a few disciplines such as science and engineering) and training at the technical and school level (which are essential and if absent, reduce the overall capacity of the NIS to stimulate technological learning across sectors).
- Invest in building the technical skills necessary to operate the scientific equipment used for R&D activities.
- Invest in building the capability to repair and maintain imported equipment.
- Address the shortage of foreign exchange to import the spare parts and other inputs needed to keep the imported scientific equipment operational.
- Establish mechanisms to improve cooperation among R&D institutions and between these institutions and local enterprises, which are essential for enhancing the effectiveness of the NIS.

IV. Technology transfer, linkages and technological learning in Ethiopia

Technology transfer within and across national boundaries is critical for technological learning and innovation. While the term “transfer” suggests a direction of movement, in practice it is often a collaborative and complex process whereby knowledge and information move in many directions and human capacities develop to ensure the transfer. This process often requires an adaptation of the technology to the conditions and circumstance in the transfer destination. Technology transfer occurs when there are enough incentives to commercialize a given technology in a new location through trading products, licensing or investing. Transfer of technology usually occurs through trade, FDI, licensing, and the movement of workers, managers, professionals and academics. Trade and FDI are the major channels for the transmission of technical knowledge across countries, and their effect on technology transfer is not easy to separate.

Transfer of technology is viewed as an important channel of technological learning and innovation capability-building in Ethiopia. However, the relationship between the transfer of technology and local technological learning and upgrading is not automatic. How the transfer takes place, the policies and incentive schemes used to prompt the transfer and, more importantly, what happens to the technology once it has been transferred are key determinants of the ability of Ethiopia to upgrade its technological capability and acquire the capacity to assimilate and generate new technologies.

This chapter addresses the issue of technology transfer as an important source of technology and know-how in Ethiopia. It identifies the main channels of technology transfer to Ethiopia and the implications for technological learning and innovation.

A. Channels of technology transfer

1. International trade

In Ethiopia, trade, particularly imports of capital goods, is the most important channel of technology transfer and innovation. For

example, the share of capital goods imports as a proportion of GDP increased sharply from 5.1 per cent in 2000 to 13.3 per cent in 2005, reflecting the increasing reliance of the country on imported technologies, particularly as export-oriented manufacturing activities intensifies (Gebreeyesus, 2016). Despite a slight decline since 2005, the figure has remained above 10 per cent, higher than in Kenya, Tanzania and Bangladesh (Tesfachew, 2019). Similarly, the share of capital goods in total imports, which indicates the importance attached to technological learning and innovation relative to consumption goods, is one of the highest in Africa. It has remained consistently high since the mid-2000s, accounting for above 40 per cent of the country's total import bills. This indicates both the continuing demand for imports of technologies and the importance that the Government attaches to technology transfer from abroad as compared to the generation of technologies locally. Importers of capital goods are exempted from customs duties and other import taxes. Such incentives effectively encourage the acquisition of technologies from abroad instead of searching for alternative technologies locally or using the available R&D capacities to generate technologies.

The country devotes a large proportion of the foreign currency earnings to the importation of technologies. In Ethiopia, the foreign currency required to import capital goods/technologies is more than the total amount of foreign currency that the country earns from exports of merchandise goods. This suggests that imports of capital goods/technologies is a major contributor to the country's increasing external debt. Interestingly, the origin of these imports has changed over the last 15 years, although whether this shift will have implications for technological learning is not clear at this stage. Between 2000 and 2015, the proportion of capital goods imports to Ethiopia originating from developed countries has declined from 76 per cent to 39.1 per cent, while the proportion originating from other developing countries tripled from 18.6 per cent to 60.6 per cent. This partly reflects the growing importance of South–South trade and investment to Ethiopia, notably from China, India and Turkey.

2. Foreign direct investment

Increasing FDI flows could boost technology and knowledge transfer in export-oriented sectors. For many years, Ethiopia attracted much less FDI than might be expected for a large and

fast-growing economy with diverse investment opportunities in various sectors. FDI inflows in 2000–2005 were less than 2 per cent of GDP. The peak was 12 per cent of GDP in 2017 when FDI exceeded \$4 billion. The contribution of FDI to national fixed investment also remained low until 2012–2013, rising after that as FDI aimed at export-oriented activities in the industrial parks increased. Since 2012, FDI inflows into Ethiopia have grown by 50 per cent per year on average, reaching \$4.1 billion in 2017; much of this investment has occurred in export-oriented manufacturing activities (UNCTAD, 2017).

However, an assessment of the impact of FDI on transfer of technology into Ethiopia is difficult because of the lack of reliable information on technology flows through FDI.

The country's investment promotion agency, EIC, which is responsible for attracting and monitoring FDI inflows, does not regularly and systematically collect information on the nature of technology and skills that FDI is bringing into the country. This deficiency should be corrected as it is important for understanding the types of technology imported and, more importantly, whether the transferred technology has created the conditions for technological learning in the domestic economy.

Linkages and the interactions between foreign and local firms are limited. Experiences from other countries show that the contribution of FDI to technological learning and capability-building through spillovers and demonstration effects is greatest where skill-intensive jobs are created and movement of labour between foreign and domestic firms is high (Görg and Strobl, 2005). FDI operating in the Ethiopian industrial parks has created thousands of jobs, although not as much as initially expected. However, the jobs created to date have not been skill-intensive and do not require high-level qualifications. Neither has Ethiopia yet developed an industrial workforce with the discipline and culture needed for learning by doing, interacting and engaging in a dynamic and modern knowledge system (Oqubay 2019; Oya 2019). Successful learning and knowledge diffusion from FDI may thus take longer than is currently assumed. Some of the foreign investors, especially large corporations with wider global networks and reach, are reluctant to engage with local firms. If this trend continues, the private sector in Ethiopia may not benefit from opportunities for technological learning arising from the presence of foreign

firms.¹⁵ In short, FDI can be an important source of technology transfer and technological learning but the impact is not automatic. It depends on how effectively it has been used to create linkages and opportunities for learning.

FDI from developing countries could facilitate technology transfer. Over the last two decades, increasing share of trade and investment flows to African countries have come from other developing countries, particularly China and other emerging economies. This new trend has opened an alternative route for technology transfer, technological learning and capability-building for low-income economies such as Ethiopia. For example, half of the top-ten foreign investors in Africa are from developing economies, and the FDI stock of China in Africa has increased almost threefold between 2010 and 2015 (UNCTAD, 2017). While the evidence is limited, FDI flows between countries with narrower technological gaps may have qualitatively different impacts on technological learning and the development of the NIS.

3. Industrial parks

An important motivation for establishing industrial parks is the possibility for technology transfer and the dissemination of knowledge in the domestic economy through linkages and demonstration effects. Channels of knowledge transfer from foreign firms located in industrial parks to local enterprises include: carrying out subcontracting work or providing inputs to foreign firms; joint venture between foreign and local investors; locals employed and trained in foreign firms leaving to start their own businesses or to work with local enterprises; and skilled expatriate workers leaving foreign firms to work as managers or technical experts in local firms (UNCTAD, 2014). Another channel of knowledge transfer is the demonstration effect whereby local firms imitate foreign firms and acquire similar technologies and processes. The assumption is that local firms already have the knowledge and the capability to select and operate the same types of technologies as foreign firms. The movement of skilled labour from foreign to local firms is also another important channel of knowledge transfer. Such movements allow the transfer of tacit knowledge, which is often difficult to transfer because it is knowledge accumulated by individuals through experience, on-the-job training and “learning by doing”.

However, the impact of industrial parks on the transfer of technology through linkages and domestic sourcing of inputs is not automatic – neither is it as straightforward as is often assumed. Only a limited number of countries have succeeded in maximizing the technology transfer and development impact of industrial parks. As Milberg points out, “The Korean, Taiwan and Mauritius examples of considerable linkages between the economic zones and the rest of the economy are exceptional. More common is a range of 3 per cent to 9 per cent of inputs purchased domestically, reported for Sri Lanka, Philippines, Guatemala and many other countries” (2007: 24). The picture emerging from African industrial parks is also less impressive. Based on an extensive review of the pattern of development, size and performance of African industrial parks and special economic zones (SEZs), Farole and Moberg conclude that “The African experience with SEZs over the past two decades has been less than spectacular. With the exception of Mauritius and the partial initial success of Kenya, Madagascar, and Lesotho, most African zones have failed to attract significant investment, promote exports, and create sustainable development” (2014: 3).

Technology transfer does not necessarily depend on creating industrial parks or SEZs but rather on the global value chains that would be attracted.

For example, a recent study of the six top African apparel exporters, namely Mauritius, Madagascar, Kenya, Lesotho, Swaziland and Ethiopia, found that the most important determinants of technology transfer between foreign and local firms are the strategy of the foreign investors; the strategy of global buyers in the value chain; and the level of development of the local enterprise sector (Staritz and Whitfield, forthcoming). The impact of industrial parks on technology transfer and the diffusion of knowledge depends on the availability of local firms that are capable of supplying high-quality inputs and creating successful joint-venture partnerships with foreign firms. It also depends on the strategy of foreign firms and their willingness to engage with local enterprises. These are important lessons for Ethiopia as a newcomer to the industrial park programme and export-led industrialization strategy.

It is too early to assess the impact of industrial parks on technology transfer in Ethiopia, since the parks started recently, and it takes time for diffusion of technology to occur. The litmus test for the success or failure of industrial parks in Ethiopia rests on attaining the long-term development goals,

particularly technological learning and the development of local enterprises that are innovative and competitive in the international markets. Ethiopia has made some progress in the development of domestic productive capacity, supported by massive public investment in infrastructure and domestic demand-driven growth. Although many aspects of productive capacity require further investment, it is important to leverage what has been achieved to date and build the capacity to monitor progress in technological development. A good starting point would be to establish an institutional mechanism – involving MInT and EIC – with the specific task of monitoring technology flows and the constraints to knowledge linkages, and identifying the policy measures and the support needed to overcome these constraints.

Recommendations

Generally domestic firms tend to supply domestic markets and, therefore, they are reluctant to operate within industrial parks, which are export-oriented. The absence of domestic firms makes the park an enclave of foreign firms. As a result, foreign firms do not have many linkages with domestic firms outside the industrial park. In other words, there is less linkage with the rest of the economy.

Medium term

- Maximize industrial parks’ potential for linkages by allowing local firms to operate within the industrial parks, even if they are unable to export directly, but export indirectly by providing inputs to export-oriented foreign firms in the park.
- Apply local content requirements, where appropriate, to encourage foreign firms to source from local suppliers.
- Strengthen the interactions between local firms and R&D institutions through conditionalities that link public-sector R&D funding to innovation in cooperation with local enterprises.
- While FDI can be an important channel of technology transfer, the link between FDI-related technology transfer and technological learning and upgrading in the domestic economy is not as automatic as is often assumed. Therefore, incentives towards FDI should be designed cautiously and incorporating provisions on the role of FDI in technology transfer and knowledge linkages.
- Establish a centre for promotion and facilitation of linkages between foreign and local firms.

B. The STI policy framework in Ethiopia: The need to move beyond technology transfer

Current STI policy has a strong focus on technology transfer. Adopted in 2012, this STI policy is a revised version of the 2006 STI policy (Ethiopian Science and Technology Agency, 2006), but with a strong emphasis on transfer of technology rather than local technological learning and innovation capability-building (MOST, 2012). The decision to revise the STI policy in 2012 was carefully coordinated with changes in the Government's national development strategy as articulated in the First Growth and Transformation Plan (GTP I), which became operational a year earlier, in 2011. In addition to continuing with major programmes that started in previous five-year plans, GTP I gave a renewed impetus to export-led industrialization, anchored in the manufacturing sector. It was largely in support of the export-oriented policy that the plan gave special emphasis to “transfer of technology” and access to essential inputs required by exporters. GTP I stated that “The main objectives of science and technology during the plan period are to establish organizations and agencies that contribute to improvements in productivity and quality of local produce. Means to facilitate technological transfer will be established. Quality and standards information will be used for the technological transfer to help exports of services and products compete in the global market” (MOFED, 2010: 118).

The focus of the transfer of technology aimed at satisfying the needs and demand of export-oriented enterprises for easier access to foreign technologies so that they would be able to produce quality products that they could sell competitively in the international market. During GTP I and including during the current development plan (GTP II), it became relatively easier to import technologies – either embodied in goods such as machines and equipment, or licensing – for businesses engaged in export-oriented activities or selected sectors earmarked for import substitution. Enterprises operating in priority areas or for export could import technologies in the form of capital goods and knowledge transfer without paying duties.

Given the Government's desire to promote innovation and technological learning, including in new technologies, the overwhelming focus towards technology transfer should be rectified in the new STI policy that MInT is currently preparing. The Government needs to find an equilibrium between enabling local enterprises to acquire technology from abroad through various channels of technology transfer and the need to ensure that the transferred technology contributes to technological learning and innovation capability-building through linkages and assimilation of technologies locally. No country has accumulated knowledge and achieved economic development without acquiring technologies and know-how from more developed countries – thus, transfer of technology is essential; but neither has any country succeeded in accumulating technological capabilities and fostering a robust NIS without concerted and State-led efforts in technological learning and innovation. How to create harmony between these essential processes is one of the challenges of formulating effective STI and technology transfer policies.

Recommendations

The link between the transfer of technology and knowledge diffusion within the domestic economy is not automatic. It requires carefully crafted policies and incentives to entice local technological learning and create the absorptive capacity necessary to assimilate, adapt and master the imported technology and knowledge.

Short term

- Set the primary goal of the revised STI policy in Ethiopia to foster technological learning and innovation.

Medium term

- Mainstream STI policies into sectoral policies so that sectoral support institutions can monitor technological learning and upgrading by enterprises and at the sector level.
- Ensure that the next five-year plan highlights and integrates into the national development plan the shift in policy focus from transfer to technological learning and innovation.

Notes

- ⁵ For a detailed discussion of how the Ethiopian developmental state operated in practice, see Oqubay, 2015.
- ⁶ This report focuses on governance related to STI policies and the NIS and does not address issues related to political or macroeconomic policy governance, although the importance of the latter for STI governance is acknowledged.
- ⁷ During an interview with the officials at the new MInT, it was revealed that the Ministry is now preparing the draft for a parliamentary proclamation establishing an Innovation Fund to be managed by the Ministry and aimed at supporting innovative start-up companies. The Ministry has established a small incubator to facilitate the start-up companies with the infrastructure support structure that they require to succeed. During the interview, it became clear that the idea of establishing an innovation fund was initiated by MOST but obtaining the necessary approval from parliament and the Ministry of Finance was difficult. It was only now with the new administration in government that it has been possible to operationalize the special public “venture fund” to finance innovative activities.
- ⁸ Interview with high-level officials at the Ministry of Innovation and Technology.
- ⁹ Most of these institutions are recent creations and no systematic evaluation of their effectiveness exists. Therefore, the information available on these support institutions is obtained through interviews with both the representatives of some of these institutions and beneficiary enterprises.
- ¹⁰ For firm-level analysis of innovation activities among enterprises in Ethiopia, see Wakeford et al., 2017; Talegeta, 2014; and Gebreeyesus and Mohnen, 2011.
- ¹¹ For details, see MOST, 2015a.
- ¹² The Ethiopian government has established a number of specialized intermediary institutions to support the development of priority subsectors, including through technology transfer and technological learning.
- ¹³ When initiating the R&D survey in 2015, the former MOST identified a total of 118 institutions with R&D capacities and dedicated funds to carry out R&D activities, although in many cases the tasks carried out are largely research, particularly scientific research, without further advancement into the development stage. When conducting the survey, MOST approached the 118 institutions; of these, 101 were willing to participate in the survey and provided the necessary information. Thus, the size of the sample of the survey was a reliable representative of the total picture of the R&D capacities in Ethiopia.
- ¹⁴ It is possible that the share may have increased further since 2014, but information was not available at the time of writing this report. However, from the observed trends, it is evident that Ethiopia was positioning itself to fulfil the decision reached at the Executive Council of the African Union on Science and Technology in Khartoum in 2006 to increase the share of public expenditure on R&D to 1 per cent of GDP.
- ¹⁵ See, for example, the response of the representative of PVH, a major foreign investor in Hawassa Industrial Park, to a question regarding the potential for supplier linkages with local firms: “We want to work with a few people, and we want them to be global. We are asking our approved level suppliers to come and open in East Africa. We are asking our trade suppliers to come and open in East Africa. So we don’t want to buy locally produced. We want to encourage our global supply chain people to come here” (Mihretu and Llobet, 2017: 43).



Part III
Policy experiments: Building the future

V. STI in the textile and apparel industry of Ethiopia

The textile and apparel industry is one of the three priority areas that the Government of Ethiopia has identified for export-oriented activities – along with leather products and agroprocessing. Export-oriented manufacturing activities are expected to stimulate local technological development through linkages between foreign and local enterprises and provide the incentive that engagement in highly competitive export trade generates for learning and acquiring the technical skills and knowledge necessary to produce higher-value, more sophisticated and high-quality products.

The chapter applies the sectoral innovation system approach to analyse technological learning and innovation in the textile and apparel sector of Ethiopia as a case study that could provide information for the national STI framework to promote this and similar resource-based labour-intensive light manufacturing sectors. The sectoral system of innovation can be defined as a set of agents carrying out market and non-market interactions for the creation, development (or transfer), and diffusion of new products (or technologies) in the specific sector. The key elements of sectoral innovation are actors

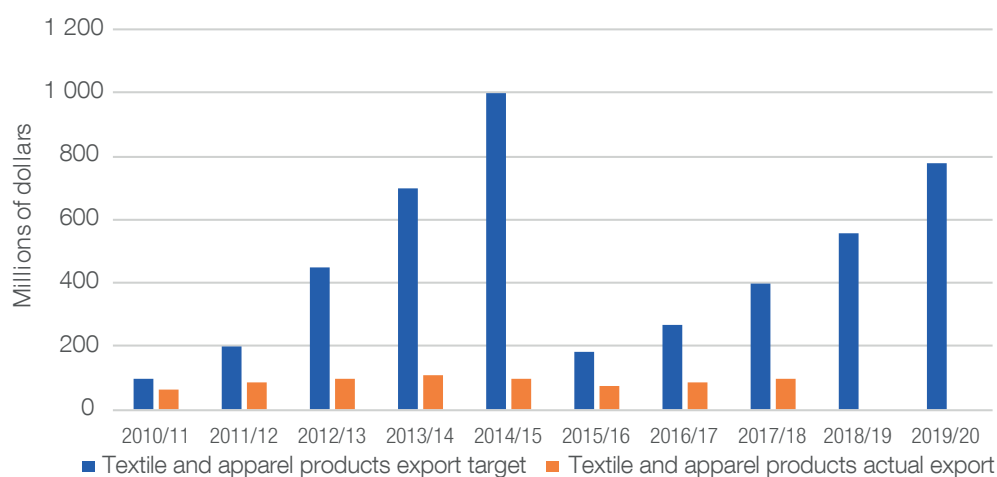
(firms and agents), networks and institutions – including the policy regime (Malerba, 2005). The actors include public and private firms along the value chain, public research institutions and several other organizations that have a role in the creation, transfer or diffusion of technological innovations.

The chapter analyses the challenges constraining technological progress among enterprises, including those engaged in the textile-related domestic value chains, and highlights the way forward to enhance the sector innovation systems and address these challenges.

A. Overview of the industry

Ethiopia has a long tradition in textile and garment production. Using simple hand tools and technology, and the cotton produced by smallholders, traditional cottage industries have been covering a significant portion of the textile demand. The modernization of the Ethiopian textile industry started with the establishment of the first integrated mill factory in 1939 (Dire Dawa Textile factory) and second textile factory established in 1958 (Addis Garment plc). There were only 19 textile and garment factories in Ethiopia until the command economic system of the country ended in 1991 (ETIDI, 2014). Since then, the transition to a free-market economic system gave rise to the textile and garment industry in the country. In 2018, the number of large and medium-scale textile and garment manufacturers reached 255 (ETIDI, 2018).

Figure 3 Textile and apparel targets and achievements



Source: FDRE and NPC (2016) and NBE (2019).

In the past 10 years, the sector has witnessed a remarkable flow of foreign investment. The FDI came in two waves (Staritz and Whitfield, 2017). The first wave was predominantly Turkish investment from around 2008–2009, following the close diplomatic relations between the two countries. The second wave of investment started in the mid-2010s, which was driven by Asian transnational apparel companies in search of low-cost countries. The strategy of the Government to establish specialized apparel and textile industrial parks has contributed immensely for the recent boom. Many renowned global corporations with specialized brands have set up their factories in Ethiopia, particularly in the Hawassa Industrial Park. These include, among others, the second largest apparel corporation in the world – PVH (which own brand names such as Calvin Klein and Tommy Hilfiger); Dubai-based Velocity Apparel Companies (Levi's, Zara and Under Armour); and from China, Jiangsu Sunshine Group (Giorgio Armani and Hugo Boss). Other industrial parks such as Bole Lemi, Kombolcha and Mekelle have also become destinations for the global apparel industry.

However, the textile and apparel sector is not performing as expected despite the increasing flow of FDI. To date, the sector has generated only a fraction of the expected amount of foreign exchange from the export of textiles and apparel. The textile and apparel sector was expected to generate \$1 billion by the end of the GTP I period (2014/15) (see Figure 3), but the achievement by

the end of the GTP I period was \$98.1 million, which was only 9.8 per cent of the planned target. The target for the GTP II period was revised downward and was set to generate \$778.8 million by the end of GTP II in 2019/20. But the performance seems not to be any different from the previous GTP period. For example, in 2017/18, the textile and apparel sector generated only \$98.5 million, which is nearly 25 per cent of the target (\$397.9 million) for this fiscal year. According to the ETIDI database, apparel exports constitute above 80 per cent of the total textile and apparel exports.

The textile and apparel sectors have not increased their share in manufacturing exports, although, at the same time, they have increased their import intensity. The share of the textile and apparel sector in overall manufacturing export remained unchanged at around 13–14 per cent over the period 2002/03–2016/17. The share of export sales to total sales is also low in these sectors (Table 5). In 2016/17, respectively only 15 per cent and 3 per cent of textile and apparel products were exported. That means 85 per cent and 97 per cent of textile and apparel products were sold in the domestic market. The textile import intensity grew from about 29 per cent in 2002/03 to 64 per cent in 2014/15 but declined somewhat to about 45 per cent in 2016/17, whereas the apparel sector shows a consistent increase of import intensity through the sample period, reaching about 57 per cent in 2016/17.

Table 5 The textile and apparel sector export contribution pattern
(Percentages)

	Industry contribution in terms of export earnings			Exports' share in sales			Import intensity (ratio of imported raw materials)		
	2002/03	2014/15	2016/17	2002/03	2014/15	2016/17	2002/03	2014/15	2016/17
Food and beverages	24.94	32.59	41.7	6.0	3.54	4.7	22.03	31.1	27.9
Textile	14.13	9.43	9.1	17.24	8.24	15	29.04	64.2	44.7
Apparel	0.01	0.33	4.25	0.1	2.92	3.1	25.66	51.6	56.6
Leather	60.26	42.25	24.5	69.11	42.68	30.8	21.64	27.6	44.6

Source: UNCTAD based on data from the Central Statistical Agency of Ethiopia, annual large and medium manufacturing industry surveys, several years. Available at: <http://www.csa.gov.et/survey-report/category/17-large-and-medium-manufacturing-industry-survey>.

Table 6 Sectoral share of value added and employment in the medium and large manufacturing sector

Sector/Year	Value added in national account concept (sectoral share %)			Employment (sectoral share %)		
	1995/96	2004/05	2016/17	1995/96	2004/05	2016/17
Food and beverages	41.2	44.1	30.1	25.8	29.1	21.6
Textile and apparel	10.8	6.2	11.9	36.0	21.2	17.2
Leather	9.1	3.9	3.8	8.6	7.2	4.7
All other sectors	38.8	46	54.4	29.6	42.3	56.6
Total value added (\$ million)	50	260	2 500			
Total employment				101 155	110 160	298 510

Source: UNCTAD calculations based on data from the Central Statistical Agency of Ethiopia, annual large and medium manufacturing industry surveys, several years. Available at: <http://www.csa.gov.et/survey-report/category/17-large-and-medium-manufacturing-industry-survey>.

Box 3 Female workers in the textile and apparel sector

Similar to global practice, the Ethiopian textile and apparel industry is dominated by female employment. The ETIDI (2018) data revealed that more than 80,000 people were employed in the textile and garment industry in 2016/17, of which 75 per cent are females. Staritz et al. (2016) similarly reported that women comprise around 75 per cent of employment in the sector with a higher share in apparel than in textiles, and men occupy the majority of technical and management positions. A recent survey in the emerging three industrial parks (Hawassa, Bole Lemi I and Mekelle), covering about 18 apparel firms, shows that female workers account for about 93 per cent of production workers.^a This implies that the emerging textile and apparel industry is creating more jobs for females. In terms of age, the survey report also shows that most workers are youth. For example, the 18–25 age group accounts for 89 per cent of sewing-machine operators. The sector should be commended and promoted from the perspective of supporting vulnerable group of the society like women and youth.

Source: UNCTAD based on Ethiopia Productivity Report (forthcoming) joint publication of Ethiopia Policy Studies Institute (PSI) and the National Graduate Institute for Policy Studies (GRIPS).

Note:

^a Ethiopia Productivity Report (forthcoming), joint publication of Ethiopia Policy Studies Institute (PSI) and National Graduate Institute for Policy Studies (GRIPS).

Although the employment in the textile and apparel sector has increased in absolute terms, its contribution to overall manufacturing employment has declined. The share of employment was reduced from 36 per cent in 1995/96 to 17 per cent in 2016/17 (Table 6). The number of people engaged in the textile and apparel industry in 2016/17 was estimated to be 51,317. The majority of them are women (see Box 3). The value added contribution of the textile and apparel sector has similarly shown a declining trend but somewhat revived in the last couple of years.

B. Policy framework

Ethiopia has attached strategic importance to the textile and garment sector. In 2002/03, the Government formulated a comprehensive industrial development strategy (IDS) that identified the textile and garment sector among the priority sectors along with the leather industry, for Government support and export promotion (FDRE, 2002). The justifications for prioritizing the textile and apparel industry was that (1) there is abundant export market for such products, (2) the sector uses more labour which is abundant in the country and (3) it

Table 7 Industry road map: Three phases of textile and apparel development

Phase I 2013–2015	Phase II 2016–2020	Phase III 2021–2025
Upgrading and capacity increment (quality and productivity improvement and value chain strengthening) <ul style="list-style-type: none"> • Improve the cotton supply chain • Further expand and increase productivity to achieve export targets in textiles and garments • Build capacity for new technology in textiles and garments 	Diversification to the different sources of growth <ul style="list-style-type: none"> • Produce synthetic fibre (polyester) • Produce man-made fabric and garments • Build capacity for manufacturing of technical fabrics 	High-tech and capital- and knowledge-intensive diversification areas <ul style="list-style-type: none"> • Export man-made fabric and garments • Manufacturing of technical fabrics • Expand the variety

Source: FDRE and MOI (2013).

can create strong backward linkage as the sector uses cotton as main input and thus can spur the development of the agriculture sector.

The Government designed national and sectoral plans to promote the textile and garment sector. In the first half of the 2000s, it developed the Textile and Apparel sectoral development plan. It also set five-year midterm plans in reflection of the consecutive national development plans. The development plans set targets in terms of investment, employment and exports. For example, GTP I and GTP II set targets to generate foreign exchange from the export of the textile and apparel products of \$1 billion and \$779 million respectively by the end of plan periods. GTP II sets to create 174,000 direct job opportunities. In reflection of the new climate-resilient green economy strategy for green growth, the plan also aims to reduce the carbon emission of the sector by 25 per cent by the end of the plan period (FDRE and NPC, 2016: 128).

The Government also prepared road maps to guide the implementation of the plans for the sector. In 2013, Ethiopia developed an ambitious and longer-term industrial development road map (FDRE and MOI, 2013), covering 2013–2025, in which it identified three phases of the textile and apparel industry development (see Table 7). In 2017, MOST (now MInT) prepared a textile technology road map based on that sector development plan and other various government policy documents (FDRE and MOST, 2017). The technology road map identified more than 40 products, out of which seven strategic products were identified based on their economic and strategic importance as well as the potential

for success in the country. It also identified major value-chain gaps and needs as well as technology selections, critical technology requirements and technology trees. It carries 10 years of detailed targets regarding quality improvement, production costs and productivity for each technology area.

The Government designed and implemented various support programmes to promote the textile and garment sector. The reason is that the textile sector is generally a low margin and profit sector, in which firms can survive in the international market only if they are very efficient by way of using modern and upgraded machinery, reducing costs and time delays. To ensure the global competitiveness of the sector, the Government established the Ethiopia Textile Industry Development Institute (ETIDI) in 2010 under the Ministry of Trade and Industry (MOTI). It also established a sector-focused special training centre, the Textile and Apparel Institute (TAI) under ETIDI. The Government introduced various capacity-building initiatives that include the benchmarking scheme, the institutional “twinning” programme, and kaizen. The benchmarking scheme was introduced in 2009 with the aim of upgrading technology and raising the capacity of the firms in the priority sectors. The twinning programme is a long-term knowledge and experience sharing scheme between ETIDI and other international and domestic selected similar renowned institutes, so that the former will be able to raise their capacity to provide better services. Kaizen is a nationwide programme that started in 2009 and aimed to bring incremental and continuous changes. Many textile and apparel firms have been involved in this

productivity improvement scheme (Gebreeyesus, 2016). The strategy to establish industrial parks also promotes the sector. About 10 of the 14 public industrial parks that are planned to be built over the period 2015–2020 are specialized parks designated for textile and garment production.

However, generally, the textile and apparel sector is not performing as initially expected despite the increasing flow of FDI. As shown, the sector’s contribution to exports, employment and value added to the overall manufacturing sector have been generally declining. Different reasons can be cited for the poor export performance of the manufacturing sector, including the textile and apparel sector. These include a highly protected domestic market generating large anti-export bias, misalignment of certain macropolicies (for example, tariff structure and exchange rate management) with export promotion, and weak institutional capacity to implement the export incentive scheme (Gebreeyesus and Kebede, 2017). Domestic investors seem to be reluctant to make any meaningful investment in the sector and enter into the industrial parks and global value chain but merely focus on the domestic market. The implication is that domestic firms have less motivation to learn new technologies and upgrade. Moreover, the companies that came in the second wave of FDI are mostly apparel firms engaged in the cut, make and trim (CMT) type of activity with low value added and net export.

Recommendations

Tapping into the international knowledge market and joining the global value chain are some of the major sources of technology for developing countries like Ethiopia. The STI and industrial policies of Ethiopia have made this clear and the export sector has been given priority. The textile

and apparel sector has been identified as a priority primarily for its potential in the export market. However, the export performance of this sector and the manufacturing sector at large remained weak. Given these realities, the Government could consider the following recommendations:

Medium term

- Align the STI policy with the industrial policy and identify necessary policy instruments and incentives to engage the private sector.
- Revise the textile technology road map to identify the role of different actors (government and non-government), the interaction and coordination among them, the resources required and the mechanisms to acquire and diffuse these technologies, as well as the required policy and institutional support.

C. Value chain

This section analyses the challenges constraining technological progress along the value chain. The textile and apparel sector spans from the treatment of raw materials (cotton, wool, artificial fibres) to final goods such as textiles and clothing (see Figure 4). The raw materials supply constitutes both locally produced cotton and imports of various types of inputs such as cotton, fabrics and accessories. Cotton production is the most common input for the textile industry in Ethiopia, while artificial fibre is underdeveloped and the wool sector very limited. The next step in the value chain is ginning, which is separates the lint from the seed of cotton. This is followed by spinning and weaving/knitting for the production of textiles. Spinning is the process of making thread out of raw fibres, while weaving/knitting is the process of taking threads and making

Figure 4 The value chain of the textile and apparel sector

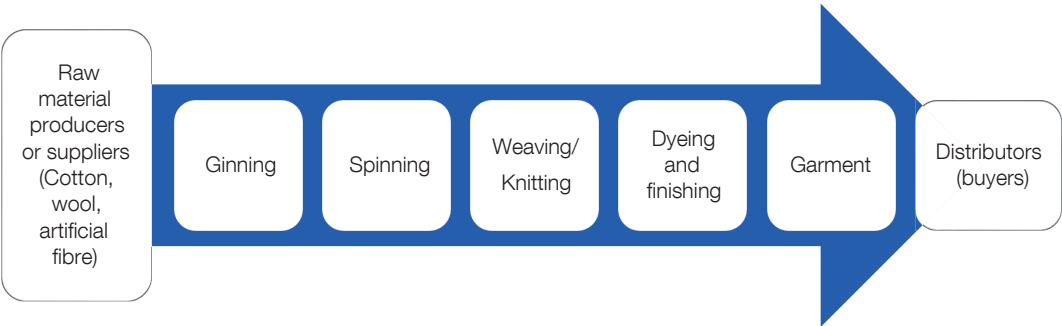


Table 8 Numbers and production capacity of textile and apparel manufacturers

Area of operation	No. of factories		Production capacity (2018)	Capacity utilization (2018)
	2014	2018		
Ginneries	18	19	330,000 bales of cotton, or 70,000 tons of lint per year	37%
Spinning	5	4	102,000 tons of cotton yarn per year	70%
Integrated textile mills	20	22	207 million metres of woven fabric and 50 million kg of knitted fabric per year	45–50%
Weaving and/or knitting	12	20		
Textile finishing and processing (dyeing and printing)	..	3	Daily processing capacity: <ul style="list-style-type: none"> • Fibre dyeing (17 tons) • Yarn dyeing (91 tons) • Knitted finishing (72 tons) • Woven finishing (555,200 square metres) • Garment processing (24,000 pieces) 	48–54%
Handloom	6	5	283,053 pieces of different products per year	65%
Garment	60	176	63 million pieces of knitted garments and 28 million pieces of woven garments per year	70%
Blanket	6	6	76,078,000 pieces of blanket and comforter per year	70%
Total	127	255		

Source: UNCTAD, compiled from ETIDI (2014, 2018).

them into fabric.¹⁶ The textile and apparel sector perform the final steps of dyeing and finishing and preparing the final textiles and pieces of clothing.

Recently, the number of large and medium-scale textile and garment manufacturers has grown fast. From 2014 to 2018, the number of large and medium manufacturers in the industry almost doubled and has reached 255 in 2018 (Table 8). The large rise in the number of enterprises mostly comes from the apparel subsector, which has almost tripled in this same period, whereas the growth of other subsectors seems to be stagnant.

However, the production capacity is largely underutilized in most of the subsectors. The ginning industry capacity utilization is the lowest (37 per cent) followed by the textile subsector in the range of 45–54 per cent capacity utilization (Table 8). According to the interviews with the key informants, some of the major reasons for the low capacity utilization are shortage of inputs, spare parts and foreign exchange.

1. Raw material producers and suppliers

Cotton cultivation is low despite the huge potential. Ethiopia is endowed with a total of 2.6 million hectares of land suitable for cotton farming,¹⁷ but only 84,000 hectares are currently cultivated, which is 3 per cent of available land for cotton production. Moreover, only 35,000 hectares under cotton cultivation is irrigated.

Cotton productivity (yield per hectare) in Ethiopia is generally very low compared to the global average. The country's average cotton yield is 0.586 tons per hectare, which is only about one third of that of the high-productivity country, Australia (which obtains 1.88 tons per hectare).¹⁸ Based on the 2015 estimates, about one third of the land was cultivated by the smallholders and nearly two thirds by large-scale farmers. There is not much difference in productivity between the smallholder and large-scale farming, implying the latter is doing little to introduce new technologies and production methods. The low level of yield is mainly due to the sector's continued reliance on old technologies in terms of cotton varieties

Table 9 Ethiopia cotton production and consumption

	2013/14	2014/15	2015/16	2016/17
Production (thousand MT)	37	38	31	43
Imports (thousand MT)	1	7	13	14
Export (thousand MT)	3	1	0	0
Total domestic consumption (thousand MT)	36	42	53	57
Imports share of consumption (%)	3	15	24	25

Source: UNCTAD based on USDA Foreign Agriculture Service (2018).

and farming practices. The technology diffusion system is weak because of the lack of extension service staff and the fact that the existing extension services mainly focus on food crops. Cotton farmers received no support of research and knowledge to apply new varieties and chemicals.

The local cotton production has slowed down while consumption exhibited continuous growth leading to increasing imports. Local cotton production declined following the Government's export ban in 2010 and price-setting practices in the domestic market. The ban was a reaction to the increasing global cotton price at the time and aimed at reducing the pressure on the local textile industries. Several cotton farmers were discouraged and shifted their production to other cash crops, such as sesame, that were more profitable to grow. The consequent decline of cotton prices in the global market has further aggravated this problem. As a result, local cotton production has not increased substantially (see Table 9). In contrast, cotton consumption exhibited continuous growth. The gap between production and consumption has been filled by the rise in imports and to some extent the decline in exports. As a result, the share of imports of cotton in total consumption showed a sharp rise from about 3 per cent in 2013/14 to 25 per cent in 2016/17.

There has been little effort to address environmental concerns. The cotton production is known to be the most polluting crop in the world due to the intensive use of fertilizers and chemicals. There are four main global standards such as Better Cotton Initiative (BCI), Cotton Made in Africa (CmiA), Fairtrade-Max Havelaar and Organic Cotton that aim to address the environmental concerns. Yet there is limited effort to adopt global standards and labels so that to address environmental concerns in the cotton sector in Ethiopia (ETIDI, 2016).

2. Ginning

There has been no new investment in the ginning sector in recent years. In Ethiopia, currently, there are 19 ginneries, all of which are privately owned. The number has only increased by one between 2014 and 2018 (see Table 8). Referring to other sources, the number of ginning mills was about 21 some years ago, suggesting a decline in number. About half the ginners were established before 2006, with only one third after 2010.

The ginning capacity geographic distribution is not consistent with the seed cotton production area. For example, about half of these are in Addis Ababa and Oromia, which are relatively far from the cotton farming area. In contrast, there is low ginning capacity in the remote areas where cotton is widely produced. The moisture level of the seed cotton decreases during long-distance transport. This causes the seed cotton to be ginned when it is too dry, thus, the low quality. Furthermore, the long distance from the cotton-producing areas to where the ginners are located causes high transport costs and reduces the competitiveness of the product. A related problem in the cotton value chain is the lack of proper market linkage between cotton producers and ginners leading to the presence of intermediaries, who benefit more than producers and ginners. There is a very limited practice of contractual farming arrangement in cotton production. The consequence of this absence of selection and blending is usually a non-homogeneous quality of lint cotton, sometimes inside the same bale.

Ethiopian ginning factories have outdated technology. This increases the cost of production and degrades the quality of lint and seed (ETIDI, 2016). Most of the ginners (above 80 per cent) are using a saw-type machine, which is outdated

technology negatively affecting the length (quality) of the fibre. The ginning also suffers from a lack of spare parts due to difficult access to hard currencies.

3. Spinning, knitting and weaving

Like the ginning sector there is little investment in the integrated textile mill and spinning subsectors, thus, most companies rely on old technology. Currently Ethiopia has 22 integrated textile mills, four stand-alone spinning and 20 weaving/knitting factories (see Table 8). Between 2014 and 2018, the number of integrated textile mills only increased by two while the number of spinning factors reduced from five to four. There has been a modest growth in the weaving/knitting subsector, which increased from 12 to 20 in the same period.

Poor quality of inputs is a challenge for the sector. The spinning factories have a poor supply of cotton both in terms of quantity and quality. They are also affected by the inadequate inputs of other types of inputs such as dyes and chemicals in the local market. The weaving/knitting subsector also faces a shortage in the availability of quality of yarn. Importing such inputs from abroad is becoming more difficult due to the increasing shortage of foreign exchange. Several of the integrated textile sectors are under distress and a significant number of them partially or fully possessed by DBE.

4. Apparel

Unlike other subsectors, apparel has shown a sharp rise in the past five years. Between 2014 and 2018, the number of stand-alone apparel manufacturers increased from 60 to 176, which is about threefold growth. This growth is a result of the strong promotion of textile and apparel specialized industrial parks and the consequent influx of foreign investors. From 2012 to 2017, 72 foreign-owned textile and apparel companies have started operation in Ethiopia (Table 10). Of these, nearly half are from China (fully owned) and about 16 per cent represent Chinese joint venture with Ethiopian and other countries' firms. With nine and seven operational firms over this period, Turkey and India investors are respectively the second and third largest investors in the textile and apparel sector in Ethiopia. Regarding locational distribution, the regions of Oromia and Addis Ababa account

for 55.6 per cent and 34.7 per cent of these operational foreign companies, respectively.

The textile and apparel industry can be categorized into two segments: older firms oriented to the domestic market, and newly established firms targeting exports. The first category includes relatively older firms, both domestic and foreign-owned, that have run in the country for many years (mostly established before 2015). Several of the foreign firms are from Turkey, India and China. Some are integrated with textiles while others are stand-alone apparel firms. There are also several firms owned by the Government and domestic investors. The second category refers to the firms that start operation after 2015 in the newly established industrial parks such as Bole Lemi, Hawassa, Kombolcha and Mekelle, and the Eastern Zone. Most of these companies are apparel companies while only a few produce integrated or stand-alone textiles. For example, the Hawassa Industrial Park hosts about 19 companies, all but two of which are in apparel (one textile-producing – JP; and one nappy/diaper producer – Ontex Ethiopia). All are also foreign-owned except one joint venture (Spanish–Ethiopian). Similarly, foreign-owned apparel companies dominate other industrial parks. Most new entrants engage in CMT activities with low value added and net export.

The two categories of firms have a difference in their adopted level of technology and market orientation. The older firms usually use of outdated machines and have poor management and marketing capability. They are largely interested in the domestic market with limited participation in the export market. Many of them (particularly those owned by Turkish investors) are commercially under stress and partially or fully owned by DBE due to failure to pay back their debt. Unlike the first group of firms, the newly established firms have their own brand name and an established global market outlet. They have their own chain of supply of inputs, mostly imported. They use new and efficient technologies and machines including automation, and they have no major problem in foreign exchange as they can use part of their foreign exchange earnings for importing inputs. They also receive better attention and treatment from the Government, including a one-stop-shop service centre, providing services such as customs and permits, as most are in the industrial parks.

However, the industrial parks are becoming enclaves of foreign firms with limited linkage

Table 10 Operational foreign-owned firms in the textile and apparel sector in Ethiopia (2012–2016) by country origin and location

	2012	2013	2014	2015	2016	Total
Country of origin						
China	4	8	10	10	3	35
China/Ethiopia	0	1	3	4	0	8
China/Hong Kong	0	0	0	0	1	1
China/Sri Lanka	0	1	0	0	0	1
China/United States/Ethiopia	0	1	0	0	0	1
Hong Kong, China/United Arab Emirates	0	0	0	0	1	1
India	2	1	3	0	1	7
Italy	0	0	0	1	0	1
Pakistan	1	1	0	0	0	2
Saudi Arabia	0	0	1	0	0	1
Singapore	0	0	0	0	1	1
Republic of Korea	0	0	1	0	0	1
Republic of Korea/United States	0	1	0	0	0	1
Sri Lanka	0	0	0	1	0	1
Turkey	2	0	0	3	0	5
Turkey/Ethiopia	2	1	0	0	1	4
United States	0	1	0	0	0	1
Total	11	16	18	19	8	72
Region of investment						
Addis Ababa	5	5	7	6	2	25
Amhara	0	0	1	0	0	1
Oromia	6	11	9	11	3	40
Southern Nations, Nationalities, and Peoples' Region	0	0	0	1	3	4
Tigray	0	0	1	1	0	2
Total	11	16	18	19	8	72

Source: Mihretu and Llobet (2017).

with the domestic economy. Most new entrants almost exclusively rely on imported fabrics leading to very low domestic value added. There is a clear absence of domestic firms in the newly established industrial parks due to low interest by the domestic firms. Therefore, there is no company in the park that can be the catalyst to create linkages between foreign and domestic firms. As the foreign firms' local sourcing is very limited, they do not have many linkages with other domestic firms outside the park (see Box 4). There is also no incentive mechanism and monitoring system by the Government to facilitate technology and knowledge transfer from FDI to local firms, which has limited the knowledge spillover to the domestic economy.

The domestic investors lack incentives for entering the industrial parks and the export

value chain. They are comfortable with the local market, where they can even get higher prices with lower quality standard requirements than in the export market. Many constraints hinder the Ethiopian domestic private sector from robustly entering into the global market (Gebreeyesus and Kebede, 2017). There is a large anti-export bias emanating from tariff and non-tariff trade barriers such as inefficiencies in infrastructure, logistics and customs services. For example, in 2017, Ethiopia ranked 167th out of 189 countries in the ease of trading across borders, with 44 required days for export processing and about \$2,388 of inland cost per container. The increasingly overvalued exchange rate of the Birr also penalizes exporters. At the same time, the export incentives provided to correct the anti-export bias are either mediocre

Box 4 The case of PVH in the Hawassa Industrial Park

PVH Corp. is one of the largest global apparel companies with nearly \$9 billion revenue in 2017. It owns the iconic brands Calvin Klein, Tommy Hilfiger, Van Heusen, Izod, Arrow, Speedo, Warner's, Olga, Geoffrey Beene and True and Co., and market a variety of goods under their owned and licensed brands. PVH used to have no single factory, acting as a global buyer working with more than 36,000 associates operating in 40 countries. PVH established its first garment manufacturing facility in Ethiopia, at the Hawassa Industrial Park (HIP).

PVH also has an office in Addis Ababa sourcing from different garment producers. The company tries to attract suppliers from HIP and garment factories established in other parts of the country. By December 2018, PVH had been able to source from five companies from within Ethiopia, all of which are foreign-owned. Despite the support of EIC in providing a list of potential domestic suppliers, PVH was only able to find one packaging producer, but not a single locally owned garment supplier. The main challenges for local producers are meeting the quality, delivery time and compliance with the globally accepted way of production of PVH. Local companies do not want to engage in such strict procedures of value-chain management, as they can sell their products (even low-quality output) in the local market at a higher price than the export market.

Source: UNCTAD based on an interview with PVH Corp. and data publicly available at: www.pvh.com.

or less effective due to implementation problems. In contrast, other sectors, notably in the service sector, create large rents (substantial and rapid returns). Thus, private investors do not have the incentives to invest in less-profitable sectors such as manufacturing and the export market.

The lack of domestic inputs in terms of quantity and quality and thus weak domestic backward linkage, is one of the critical challenges for the development of the textile sector. The increasing investment in the apparel sector in recent years increased the demand for raw cotton and fabrics. However, the domestic supply of these inputs has not improved accordingly. The new FDI apparel companies are largely relying on imported fabrics, while most integrated textile factories produce for themselves. There is also an inadequate supply of other inputs and accessories in the country, like chemicals for textile industries and zips, sewing thread and buttons for garment industries, which influence production capacity and quality of production. The high import intensity has further aggravated the trade deficit and shortage of foreign exchange leading to its rationing.

5. Innovation efforts and challenges

The innovation level in the textile and apparel sector is generally low. Out of the 62 textile firms that took part in a recent study that examined innovation systems and activities, only 11 per cent and 18 per cent of firms reported having conducted

product innovations and process innovation respectively.¹⁹ This is below the average product (29 per cent) and process (21 per cent) innovation reported by the three prominent industrial sectors in Ethiopia covered by the study, namely cement, leather and textiles.

Innovation is driven by market strategies and inhibited by economic factors. The firms surveyed reported that the most important drivers of innovation in the textile sector are “increasing market share” and “improving the value of goods and services”. On the other hand, a “high cost of new technologies” and “lack of adequate finance” emerged respectively as the first and second strongest inhibitors of innovation in the textile firms.

There are weak links with actors outside the firms. Information from within the enterprise or group was considered the most important source of information for firms. Government, public or private research institutes constituted a marginal source of information for innovation. The linkage with higher education institutions is also very weak. But the survey shows that the sectoral Industry Development Institutes are playing an important role in the facilitation of interactions and knowledge transfer among the innovation system actors.

Demand and participation of the private sector in technology learning and innovation in general are weak. The interviews with representatives of textile and garment companies conducted during the preparation of this Review have shown that, unlike the public sector, the private sector does not participate in collaborative R&D with

the universities. Moreover, the private sector does not adequately participate in internship programmes for fear that interns might break their machines, or an unwillingness to contribute to capacity development. Technology transfer and development cannot be successful without motivation from, and the active participation of, the private sector.

Obsolete technology and lack of investment is the rule. In the textile sector, equipment needs retooling every 10 to 15 years to keep up with rapid technological advancement. This modernization gives a cost advantage through highly productive, high-quality and automated equipment. However, apart from the apparel subsector, the textile sector in Ethiopia in general uses obsolete technology. There is little investment in the cotton sector and textiles, particularly spinning and weaving, as well as the production of chemicals and accessories. Old machines severely limit the quality and productivity of local producers. It leads to high production costs (due to high energy consumption and high maintenance costs) and reduces the ability to produce quality and more diversified products. This obsolescence has negatively affected the competitiveness of the textile and apparel sector in Ethiopia.

Recommendations

Promote the backward linkages and a shift of focus toward the upper stream

Currently most of the new investment is flowing to the apparel sector. Although the sector can generate large employment and exports, it is characterized by low value added activity and limited scope for learning. In contrast, there is little investment in the upper stream of the supply chain such as cotton production, ginning, spinning and weaving. Investing in the upstream sectors could enhance the industrial base of the country. Given its endowment, Ethiopia has the potential to develop very large production of raw cotton coupled with a modern and dynamic textile sector like China, India and Turkey. The upper stream of the supply chain can generate more value added and provide better scope for learning, unlike the apparel sector. Strengthening the local value addition can help improve the country's export prospects, as some of the export market access under AGOA (the African Growth and Opportunity Act 2000 of the United States) requires about 30 per cent of value addition to using the benefits.

It will reduce the excessive reliance on imported inputs, thus improving the competitiveness of the sector at large. This requires a policy shift of focus from apparel towards developing the upper stream supply chain. This shift will promote an update of the upper stream's old and obsolete technologies and farming practices, so it can satisfy the demand of the apparel sector and improve direct exports.

Short term

- Design new incentive schemes to encourage investment in the subsectors such as cotton, yarn, fabric, accessories and chemical for dyeing producers.
- Extend incentives for indirect exporters, which currently only cover the production of fabrics, to include yarn and cotton production.

Medium term

- Assess the potential for the development of the artificial fibre sector to meet domestic demand.
- Promote the increase of irrigation of the land under cotton cultivation to increase yield.
- Strengthen the extension service, including the number of staff, related to cotton production to increase yield through technology and knowledge diffusion.
- Adopt global standards and labels to address environmental concerns in the cotton sector in Ethiopia.

Promote the participation of the private sector in innovation and export

Technology transfer and development cannot be successful without motivation and active participation of the private sector. In this regard, it is crucial to address the main factors discouraging private-sector participation in export and technology learning. One problem is the very demanding requirements in the export market, including quality and compliance with global social and environmental standards (for example those of the Business Social Compliance Institute (BSCI) and Worldwide Responsible Accredited Production (WRAP)), whereas the profit margin of exporting is low. This has partly led to the underutilization (below 5 per cent) of market access to the United States and Europe through AGOA and "Everything But Arms" (EBA). In contrast, the domestic market, which is protected, accommodates low-quality products even with a better profit margin.

Considering these elements, the Government should consider:

Medium term

- Reduce the protections that arise from policy and non-policy factors to make the domestic market more competitive.
- Devise incentives and support programmes to reward the exporters.
- Address the poor infrastructure and expensive logistics (railway not efficiently run – more delay and cost than trucks), and bureaucratic hurdles, particularly customs services.
- Address the lack of access to finance including foreign exchange.

Enhance the linkage between FDI and local firms

In recent years, Ethiopia has seen a large inflow of FDI to the apparel sector, most of which located in the industrial parks. These industrial parks risk becoming enclaves in which all enterprises are foreign-based, all inputs are imported, and locals engage only in simple assembly processes. It is critical to address this challenge if the country is going to adequately benefit from the presence of FDI and particularly improved linkage and spillover to the domestic economy. Co-location of FDI and local firms is a crucial mechanism for knowledge spillover by way of learning-by-demonstration (through observation) and enhancing labour pool mobility and spin-off. A supplier relation is often the main mechanism of the technological spillover of FDI in many successful countries, such as China and Ireland. A scheme of joint ventures among FDI and domestic firms has played a crucial role in China to transfer knowledge from FDI to local firms. Therefore, the Government could consider the following measures:

Medium term

- Re-examine the existing incentives and devise appropriate incentives and support for local firms to locate in the industrial parks.
- Design a support programme to improve the productivity and quality of production of domestic firms.
- Design preferential incentives to motivate FDI to engage in backward and forward linkages in the value chain.
- Encourage joint venture among FDI and domestic firms.

D. Education and research

Ethiopia has no shortage of low-skilled labour to meet the demand of the textile and apparel sector, but poor work culture and ethics are a problem. Low-skilled labour is a large part of the labour demand of the textile and apparel sector. Low-skill jobs such as operating a sewing machine do not require more than a high school education. A few weeks of job training is enough for the operators to acquire the skill. There is no shortage of supply of such labour in the market with the rapid expansion of the education sector. The challenge affecting labour productivity is not lacking technical skills but soft skills – poor work culture and ethics. Most workers come from rural areas with little urban exposure and no prior industrial work experience. Currently, the education system does not give attention to building these soft skills.

A challenge for the textile industry is the high turnover of low-skilled labour. For example, in Bole Lemi the labour turnover reaches up to 84 per cent a year. The main reason for the high turnover is low pay and poor working conditions. But the effect of such high labour turnover is to reduce the accumulation of knowledge and skills by local workers and transfer to local firms.

Another challenge is the mismatch of skill supply and demand at professional and middle management levels. Middle-level management often comes from universities and TVETs. For example, when PVH opened its factory it recruited 137 graduates (engineers) from Bahr Dar University (Textile Department). Certain institutions such as Bahr Dar, Kombolcha and Axum Universities have established specialized textile training departments. The number of textile and garment graduates from universities has increased in each fiscal year. However, although the graduates from these universities have theoretical knowledge, they often lack practical skills. TVETs graduates have better practical skills but lack language skills. This requires revision of the curriculum at both levels.

Recommendations

Despite the large supply of labour at the disposal of the textile and apparel industry, the mismatch of skill supply and demand is a critical problem. In light of that, the Government should consider:

Medium term

- Assess the demand and redesigning of the education programmes (starting from high school) with more focus on practical training and soft skill development.
- Review the current apprenticeship programme and explore incentives schemes such as tax breaks for enterprises accepting and training apprentices.
- ETIDI should design programmes which enable university and TVET lecturers to spend time in textile and apparel companies observing production-level technical activities.

E. Governance

1. Main actors and coordination

Various government agencies are key actors involved in the textile and apparel sectoral innovation system. The major ones are the Ministry of Trade and Industry (MOTI), Ethiopia Textile Industry Development Institute (ETIDI), Ministry of Innovation and Technology (MInT), Ethiopian Investment Commission (EIC), Quality Infrastructure, and the Development Bank of Ethiopia (DBE) (see Table 11).

Table 11 Major government actors and instruments of the Ethiopian textile and apparel innovation system

Ministry of Trade and Industry (MOTI)	MOTI gives support and direction to various sectoral Industry Development Institutes including ETIDI, which is directly responsible for the textile and apparel sector.
Ethiopia Textile Industry Development Institute (ETIDI)	ETIDI was established in 2010 under MOTI to enable the Ethiopian textile industry to become competent in the global market by providing sustained investment expansion, consultancy, training R&D laboratory, and marketing support and services. Currently, ETIDI has 17 directorates organized along the value chain. It oversees both cotton and textile sectors, each having deputy directors. ETIDI also acts as liaison with universities and industry linkages. It is relatively well equipped with training facilities and laboratory equipment.
Ethiopian Investment Commission (EIC)	EIC is the country's primary investment promotion agency and the regulator of industrial parks. It has been aggressively promoting investment in the textile and apparel sector as its priority. Several industrial parks specializing in textiles and apparel have been established through the Industrial Park Development Corporation (IPDC), which is currently accountable to EIC. Currently operational publicly owned industrial parks include Hawassa, Bole Lemi, Mekelle and Kombolcha. Other privately owned industrial parks focusing on textiles and apparel such as Eastern Zone and Velocity are also emerging.
Ministry of innovation and Technology (MInT)	MInT has recently prepared 20+ sectoral technology road maps including one for the textile industry.
Quality infrastructure	Ethiopia Standards Agency (ESA) has a textile and leather sector development team. ETIDI also has quality infrastructure and it handles facilitation, standards and conformity of the textile sector.
Development Bank of Ethiopia (DBE)	DBE is a policy bank particularly financing priority sectors including the textile and apparel sector.
Private sector associations	There are two private sector associations in this sector: the Ethiopian Textile and Garment Manufacturing Association (ETGAMA) and Ethiopian Cotton Producers & Ginneries Exporters Association (ECPGEA). The former is older and more active. It was established in 2003 with 85 members representing 87% of the manufacturers in the sector. Membership requires having 50 or more employees. The objective of ETGAMA is to build the capacity of its members and improve their market linkages as well as serving as a window for policy dialogue with the Government.

Source: UNCTAD.

However, the promotion of STI in the sector suffers from poor coordination, lack of focus on innovation, and shortage of a skilled workforce. There is no agency responsible for innovation and technology in a traditional sector like the textile and apparel sector. MInT is more active in the modern sectors of the economy, while MOTI and EIC are more concerned with the production side and exports. There is little coordination among MInT, MOTI and ETIDI. Another challenge is the lack of focus on innovation and technological learning. For example, ETIDI, which is assigned to lead the capacity-building of enterprises, including technology, has focused on investment facilitation. The institute has now been instructed to focus on supporting local firms as part of the recent reform of MOTI. In addition, almost all the relevant government agencies suffer from the shortage of a skilled workforce. They face high turnover and poor motivation for work mainly due to low pay, which impacts the services they provide to the private sector.

2. Quality infrastructure

The capacity of the quality infrastructure is generally limited and affects all industries. Laboratories are not enough for testing all kinds of conformity assessment. Some tests are made outside of the country, making it costlier. There is also a large gap in maintenance and installation services in the country. Coordination among different organizations is weak. For example, the universities have larger capacity but remain idle due to a lack of experts to operate and maintain them, and they are less interested in engaging in commercial services. Private sector participation in terms of being the customer and as a supplier of quality infrastructure is very limited. Testing and quality assurance facilities to monitor the quality of the inputs, work-in-process and the final products are in short supply in the individual firms as well as in the sector. Enforcement of standards is lacking due to limited capacity (high staff turnover) and poor awareness of stakeholders. ESA has adopted more than 1,500 standards for the textile and leather sectors, but these standards are often adopted to promote trade and are not much used yet for technology transfer. Moreover, the implementation of standards is weak, apart from safety or health-related standards. There is also a coordination problem between ETIDI and ESA.

Firms in the sector, particularly exporters, are under pressure from global buyers to comply with standards to enter and continue in the United States and Europe markets, such as BSCI, WRAP and OCOTEX. In this context, ETGAMA is engaged in capacity-building efforts for the firms to meet international standards and receive certificates of compliance with the support of international donors/organizations. To address these requirements, the association is preparing a social requirement manual in collaboration with development partners like the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and the Embassy of the Kingdom of the Netherlands. The association holds quarterly meetings with the MEFCC to discuss issues of environmental compliance (Wakeford et al., 2017). ETGAMA works closely with ETIDI and collaborates in the provision of training and the formation of market linkages and development through organizing trips abroad for members to participate in international trade fairs.

3. Domestic finance

Lack of access to finance remains a critical problem for a highly indebted sector. The supply of credit by the public banks is geared towards investment (purchase of machinery and construction) and working capital for established firms. DBE has recently started a lease financing scheme to support the small and medium enterprises sector within the traditional sectors. The bank is involved in the selection of pieces of machinery and importing (logistics and customs services), delivery and training. The companies complain about the bank's lengthy bureaucracy to get funds and its high interest rates. But the main exiting problem is that the textile and apparel sector is already highly indebted, even threatening the very survival of the bank itself.

Textile and apparel firms that entered in the first wave of FDI in the 2000s are currently under stress. These companies, mainly from India and Turkey, came to Ethiopia to take advantage of cheap power, easily trainable and cheap labour, and privileged access to European and United States markets. DBE could not properly evaluate the creditworthiness of these investors, and there was too much intervention from government officials on the bank, leading to too much pressure. Thus, DBE was not able to

make an independent analysis on the feasibility of the projects. As a result, about 15 textile and garment companies that entered in the first wave of FDI are currently (fully or partially) owned by DBE for failure to pay their debt.²⁰

The poor performance of the textile and apparel sector is in turn negatively affecting the sustainability of the bank. The outstanding loans as well as the non-performing loans of the bank for foreign investors concentrate in the textile and garment sector, followed by manufacturing of household appliances. For the textile and garment sector, DBE has 7,595 billion Birr (\$237 billion) in outstanding loans, out of which 5,139 billion Birr (\$160 billion) (67 per cent) is in non-performing loans (NPL). The number of projects financed by the bank is also much higher in the textile and garment sector than those in the other sectors. Of the 43 projects that took loans from DBE, 18 projects are textile and garment.

Mismanagement, old technology and difficult political and economic contexts have contributed to the failure of the first wave of FDI in the textile and apparel sector. The ongoing unrest and economic slowdown might have contributed to the distress. Moreover, the technology these investors brought was very old and largely second-hand machinery. The time since their investment, which is about 12 years, makes the age of the machinery much greater. However, the main reason seems to be mismanagement.²¹

Recommendations

Enhance coordination

Poor coordination and institutional quality have been identified among the critical challenges for the sector development. There needs to be close

coordination between MInT, MOTI and particularly the sector development institute, ETIDI.

Short term

- There is an urgent need for integrating STI policy with the broader industrial policy objectives. In the context of the textile and apparel sector, MInT, MOTI, EIC and ETIDI should establish a joint steering committee to coordinate the implementation of STI policy in the development of the textile and apparel sector.
- Enhance the capacity of ETIDI in terms of staff, equipment and other resources. This institute can also play a significant role in strengthening the link between foreign firms and domestic linkages, thus enhancing the technology and knowledge transfer.

Improve the quality infrastructure

One of the critical factors discouraging local firms from exporting is the many and stringent requirements (safety, social and environmental) with which they should comply to access the foreign market. While the country adopted several global standards, enforcement is weak due to limited capacity (high staff turnover) and poor awareness and capacity of the private sector. The lack of quality infrastructure service is a related challenge.

Medium term

- In partnership with other stakeholders, invest in improving the quality infrastructure and building the capacity of the private sector.
- Use global standards as an incentive to promote technology transfer and innovation. A typical example in this regard is the initiative the Government has taken to build industrial parks with zero liquid discharge.

VI. STI in the pharmaceutical industry of Ethiopia

Improving local pharmaceutical production²² (LPP) promotes sustainable development by contributing simultaneously to both economic and social development.

Ensuring a sustainable supply of, and access to, quality-assured essential medicines is critical for SDG3 (ensure healthy lives and promote well-being for all at all ages) and for the well-being of all Ethiopians. It promotes socially inclusive development to the extent that access at an affordable price is assured for all who need essential medicines.²³ At the same time, the development of a local pharma industry promotes local manufacturing in a knowledge-intensive, high-tech industry and promotes industrialization and structural economic transformation, which is essential for economic development. Pharmaceuticals is one of the three industries identified by the Government of Ethiopia as potential import-substituting activities (the others are chemicals and metalworking). It is a strategically important industry for improving domestic health security.

The chapter applies the sectoral innovation system approach to analysing technological learning and innovation in the pharma sector of Ethiopia as a case study that could provide information for the national STI framework to promote pharma and similar knowledge-intensive and highly regulated sectors.

The main players in the country's pharma industry include pharma firms and the industry association, research and education institutions, regulatory agencies, support bodies and policy and governance bodies that play a role in the key policy areas of STI and closely related policy areas (see Annex I for an institutional mapping of the innovation system for pharma). The use of an innovation system framework helps analyse the systemic nature of the processes through which these actors engage in technological learning and over time build technological capabilities and the capacity to innovate. The innovation system for pharma enables a systemic analysis that can help with a diagnosis of the industry.

A. Overview of the industry

The Ethiopian pharmaceutical industry remains at a basic level of development, but this may begin to change with the entry of foreign producers. Since 2005, the Government has established policy support measures and incentives for LPP, and has engaged in collaboration with agencies such as UNIDO, WHO, UNCTAD, BMZ/GIZ, USAID and others. This review is the latest collaboration of UNCTAD with Ethiopia on LPP. However, many challenges still remain. Today, the industry is composed of 22 small and medium-sized generic drug producers. The domestic market is growing, and there is a great need for, and potential for growth in, LPP. Foreign generic producers have begun to enter Ethiopia, with two recent relatively large foreign generic producers that are good manufacturing practices (GMP) compliant entering the country. This follows efforts spearheaded by EIC to encourage generic pharma firms to invest in LPP through a package of support measures and incentives. EIC is actively targeting joint ventures in pharma as a preferred form of entry due to the higher opportunities for collaboration and learning by local partners.²⁴

Pharma is an import-substituting industry and can contribute to lowering foreign exchange outflows and reducing the foreign exchange gap (financing and foreign exchange). Ethiopia spends relatively little on medicines per capita, and there is huge room for growth. But most medicines are imported, which is a large drain on foreign exchange. About \$666 million was spent on imports of medicinal and pharmaceutical products by Ethiopia in 2018. Currently, about 85 per cent of pharma products consumed in the country are supplied through imports. The industry is also important for improving health security and strengthening the health system.

These considerations have led the Government to place a high priority on this sector in the country's recent national development plans, starting with GTP I. The objectives outlined in GTP I for the pharma industry were to create the capacity to produce essential pharma products that substitute for imported products and supply export markets. The targets were set to achieve full utilization of the existing capacity of local pharma and medical supplies manufacturers, to raise the share of the domestic market held by local producers to 50 per cent, and to increase export earnings of local producers to \$20 million. These targets have not yet been fully met.

B. Policy framework

The policy framework in the health sector includes various key policy documents, operating at three levels. The first level is the national health policy and health sector strategies, the current one being the Health Sector Transformation Plan 1 (HSTP1) (2015–2020) which has as its main goal to ensure that everyone who needs health services can get them without undue hardship.²⁵ The second level is the five-year development plans, most recently GTP II. The third level is the industrial development plans, including the Ethiopian Industry Development Strategic Plan 2013–2025 (see Annex II for a list of the main policy documents relevant to the pharma industry). The national policies fit under the broader context of Africa-wide strategies to build local capacity in pharmaceuticals in the continent and to develop local pharma production in Africa.²⁶

The Government has prepared a detailed plan, the National Strategy and Plan of Action for Pharmaceutical Manufacturing Development in Ethiopia (2015–2025) (NSPA-Pharma), to build a dynamic and innovative local pharma industry, but strong leadership is needed to drive implementation.²⁷ The 10-year strategy established an implementation mechanism through a joint steering committee (JSC), a technical committee and three working groups on industrial capacity-building, regulatory capacity-building and finally on market access and investment promotion. The JSC includes most key ministries and agencies relevant for the pharma innovation system, and could help to overcome the problem of silos by coordinating the implementation of policy actions in the sectoral innovation system. Such a mechanism is essential. Some firms and agencies interviewed were not aware of the existence of the NSPA-Pharma. There needs to be strong leadership from the Government to drive the implementation of the strategy. It does not appear that the private firms and the business association can drive the industry's development.

The national STI policy does not specifically mention pharma, but a technology road map was prepared for the sector. STI policy should play a central role in strengthening the pharma innovation system and helping pharma firms to develop the technological capabilities required to innovate by producing new products that meet regulatory requirements, or new processes, marketing or management methods, or business models. In

2017, MOST coordinated the preparation of the Pharmaceutical Technology Roadmap (PTRM). The road map was developed by seven experts in pharma and pharma technologies (MOST, 2017a). The road map identifies the strategic pharma products along with the key technologies that should be developed in Ethiopia over the period 2017–2026. Awareness of the road map among pharma stakeholders was relatively limited, although some of the agencies and at least one firm were aware of it (the firm reported participating in its preparation).

There is a relatively high degree of coherence across the major strategic policy documents in other domains relevant to the pharma industry.

The policy areas that have a significant influence on the effectiveness of the policy effort to develop local pharma production includes FDI, trade, education and training, intellectual property rights, financing, enterprise development and entrepreneurship, and competition policies. For example, EIC offers incentives for pharma firms locating in the new pharma industrial park and has a programme to target pharma FDI by foreign generic producers from several countries, especially China and India. The Higher Education Proclamation (No. 650/2009) establishes a provision for every higher education institution to establish a Research and Innovation Fund (RIF) to finance R&D, which could help finance pharma R&D. Public procurement rules for pharma provide powerful incentives with a 25 per cent price preference for local producers and a prepayment of 30 per cent of the tender value to local manufacturers that are awarded a supply contract with the Ethiopian Pharmaceutical Supply Agency (EPSA).

One exception is the intellectual property regulations. IP regulations are highly important in the pharma industry and hold importance even for the production of generics. Some firms did not see intellectual property rights (IPR) as relevant for them because they specialize in the production of generic copies of originator's products. The relevance of IPR for the pharmaceutical sector should reflect the different roles of different categories of IPR. Trademarks, trade names and protection against unfair competition remain important to protect the brands, business names and reputation of generics producers. Patent regulations remain important for generic producers. Ethiopia is not a World Trade Organization (WTO) member (although they are interested in acceding to the WTO), and are not formally bound by the

TRIPS agreement. Also, as an LDC, Ethiopia is not obliged to observe product patents.²⁸ However, under the current proclamation on IP, Ethiopia is observing product patents. Policymakers could take advantage of the transition period for the introduction of pharmaceutical product patents and the protection of undisclosed pharmaceutical test data to accelerate the development of the industry considering the early stage of its development (UNCTAD, 2016a).

Stronger coherence is needed in the design of three broad policy areas at the core of any successful effort to develop local pharma production in Ethiopia: health, industrial and STI policies. Despite the comprehensive policy framework, policy design in relation to STI in pharma still seems to lean more towards a silo approach, without adequate cross-ministry and agency collaboration at the design stage. For example, the NSPA-Pharma does not make an explicit linkage with the PTRM, although MInT is a member of the governing management structure of the NSPA-Pharma. However, there is a substantial degree of alignment between the findings of the PTRM and the objectives of the NSPA-Pharma.

Another challenge is that STI plans and strategies for the sector do not always include action plans or implementation plans. For example, the PTRM is a strategy document but does not (yet) include an implementation plan. This is due to the structure of the technology road maps initiative, which foresees a strategy document laying out the products and technologies to be developed and an implementation protocol, yet to be developed, that serves as an implementation plan for the technology road maps. The implementation protocols will require time to prepare, which will delay actual implementation.

Progress is undermined by limitations in implementation capacity in some agencies. These limitations are due to the high rate of turnover of personnel in many agencies that disrupts continuity, and mandates that exceed current sets of skills, staffing, infrastructure and equipment, and budget allocations.

Moreover, monitoring and evaluation (M&E) are often weak or non-existent. Institutions, as well as implementation plans for policies, are often weak on M&E mechanisms. This is a common finding across many countries that can undermine implementation performance.

Recommendations

The development of local pharma production in Ethiopia requires adequate policy coherence across major policy areas, including health, industrial and STI policies. Mechanisms are needed to push the policy areas closer together to create an adequate level of policy coherence at the design stage and concerning content. Good practice from international experience is to agree on an implementation plan that contains key performance indicators, milestones showing the timelines for implementation, identification of the actors responsible for implementation, and the budget involved, including the sources of funds. Stronger M&E will be needed to evaluate on an ongoing basis the progress being made. Taking advantage of transition periods for LDCs, even as a prospective WTO member, would allow the local production of patented essential medicines and enable faster capability-building through reverse engineering of such medicines. In light of this, the Government could consider:

Short term

- Establish mechanisms to ensure adequate policy coherence across health policies, industrial policies and STI policies for them to support each other and have a complementary effect in promoting local pharma production.
- Strengthen the JSC, technical committee and working groups tasked with the implementation of the NSPA-Pharma to support closer collaboration, greater coherence and improved implementation, and establish under the JSC an M&E mechanism for annual implementation of the NSPA-Pharma strategy in order to strengthen accountability for the strategy.
- Develop the implementation protocol related to the Pharmaceutical Technology Roadmap, identifying specific tasks, which agencies are to be involved in implementation, who will be responsible for which actions, and an M&E mechanism.

Medium term

- In the design of the next five-year development plans for 2021–2026, aim to improve further alignment across all the major policy areas relevant for pharma, and other high-priority areas.
- Improve the alignment of policies on IPR and the national STI policy with the industrial policy.

- Build capacity to systematically establish plans of action (including M&E) for policies and implementation capacity to improve implementation performance.

C. Value chain

1. Pharma firms in Ethiopia

The number of local firms is small, and their activities limited in scope, leaving most high-priority medicines undersupplied. There are 22 pharma firms, with three fully locally owned, one foreign and 18 joint ventures. Of these, nine produce generic human medicines and the others engage in veterinary drugs, medical supplies, medical equipment, and packaging such as empty hard gelatin capsules (EHGCs).²⁹ The medicines produced include tablets, capsules, powder and liquid preparations, with some parenteral preparations, creams and ointments. There is scope for increased local production of high-priority medicines that are needed locally and can be produced locally but are currently undersupplied.

Most firms do not meet GMP standards, but new foreign producers must be GMP compliant. These standards ensure safety and quality in manufacturing to avoid contamination. As at February 2019, only two out of nine local pharma producers were certified as meeting GMP. The compliance gaps of firms vary (FDRE, 2015a). The regulator, the Ethiopian Food and Drug Administration (EFDA), has collaborated with each of the local producers in preparing a five-year GMP road map for 2013–2018, which measures the degree of compliance of local producers with current GMP (cGMP; the requirement for firms to use up-to-date technologies and systems to comply with the regulations) and lays out plans for each firm to reach full compliance by end 2018.³⁰ EFDA has collaborated with relevant agencies (Ministry of Health (MOH) and MOTI) and the firms concerned on the plans for each firm to implement the GMP road map and upgrade to meet cGMP. Lack of WHO pre-qualification of local producers also disqualifies them from participating in the major drug procurement programmes operated by UNICEF and the Global Fund, even if they were able to produce at a competitive price. Two new foreign generic producers are GMP compliant, following current pharma industry policy.

The competition among local firms is currently low, but they face competition from imported drugs and new foreign entrants may change the competitive landscape. There is such a large unmet domestic market demand to which local producers can sell their output without running into limits to demand. The lack of local competition reduces the incentive for firms to invest in technological upgrading, through investment in machinery and equipment, training etc. This may help to explain why so many of them have been slow in meeting GMP requirements. However, the competitive situation among local producers may change with the entry of additional new firms. New firms entering from China and India are likely to increase the level of competition over time. Local producers face competition from drug imports, especially from larger, low-cost Asian pharma producers, with whom competition is strong in Ethiopia. There is also competition from substandard and counterfeit (illegal) drugs that enter the market. These are supposed to be prevented by the Government through EFDA³¹ and the Ethiopian customs, but it has proved difficult for the agencies to block these drugs from entering Ethiopia. Some firms are interested in exporting in the subregion, including countries of the Common Market for Eastern and Southern Africa (COMESA) or of the Intergovernmental Authority for Development (IGAD) countries, but this requires upgrading to meet GMP.

Many local pharma producers have low productivity due to low technological capabilities and various challenges such as deficient infrastructure (unreliable power supply, weak transport systems and lack of clean water supply) as well as outdated machinery and equipment. The inadequate and unreliable power supply was reported to be a fundamental challenge faced by the industry, and by firms in general, including in industrial parks. The machinery and equipment used by producers is a critical element of their technology. Several firms are using old equipment and machines which makes obtaining spare parts and maintenance services a challenge, partly due to the age of the equipment and partly due to the shortage of foreign currency. Firms have also pointed to challenges in accessing credit to make large capital investments required for upgrading. For most local producers (excluding new foreign firms), the strongest incentive for upgrading is the need to gain certification of meeting GMP standards. Strong competition from low price imports and the desire to export provide additional incentives.

2. Raw material producers and suppliers

The local production of raw materials is extremely limited, thus almost all raw material must be imported. Reportedly, the only raw materials produced locally are sugar (firms use pharma-grade sugar for syrups), EHGCs and some packaging materials. Medical producers use imported raw materials that include active pharmaceutical ingredients and excipients (or inactive ingredients), as well as most packaging material. Import tariffs on packaging materials needed for production make production expensive. Most firms have small-scale production, which leads to small-volume orders for raw materials and high raw-material prices. The high import content of pharma production weakens domestic value added, undermines the creation of strong local value chains and reduces the contribution of local pharma production to import substitution and foreign exchange conservation. In recent years, often due to inadequate access to foreign exchange to import machinery and equipment and raw materials, firms have faced difficulties in importing raw materials leading to low capacity-utilization rates.

3. Innovation efforts and challenges

The basic level of capabilities of most producers limits their innovation capacity to develop new products. In Ethiopia, firms develop pharma formulations mainly through reverse engineering with limited R&D. Three or four local producers engage in engineering and R&D to produce formulations that are new to the firm or new to the local pharma market in Ethiopia. The latter generally represents a higher level of “innovativeness” than formulations that are new to the firm but exist already in the local market. Some firms use standard formulations that may not be innovative in terms of the local market, although they may be new to the firm itself. Based on interviews, only one firm has introduced new products to the market, but the R&D for the development of the new formulations is performed outside Ethiopia by a sister firm abroad. There is no local engineering or R&D aimed at creating new chemical entities or new to the world pharma products, which represent the highest level of capabilities found at or near the technology and innovation frontier.

FDI in the sector can promote technology transfer but low absorptive capacity may be a challenge. Larger foreign producers with stronger capabilities have begun to enter Ethiopia and produce medicines locally. The successful experience of the Sino-Ethiopian (Africa) Associates Private Limited Company, a joint venture, in technological learning and capabilities upgrading from foreign partners, shows that joint ventures may improve the chances for achieving effective collaboration on production and technology that lead to technological learning and upgrading through FDI. However, the basic level of capabilities of most producers may also present a challenge to establishing collaborative linkages with foreign firms, given that they may not have strong enough capabilities, or “absorptive capacity”, to enable effective collaboration on production, research or innovation.

4. Kilinto Industrial Park as a pharma cluster

Kilinto Industrial Park (KIP) for the pharma industry is expected to provide the physical and regulatory infrastructure for firms to be productive, and could be a game changer. KIP is a 279 hectare park that is being constructed in Kilinto, Addis Ababa, to act as a cluster for pharma firms. It will include essential infrastructure (wastewater treatment, reliable water supply, dedicated power substation) and services (customs clearance, investment licensing, administration, product registration, joint warehousing, calibration and testing services). KIP will remove infrastructure challenges faced by firms outside the park. For example, several firms have reported unstable energy supply in the country as a major issue, which causes disruptions even with the installation of large generators. The success of KIP is important for the future of LPP.

However, few local producers currently have plans to relocate there, and there is a risk that KIP will develop into an enclave with limited local linkages. As an enclave, the first-level benefits of increasing foreign investment, increasing employment, increasing production and GDP might be achieved, but not the deeper knowledge and learning and technology linkages that represent the second-level benefits that can in theory accrue from FDI. Both domestic and foreign firms are allowed, and indeed encouraged, to locate in KIP but, as at February 2019, EIC had

not received explicit interest from any existing local firms to move to the park. Existing producers have already made large capital investments in land and factories outside KIP, and the cost of relocating to the park would be high. It may therefore not be commercially feasible for them to relocate to KIP. One joint-venture firm operating near Addis Ababa for more than 10 years reported that they plan to expand their current production lines and were also looking into the possibility of locating in KIP in 2022. A key issue for KIP is whether, once operational, it will lead to strong production, research, knowledge and technology linkages between foreign firms and local firms, and foreign firms and local research institutes, universities and TVETs. Promoting the development of strong local linkages is highly desirable.

KIP will bring major advantages to firms that locate there, which could lead to a competitive disadvantage for existing producers not located in an industrial park vis-à-vis new firms.

For example, firms that locate in KIP will benefit from a special tax incentive scheme, which is more generous for firms that export a larger proportion of their output (firms locating in the park must export at least 80 per cent of their production). Another issue is the tariff-free import of inputs into pharma production. As in other industries, there is a trade-off between reducing production costs for local production for export on the one hand, and the desire to promote local production of input industries. The latter may imply the need for some level of temporary tariff protection as a measure to allow the start of local production, which will initially be relatively high cost before any scale economies and technological learning enable lower production costs.

Recommendations

Most local pharma firms currently have a basic level of technological capabilities. The most direct challenge is upgrading processes and facilities to become fully GMP compliant. They need to invest in learning and upgrading of technology, processes (quality management systems) and premises, and in building stronger innovation capacity. There are several potential incentives for firms to upgrade their capabilities. They include market competition, expansion into export markets and meeting regulatory standards. New, larger foreign producers entering the country from China and India have stronger capabilities and will expand

local production, while raising the level of local competition. There remain major weaknesses in supply industries that need strengthening to the extent feasible, including the production of active pharmaceutical ingredients, excipients and packaging depending upon the feasibility of local production. The chemical and biotechnology industries could also play a stronger support role if they develop. The success of KIP is important for the industry. In that regard, the Government could consider the following:

Short term

- Identify the medicines that are a high priority and can be produced locally but are undersupplied, and consider providing incentives to local producers to produce them.
- Strengthen incentives for LPP of high-priority medicines that are undersupplied. This might include a larger preferential price margin for local production of such medicines, higher tariffs on the import of such medicines or restrictions on their importation.
- Implement the GMP road map, support access to foreign exchange to enable upgrading of firms to attain GMP certification and, if necessary, consider additional support measures or incentives for local pharma producers to invest in upgrading facilities, quality management systems etc. for this purpose.
- Introduce appropriate quality assurance systems at KIP during the zoning of the park for the production of various types of pharma products, conduct proper due diligence of foreign investors entering the park, and maintain mandatory GMP compliance of firms entering the park.
- Discuss with development partners such as UNICEF and the Global Fund the inclusion of local producers in their local drug procurement programmes for those local producers that attain GMP compliance and gain WHO pre-qualification.
- Equip the Ethiopian Pharmaceuticals and Medical Supplies Manufacturing Association (PMSMA; the pharma producers association) and the Chambers of Commerce to provide effective advocacy for local pharma firms and seek to represent and support all local pharma firms.

Medium term

- Strengthen early stages of the pharma value chain by designing appropriate measures to support local production of active pharmaceutical ingredients and excipients based on the feasibility of local production. This could include the financing of feasibility studies and tax credits for R&D in promising areas of local raw-material production.
- Design and implement a central system for the import of raw materials (active pharmaceutical ingredients and excipients) for local producers and ensure that the information management system required to make this effective is in place.
- Introduce a tax deduction for the training of staff to incentivize on-the-job training at pharma firms through discussion among MOTI and MOF.
- Introduce an R&D tax credit in specific R&D areas of high priority, including high-priority pharma products, to incentivize firm-level R&D in those areas.
- Monitor Kilinto Industrial Park for the development of domestic collaborative linkages and knowledge/technology flows as well as other more typical measures of performance often used with industrial parks.

D. Education and research

There are 11 universities in Ethiopia with schools of pharmacy, which are critical for supplying the technical human resources required for the pharma industry, but human resources for pharma R&D need to be strengthened. Without them it would not be possible to develop the industry. There was little information available on the enrolments, graduates and the quality of education and training offered at these universities, although several of them have a good reputation, based on interviews. There must be a minimum number of excellent schools of pharmacy in different regions, in particular in Addis Ababa and Mekelle, where most firms are located.

However, the education and training system is not adequately matching the skills supplied with the skills needed in the industry. The balance in training for pharma is too heavily concentrated on theoretical knowledge, with too little focus on practical skills. Important skills required are in short supply, especially industrial pharmacists and

pharmacy regulation, given that most university programmes focus on clinical pharmacy. This has created a high level of competition in Ethiopia for skilled personnel, leading to high turnover rates with skilled personnel (pharmacists, biologists, chemists and engineers) moving in reaction to even only slightly better salaries. The result is that institutional memory is lost and there is ongoing pressure to find replacement personnel, and to train new graduates on the job if experienced personnel are not available. This disrupts the industry with the constant movement of key personnel, mainly across firms and the regulatory bodies, but even including unrelated activities (other industries as well as non-manufacturing activities, such as joining a higher-paying NGO).

Ethiopia has made significant progress in research in areas related to pharma. In 2008 Ethiopia ranked seventy-third in the world in terms of pharmacology, toxicology and pharmaceuticals publications, rising to sixty-third in 2018. Ethiopia overtook Ghana and Kenya in terms of research publications and has made progress in narrowing the gap with Bangladesh (the out-of-region comparator that is the lead country in pharmaceuticals production among LDCs). Within the region, South Africa and Egypt are the strongest research performers in these subjects, ranked at sixteenth and thirty-third respectively in 2018. Ethiopia has also made substantial progress in pharmaceutical science research as a single category rising from a global rank of seventy-fifth in 2008 to sixty-fourth in 2018.³² Notable areas of research taking place include traditional medicine research at the Ethiopian Public Health Institute (EPHI) and Addis Ababa University. The university reported that some of their traditional medicine research has gone to the stage of clinical trials, but not progressed further than that at the time of writing. However, the research at universities reportedly focuses more on basic research, which is not expected to lead directly to innovation through the creation of IP or a new good or service. Universities with a school of pharmacy, such as Addis Ababa University and the Food, Beverage and Pharmaceuticals Industry Development Institute (FBPIDI) could collaborate more closely on R&D, taking advantage of the human resources and infrastructure for R&D available at the former to help overcome the current deficiencies at FBPIDI (discussed below).

There are several sources of financing for research, but they may be insufficient, and

recent changes in the structure of several ministries calls for greater coordination. RIFs are foreseen at all higher education institutions (including universities and higher education TVETs) in the Higher Education Proclamation No. 650/2009, which says that “every institution shall allocate sufficient funds particularly for research focusing on technology transfer and innovation”.³³ MOST (now MInT) also operated the National Research Fund (NRF). This may have moved to MOSHE with the move of science to the Ministry of Higher Education. The demarcation between the applied research to be financed by MInT and the research financed via the RIF under MOSHE requires a degree of collaboration between MInT and MOSHE on the question of how to split and how to coordinate R&D funding between the two ministries. The need for coordination between them is natural as under the reformed institutional framework, science and engineering fall under MOSHE while technology and innovation fall under MInT. It is not clear how effectively the demarcation of roles and responsibilities, and collaboration between the two, is being addressed. There are also annual prizes for the best innovators and the best research, but they do not include an award of funds. Analysts report that current financing for health and pharma R&D is inadequate and should be strengthened.

Collaborative linkages between universities and industries are weak and should be strengthened. There are few university–industry (i.e. local pharma firms) collaborative linkages at present. There are research institute–industry linkages through FBPIDI. However, they are related mainly to facilitation and to capacity-building, not R&D, as noted above. There is an apprenticeship programme that involves some higher education institutions (such as Addis Ababa University), but they are limited in number as firms reported that they do not wish to have many people on the production floor. Addis Ababa University reported that some of their students work at pharma firms and do research at the university. One firm reported linkages with the university’s postgraduate education programme where the students could access the firm’s laboratories. The firm, now privately owned, had previously been government-owned and had started the practice at that time. Addis Ababa University has established a technology transfer programme. Reportedly, each university has a technology transfer office. MOSHE reported that universities had transferred

technologies to communities across Ethiopia, but there was no M&E of their level of success. TVET linkages with firms (particularly SMEs) are in general stronger than those of universities, but TVET extension services offered to firms are reported to often (but not always) be weak, due to limitations with technical capacity in manufacturing activities.

An industry research institute has been established to support the development of the industry. FBPIDI and EPHI were established in 2014 under the Ministry of Industry (MOI). FBPIDI aims to support the development of the pharma and the food and beverages industries. Its mandate on pharma is to support pharma firms through R&D, training, technology transfer, consultancy and facilitating access to export markets. Other research institutes in related areas have also been established. EPHI is an autonomous research institute operating under MOH with the main goals of undertaking medical R&D, promoting medical technology transfer and the management of public health emergencies. They research both modern and traditional medicines, including vaccine research. They have so far developed one vaccine (for rabies). The other research areas have so far not been translated into actual production as the industry has not taken up the research. There also exists the Ethiopian Biotechnology Institute (EBTI), established in 2016 under MOST (now MInT) and the Armauer Hanssen Research Institute (AHRI), established in 1970.

However, research institutes face challenges that reduce their capacity to support the pharma industry. For example, FBPIDI is underfunded and understaffed, has no pharma research laboratories with the requisite equipment, faces large skills shortages and does no pharma R&D, which accentuates the weakness of the R&D subsystem. Salaries are reportedly low compared to many alternatives (for example, hospitals), making it difficult to attract or retain highly qualified staff. It provides mainly facilitation services (such as marketing facilitation and helping local firms to negotiate quotas with the Pharmaceuticals Fund and Supply Agency) and to get land and bank loans and providing training/capacity-building services for firms. FBPIDI is heavily dominated by its food and beverages activities, which account for approximately 75–80 per cent of all activities. Of its 24 directorates, 20 are on food and beverages, and four on pharma. Accordingly, the number of personnel working on pharma is small, which does not allow effective support for the pharma

industry. EPHI also faces various challenges with maintaining skilled people due to high turnover, a lack of accredited laboratories for research and an inefficient procurement and logistics system for obtaining the materials needed for medical research (such as chemicals and reagents).

Recommendations

The human capital base for the pharma industry is not strong enough, with scarce skills in key areas such as industrial pharmacists, chemists, biologists and regulatory science. Several universities provide relevant higher education, but not in all areas (e.g. industrial pharma and regulatory science) and not in large enough numbers. To build a strong pharma innovation system, firms should have strong collaborative linkages with the relevant universities and specialized research institutes (FBPIDI specifically, and EPHI, EBTI and AHRI to the extent that they work on pharma). FBPIDI requires significant strengthening to be able to provide the types of support that would help the industry to develop. International linkages also appear to be weakly developed with foreign universities and flows of skilled people from the diaspora.

Short term

- Identify the skill needs for the development of the pharma industry through closer collaboration between firms, selected universities acting as centres of excellence and key agencies such as MOH, EFDA, FBPIDI, MOSHE, MOE, MInT and EIC.
- Ensure adequate collaboration between MInT and MOSHE on the question of how to split and how to coordinate support related to R&D and science between the two ministries.

Medium term

- Incorporate required skills identified and on-the-job training as part of the curriculum at universities and TVETs in the area of pharma.
- Increase support to FBPIDI, in particular its pharma arm, to align its infrastructure, organization, human resources and budget with its mandates to enable it to meet them, and promote closer collaboration on R&D with relevant universities. Consider splitting FBPIDI into two institutes, with PIDI to support the pharma industry, and a separate institute, FBIDI, to support the food and beverages industry.

- Improve the state of data intelligence on the pharma industry and indicators for STI in the pharma industry.
- Ensure that appropriate support is provided to the development and commercialization of traditional medicines, local resources and indigenous knowledge in R&D and innovation plans.

E. Governance

1. Main actors and coordination

The governance of STI policy for the pharma innovation system involves a group of ministries and other bodies that are responsible for priority setting, policy and programme design and their implementation, as well as the coordination mechanisms established to achieve these. High-level priorities are set by the Prime Minister and the cabinet, acting through the National STI Council (NSTIC; a council of ministers) and the Development Planning Commission (DPC), and in collaboration with parliament. Policy and programme design are carried out by a core group of ministries (MOH, MOTI, MInT, MOSHE and MOE) and EIC. The core ministries with a direct STI policy and programme-design role for pharma are MInT, MOSHE, MOTI and MOH. EIC has a role in registering and monitoring technology transfer agreements (TTAs). MOH and MOTI are jointly the central stakeholders driving the main pharma industry strategy, NSPA-Pharma. These bodies jointly oversee the bulk of priority setting, policy and programme design and implementation of policies and programmes on pharma that include important STI policy elements. Table 12 shows a list of major government actors in the sectoral innovation system.

However, it is not clear what degree of collaboration exists across the core agencies at present. Some of the ministries, including MInT, MOSHE and MOTI, are new in their current form following the reform process that Ethiopia underwent during 2018. Coordination has been weak in the past, despite the existence of some coordination mechanisms. Effective collaboration across these diverse bodies is by nature a major challenge. They have different mandates and perspectives. For most of them, except MInT, and perhaps MOSHE, elements of STI are a small part of their mandate and their attention. The most likely

Table 12 Major government actors and instruments of the Ethiopian pharma innovation system

Ministry of Trade and Industry (MOTI)	MOTI gives support and direction to various sectoral Industry Development Institutes including FBPIDI (see below) and has a role in the enforcement of standards through market surveillance.
Federal Ministry of Health (MOH)	MOH is in charge of the health sector policy and programme design, which include elements of STI policy (for example, clinical research at hospitals, which is not covered in this study). It is also in charge of two key parts of the innovation system, the regulator EFDA and the public procurement agency EPSA.
Ethiopian Investment Commission (EIC)	EIC designs the rules relating to incentives for FDI by foreign pharma firms and negotiates with foreign firms entering KIP on the details on the import and export percentages of their local production. EIC has established a targeted campaign to encourage foreign generic producers that are already GMP compliant to begin producing in Ethiopia.
Ministry of Innovation and Technology (MInT)	MInT is directly in charge of the design of the national STI policy, and now oversees communication technologies following the 2018 reforms.
Ministry of Science and Higher Education (MOSHE)	MOSHE oversees science and engineering higher education and higher education institutions, which are central parts of the innovation system.
National Standards Organization (NSO) and subsidiary bodies for national quality infrastructure (NQI)	NSO, through its four subsidiary bodies (ESA, NMI, Ethiopian Conformity Assessment Center and EAO), is the main organization responsible for overseeing the NQI for all manufacturing industries, including pharma.
Development Bank of Ethiopia (DBE)	DBE is an important source of financing for industries of high development priority, such as pharma.
Ethiopian Food and Drug Administration (EFDA)	EFDA (previously EFMHACA) is responsible for the regulation of preclinical and clinical trials; ensuring medical product safety, quality and efficacy; and the licensing and control of the distribution of medical products including imported and exported products. Its role is changing. Proclamation 11/12.2019 was passed in early February 2019 to reflect a new focus on the regulation of food and drug products, with EFMHACA converting into EFDA. EFDA issues market approval for medical products to be made available in the Ethiopian market. This includes testing of all drug imports to verify that they meet local quality standards. They also certify that local pharma producers meet GMP standards, that their products are allowed in the market, and that they can bid on public tenders made by EPSA.
Ethiopian Pharmaceutical Supply Agency (EPSA)	EPSA (previously PFSA, the Pharmaceuticals Fund and Supply Agency) is the public procurement agency for local and international pharmaceuticals for the public-sector health system (public hospitals, health facilities and pharmacies) in Ethiopia. It operates a main office in Addis Ababa and 17 regional offices throughout the country. It operates mainly through international and local tenders to supply medicines, funded by a Revolving Drug Fund and donor programmes.
Food, Beverage and Pharmaceuticals Industry Development Institute (FBPIDI)	FBPIDI was established in 2014 under MOTI to support the development of the food and beverages and pharma industries. Its mandate is to support firms operating in the two industries through R&D, training, technology transfer, consultancy and facilitating access to export markets.

Regional Bioequivalence Center (RBEC)

The RBEC was established in 2012 to carry out bioequivalence tests for Ethiopia and several countries in the East Africa region. Once fully functioning, it will facilitate the development of LPP in Ethiopia and Africa more broadly by providing reasonably priced bioequivalence services for African producers.

Ethiopian Intellectual Property Office (EIPO)

EIPO is responsible for IP regulation in Ethiopia. It grants patents for pharma products for 15 years, with the possibility of extension for five years. Based on FDRE (1996), they also grant a “patent of introduction” valid for 10 years, which can be issued to protect an invention that has been patented abroad but not in Ethiopia, in cases where that patent has not expired (UNCTAD, 2011).

Source: UNCTAD.

mechanism to bring effective coordination may be the JSC, technical committee and working groups mechanism that falls under the NSPA-Pharma governance structure. It represents a promising structure for the core agencies to govern the policies and programmes related to STI and closely related policy domains for promoting LPP.

2. Regulatory function

The regulator, EFDA, is strengthening regulatory capacity and taking action to reduce the backlog in drug registrations.

EFDA plays a critical role in regulating medicines to ensure their safety, quality and efficacy. There has been a backlog in drug registration. This was due to capacity constraints resulting from high staff turnover, understaffing and shortage of skilled pharmacists and biologists, the existence of only one certified calibration centre available to EFDA (which does not include all pharma industry calibration services) and the need for a better database and system for key information on the pharma industry. EFDA is taking action to address the challenges they face. It is strengthening internal systems for drug regulation, installing an electronic registration system for drugs, has developed a new drug registration strategy, and is creating a pool of drug assessors to clear the registration backlog. Their actions to strengthen their regulatory capacity should benefit the industry and the whole health system.

There has been a considerable effort in resolving the issue of achieving full cGMP compliance in the industry. EFDA has collaborated closely with WHO, UNIDO, USP/PQM and USAID who have supported this effort. There were evaluations of firms for cGMP compliance in 2013 and again in 2016. Each of

the nine local producers not yet complying fully with cGMP have presented Corrective Action and Preventive Action (CAPA) plans, and the regulator is discussing with them their upgrading plans. EFDA has also gradually built its GMP audit capacity as one of its areas of upgrading. It is also collaborating with EIC to provide an evaluation of the production facility plans of any new foreign firms entering Ethiopia to minimize GMP issues emanating from physical premises.

3. Public procurement

Public procurement of medicines, a role of the EPSA, increases access to reasonably priced and quality-assured drugs. Drug prices in public pharmacies are about half the price of private pharmacies. There is no comprehensive health insurance system coverage of pharmaceuticals yet in Ethiopia, so consumers without insurance coverage pay heavily for drugs. The Government has been working on building the health insurance system in the past decade. As an LDC, with a low per capita income level, many consumers are not able to afford expensive medicines and per capita health expenditure is low. EPSA has developed a list of 124 pharmaceuticals and medical supplies produced in Ethiopia (Gebre-Mariam et al., 2016) and buys about 400 medical items from a standard items list (which is readily available) that was created in 2018. EFDA is responsible for providing suppliers lists to EPSA, which can only procure from local producers on the suppliers list – those able to meet the standards imposed by EFDA.

Public procurement also provides critical support for local producers by providing a stable source of demand. EPSA procures about 15 per cent of its drugs from local producers. For some local producers, EPSA is a major client, and therefore

plays an extremely important role in promoting LPP.³⁴ EPSA operates a price premium of up to 25 per cent for local producers and prepayment of 30 per cent of the tender value to local producers that win an EPSA tender. The premium was originally 15 per cent, then raised to 20 per cent (UNCTAD, 2011) and is now 25 per cent. This type of advance payment is a powerful incentive for local production. However, even with the 25 per cent premium, some local firms are reported to be barely competitive in tenders. This is due to the high cost of local production that results from challenges that arise from different parts of the innovation system for pharma, as discussed in this Review.

EPSA faces challenges with supply chain management of the inflows and outflows of drugs. Meeting demand without incurring large unused stocks that expire requires excellent forecasting of demand and supply. Currently, there is a high level of expired drugs due to deficient capacity in forecasting demand and supply and tracking supplies across the 18 EPSA offices.

4. Quality infrastructure

A well-functioning national quality infrastructure (NQI) is critical for enabling the expansion of local pharma manufacturing in Ethiopia. Pharma is a highly regulated industry due to the need for safe and effective health products. Meeting standards is central to the functioning of the industry. The NQI must provide standards, testing, certification and accreditation systems, and calibration and maintenance services for measurement machinery and equipment.

Currently, EFDA has led the development of pharma standards and their enforcement. The regulatory infrastructure for the NQI includes MOTI under its enforcement mechanisms and structures for enforcing standards, and various line ministries responsible for enforcement in areas under their mandate. For pharma, MOH and EFDA enforce regulations for health, and pharma and food, respectively. EFDA also has led the development of pharma standards, given its expertise in pharma and the lack of it at ESA. The national pharma standard in Ethiopia is GMP as outlined by WHO, which must be met by local pharma firms. Smooth collaboration between ESA and EFDA may be a challenge, and ESA has reported that the two agencies will be establishing a memorandum of understanding (MOU) with MOH to address coordination between them.

There are inadequate testing laboratories and skills shortages for testing and maintenance of machinery and equipment. The personnel providing these services for the pharma industry require specialized training that is scarce in Ethiopia. The laboratories also face foreign exchange shortages in importing materials needed to undertake the tests (such as chemicals not locally produced). There are also relatively few laboratories accredited internationally, so testing of exports often must be done by importing countries. Whenever NMI is not able to provide some calibration services that they require, firms need to find qualified firms abroad and get foreign exchange to cover payment for the service. Thus, testing products is difficult and expensive.

However, Ethiopia hosts a RBEC, which should provide support for local pharma production and help to develop a dynamic pharma sector in the medium and long-term.³⁵ Bioequivalence studies are required to show the bioequivalence of a generic drug with the originator's drug. Such studies are required for imported pharma products, but not yet for locally produced ones. These studies are expensive for SMEs to undertake, especially when the service is only available abroad and requires foreign exchange. The RBEC can provide these services locally at a reasonable cost once it becomes fully operational. The RBEC in Ethiopia is the third in Africa after South Africa and Egypt. It was established as a small facility with minimum capacity and is therefore not yet completely functional. By providing bioequivalence services to other African countries, it would play a role in supporting the development of local pharma production in Africa as well as Ethiopia.

5. Domestic finance and foreign exchange

Inadequate access to affordable local financing results in inadequate investment in plant, machinery and equipment and training by some pharma firms in Ethiopia. The financial system does not provide adequate financing for pharma firms despite the high-priority status of the industry. The Ethiopian financial system is at a relatively early stage of development. Commercial banks are generally risk-averse and unwilling to lend for technology or new innovative projects. Innovation entails high risks, and specialized instruments for financing are generally required, such as technology and innovation funds, development banks and venture capital. Venture capital plays a particularly

special role in pharma in many countries with strong local pharma production, but there is no venture capital market in Ethiopia (UNCTAD, 2011). Foreign investment in the financial system is not allowed, and the sector remains heavily regulated. The need for strong and effective financial regulation in Ethiopia, as elsewhere, is beyond question. At the same time, alternative sources of financing for technology and innovation are badly needed for the local pharma production to succeed.

DBE is one important source of long-term financing for high-priority development areas and has played a significant role in the financing of pharma firms. For pharma, DBE offers financing of up to 70 per cent of the capital investment for new investments or expansion projects at an interest rate of 7.5 per cent and long repayment periods that depend on the project's cash flow projections. This support is critical for the industry and should be continued. The loan portfolio to pharma is not currently large. According to DBE, there were four major loans to local pharma producers in recent years. One was foreclosed due to non-repayment resulting from particular circumstances (the firm was later liquidated and bought by another producer), but the others presented no repayment problems. Reportedly DBE enforces strong collateral requirements which reduce the use of their loans in pharma. This is not a simple issue. DBE may not have the in-house expertise to evaluate pharma development projects, which was the case in 2011 (UNCTAD, 2011). This may be a reason for relying on collateral requirements. DBE has in recent years recorded a high level of NPL and must continue to support high-priority activities but at the same time monitor its level of NPL and preserve its long-term financial sustainability.

When there is financing, converting local currency to foreign currency to pay for imports becomes a constraint. The severity of foreign exchange scarcity reportedly increased from late 2016 through to late 2018, when waiting periods for receiving an allocation rose and the size of quotas fell for many firms. The level of scarcity reportedly dropped during late 2018 with higher net inflows of foreign exchange into Ethiopia. The quota system for the allocation of foreign exchange established by NBE benefits exporters. However, there are few exporting pharma firms apart from Sino-Ethiopia (Africa) Associates Private Limited Company, which exports EHGCs to several African countries. Pharma manufacturing has a high priority for allocations, but all pharma producers must still compete with other

high-priority manufacturing industries for foreign exchange allocations.

Pharma firms (as well as many public agencies) all reported foreign exchange scarcity as a key obstacle to increasing production and levels of capacity utilization. One firm reported that the short period allowed to use the foreign exchange after an allocation is granted (15 days) made planning difficult as orders had to be placed very quickly once an allocation was provided. One firm reported that they were unable to upgrade to meet GMP standards by end 2018 as outlined in the GMP road map because of a lack of foreign exchange needed to buy imports needed to build a new production facility and the required machinery and equipment that would make them GMP compliant. Two firms reported that in 2017 half or more of the production lines for pharma were closed because they were not able to access foreign exchange to import the raw-material inputs needed for production. They also focused more on products that require less foreign exchange to produce. Waiting periods of three months or more to acquire an allocation of foreign exchange became frequent, strongly complicating business planning. Foreign exchange is a structural challenge but must not be allowed to undermine the attainment of upgrading in high-priority manufacturing activities such as pharma.

Recommendations

Effective collaboration across relevant bodies is essential for building a highly innovative pharma industry with firms and networks that are constantly upgrading their production operations based on engineering and R&D, and through technological learning and the introduction of new technologies. This includes collaboration at the policy design as well as the implementation stages of the policy process for STI policy as it cuts across ministries, departments and agencies. Implementation is a major issue with policy in Ethiopia and should be addressed. The JSC of NSPA-Pharma needs to be an active body, bringing together high-level policymaking representatives. It would need to create real collaboration, not just reporting on activities or agreeing on an annual plan for the next year. In order to be effective, a plan of action for coming years should be developed, incorporating an M&E mechanism.

The support system for pharma is improving. This progress should continue at an accelerated pace. EFDA is going through a process of reform

and strengthening. EPSA faces challenges with the procurement system that should be resolved. Strengthening the system and offering support measures are necessary to make local production more efficient and encourage a dynamic local pharma production system that becomes more competitive over time. FBPIDI is not currently fit to meet its mandate and should be split to produce a dedicated pharma research institute, which needs substantial strengthening. RBEC is not fully functional and likewise needs to be upgraded through additional investment if local producers are expected to build their capacity to penetrate export markets as well as to produce for the local market.

The lack of effective implementation of standards, including mandatory standards, partly due to capacity-building constraints and partly from a lack of awareness of firms in general (not pharma specifically), is a key constraint to improving the quality of products in Ethiopia. The NQI (including standards, testing, certification and accreditation) is not adequate. The NQI plan and NQI strategy must address the various deficiencies.

The financing support system remains deficient. The ability of DBE to increase its level of support to pharma firms requires careful consideration. Access to foreign exchange is essential for the industry to function, like other highly import-dependent manufacturing industries. The foreign exchange constraint is particularly crippling for the industry but is not easy to address. The imbalance between fast-growing imports and slow-growing exports creates a structural, systemic challenge with no simple solution.

In light of these challenges, the Government could consider the following recommendations:

Short term

- Establish effective coordination among the ministries, departments and agencies key to the functioning of policy planning and implementation in the pharma innovation system (MOH, MOTI, MInT, MOSHE and EIC).
- Introduce additional measures to support local producers with access to finance on a timely basis by improving the operation of granting of commercial bank letters of credit and approvals from NBE.
- Evaluate options for allocating foreign exchange on a priority basis for local pharma producers who meet cGMP.

Medium term

- Improve implementation by strengthening the implementation capacity of important actors in the system – FBPIDI, EFDA, EPSA, NSO, DBE – and address the high turnover of technical professional personnel, and policy personnel, by improving the supply of skills in relevant areas.
- Establish an electronic procurement system for EPSA, which would improve the functioning of the whole procurement system. Also, invest in a functioning automated forecasting tool.
- Continue strengthening the national regulatory system for pharma. In particular, continue ongoing reforms at EFDA to strengthen further its capacity through continued capacity-building on pharma regulation. EFDA could gradually transfer some of its capacity-building for firms to the new PIDI as and when the latter is strengthened to provide capacity-building.
- Strengthen RBEC in terms of physical infrastructure, machinery and equipment and general resource base to make it fully operational, and make bioequivalence studies a requirement for those local pharma products that need the establishment of bioequivalence.
- Leverage the IPR transition periods provided to LDCs under the WTO by implementing appropriate amendments to the patent regulations on pharma products to enable local generic production of essential drugs under patent, and allow firms to accelerate technological learning and build stronger capabilities through reverse engineering.
- Lay the groundwork for establishing a regulatory framework to allow venture capital and begin promoting the development of a local venture capital industry. Consider establishing public venture capital firms in the future, to facilitate the gradual development of private venture capital over time.
- Encourage investments by foreign venture capital funds.
- Enable DBE to lend to pharma firms as a high-priority sector, subject to appropriate due diligence and loan criteria, and within its mandate and ability.

VII. Effective governance of the National Innovation System

A. Policy coherence and policy coordination at all levels

The “best practice” STI policy formulation and implementation commonly found in successful countries operate through coordination at three levels: (1) **the top leadership**: providing clearly defined vision and strategic direction; (2) **ministerial-level executive body**: providing policy direction, strategic road map and policy coherence across ministries and public institutions; and (3) **a lead ministry**: enabling coordinated execution of policies and strategies. In many developing countries, lack of policy coordination is one of the pressing challenges of governance and a major impediment to effective implementation of STI policies. Coordination here is defined as the process of reconciling and streamlining diverse policies and interests to achieve agreed common goals (Saner, 2010). Ethiopia needs to design a governance structure that coordinates policy formulation and implementation at all three levels.

The role of the top leadership³⁶ is to determine the national STI vision and the strategic direction and to mobilize and inspire the nation in pursuit of common technology and innovation policies. Strong and credible leadership is a necessary engine for the formulation and translation of the national STI vision into actual strategies and policies.

However, such a leadership and power base have positive impacts only if supported by an equally powerful executive (at ministerial level) policy coordinating and implementing body. Here is where NSTIC, chaired by the top leadership, becomes an indispensable STI governance tool at the national level as shown from the experiences of many successful economies. The bottom line is that without oversight, guidance, policy direction and coordination at the executive (or ministerial) level, it is difficult to imagine how an NIS, which by its nature involves inter-firm and cross-sectoral interactions, could be successfully implemented.

In an ideal scenario and as experienced in successful countries, the top leadership, NSTIC and the lead sectoral ministries have distinct but highly complementary roles and responsibilities. The harmony with which each of these governance structures manages its specific responsibilities and complementary roles determines the success or failure of the NIS. Typically, the main functions and responsibilities of NSTIC should include the following:

- 1 translate the national technology and innovation vision into concrete policies and actions lines and provide policy direction;
- 2 harmonize and animate the content and direction of national and sectoral innovation systems;
- 3 monitor the regulations and incentives that govern technology transfer and technological learning, ensuring that they are compatible with national development priorities and that adjustments in regulations and incentives are not conflictual or detrimental to the effective functioning of the NIS;
- 4 provide oversight and guidance to the development of technological and innovative capabilities and the Government’s own capabilities to implement STI policies;
- 5 ensure that major economic activities across sectors, including mega national projects, contribute to technological learning innovation through backward and knowledge linkages;
- 6 create a mechanism for proactive and regular consultation with the private sector on issues related to technology transfer, technological learning, skill formation and innovation; and
- 7 manage potential conflicts between different public institutions, in particular the sectoral support institutions, over mandates related to technology transfer and technological capability-building.

Thus, NSTIC is the venue where the Government as a whole shapes and coordinates the main lines of STI policy to promote successful technology transfer and local technological learning and to ensure that domestic enterprises accumulate the capability to assimilate new technologies and innovate. In effect, therefore, NSTIC – consisting of key ministries and other actors – serves as the

highest governance body where interministerial and inter-agency coordination and oversight can be ensured in pursuit of local technological learning and innovation capability-building.

Two distinctive features of the NSTIC model in successful countries that Ethiopia should emulate are worth highlighting.

(1) On technology and innovation-related issues, the Council must have an authority and influence above all other ministries, and it should be empowered to monitor the integration of STI policies into sectoral policies and the contribution of ministries and public institutions towards the implementation of the national STI policies. It should also have the authority to review progress and apply discipline if ministries and public agencies are failing to meet the expected outcomes. (2) NSTIC should be serviced by a special secretariat dedicated to providing the Council with analytical support and setting the agenda needed for its deliberation. The secretariat could be established within the lead ministry (MInT) and should be staffed with competent and experienced technocrats who understand the interactive nature of the NIS. The functions and responsibilities of the secretariat should include interacting regularly and proactively with sectoral ministries, public institutions and the representatives of the private sector and labour to gather information on progress in the implementation of STI policies and the gaps and constraints that should be brought to the attention of the Council. In addition to setting the agenda of the Council, the secretariat would act as a think tank, repository of knowledge and institutional memory, and ensure that the Council members are well informed of progress in the implementation of STI policies. This way, the Council becomes a genuine ministerial-level governance body rather than the regular Interministerial Council where ministers meet to engage in “tour-de-table” discussions, review progress in the implementation of major projects and, predictably, defend the work of their ministries and fight for additional resources.

Does Ethiopia have a governance structure that corresponds to those found in successful economies?

The answer to this question is both yes and no. On the positive side, Ethiopia has a development-focused leadership that places innovation and technological development at the top of the national development agenda.³⁷ It also has a ministerial-level council (the National Science, Technology and Innovation Council

– NSTIC), which was established in 2014 to oversee the implementation of STI-related activities incorporated within the current five-year plan (GTP II). The membership involves some ministers responsible for sectoral ministries. In this respect, the Ethiopian NSTIC meets some of the features of NSTICs that are typically found in successful countries. Finally, Ethiopia has a lead ministry (MInT, formerly MOST), which has been restructured recently to give it an innovation-focused mandate. One of the most important reforms has been the establishment of the Technology Information Center (TIC), which enhanced greatly the collection and dissemination of STI-related information.

However, whether the structure functions in harmony and as a coordinating body giving policy direction and a strategic road map is not clear.

The overall mandate of the Ethiopian NSTIC is narrow and limited to reviewing budgets for implementation of STI-related activities. It is not clear, moreover, on what basis the composition of the membership of the Council is decided. Furthermore, the Council does not seem to meet regularly. In nearly six years of existence, it has met only eight times. The records of its last meeting, held in July 2017, indicate that one of the major agenda items of the eighth session was discussing the working modality of the Council and defining its role and areas of responsibility (MOST, 2017b). The fact that the Council was discussing its mode of operation during its eighth session and after more than three years of existence suggests that the Council is still at an early stage of formation and unclear about its role. Another agenda item of the eighth session that consumed a large part of the Council's time was the review of a report by the secretariat of the Council – the then Ministry of Science and Technology – on STI-related activities undertaken in the country between 2013 and 2016. The Council also reviewed the budgetary implications of proposed plans on STI-related activities for 2017 and the three-year proposed plans covering the period 2017–2020, including the ongoing university-level reforms and plans for skill formation. Thus, it is axiomatic that the primary role of the Council is not the coordination of intersectoral and cross-cutting STI-related issues and activities – thereby preventing multiplicity of roles and responsibilities between different sectoral ministries and public institutions – but reviewing of budget allocations and discussing broad STI-related issues.

B. Ensuring accountability and follow-up

The effectiveness of STI governance depends on the strength of the institutional support that NSTIC receives, and the extent to which accountability is maintained and monitoring and evaluation are conducted regularly to ensure effective coordination and implementation of STI policies. STI is an issue that cuts across sectors and the responsibilities of many institutions, both public and private. In this situation, good governance requires clarity over who does what, how and when to deliver services, and that the respective responsibilities are communicated to stakeholders within the system. Clarity about accountability and roles helps actors in the NIS to understand how the governance system works and who is accountable for what and to whom. For Ethiopia, these basic but critical governance issues will become even more important as the economy expands and deepens its level of sophistication and begins to implement new and more ambitious strategies.

In best practice countries, the core responsibility of formulating STI policies, monitoring and evaluating the implementation and providing support to NSTIC lies on the lead ministry for STI policies. In Ethiopia, MInT occupies that position as the main government entity responsible for the formulation and implementation of STI policies. Building a dedicated, technically competent and professional staff is an essential prerequisite for creating a lead ministry that excels in its functions and contributes to the strengthening of the NIS.

Ultimately, government ministries are only as good as the people in them and the organizational culture and setting in which they work. Thus, policies that allow lead ministries such as MInT to recruit and retain “the brightest and the best” will help achieve the maximum excellence in STI policy design and implementation. Similarly, acquiring the culture and capacity for policy learning is an essential requirement for a lead ministry whose primary responsibility is to design and implement policies. Equally important is the establishment of mechanisms that allow the flow of information between the lead ministry and other ministries or public institutions. NSTIC will enforce such interactions, but a lead ministry should also be encouraged to ensure regular communication and collaboration. Another key function of the lead ministry is to ensure regular consultations with the

private sector, in particular with enterprises that are engaged in innovation. In addition, the lead ministry should establish an evaluation mechanism to identify weaknesses in the implementation of policies, find solutions and improve on performance as the learning process advances.

C. Governance of sectoral innovation systems

This section discusses the effective governance at the national level of sectoral innovation systems, based on the case studies presented in Chapters V (textiles and garments) and VI (pharmaceuticals). The section discusses how policy coherence and coordination could be ensured for strengthening the technological learning and innovation in existing sectors as well as how governance could ensure continual policy learning to support potential new sectors as the economy diversifies and upgrades.

1. Lessons from the textile and apparel case study

The case study on the sectoral innovation system of the textile and apparel industry shows that poor coordination and institutional quality is a critical challenge. There are no dedicated institutional organs that coordinate innovation and technological learning in these sectors. MInT is not active in traditional sectors such as textiles and apparel, while MOTI and EIC are more concerned with attracting FDI and overseeing production and export performance. The sectoral development institutes (ETIDI, Ethiopia Leather Industry Development Institute (ELIDI) and all others) which are assigned to lead the capacity-building of enterprises, including technology transfer, have been focusing mainly on investment facilitation.

There needs to be close coordination between MInT, MOTI and particularly the sector development institutes (ETIDI, ELIDI and others). This report proposes that ETIDI (and other development institutes) be the focal point for coordinating the efforts to integrate the STI policy with the broader industrial policy objectives in their respective sectors. These institutes can also play a significant role in strengthening the link between foreign firms and domestic linkages, thus enhancing the technology and knowledge transfer. This requires the enhancement of the capacity of sectoral institutes in terms of staff, equipment and

other resources. It also requires a change in the business model of these institutes from a mere civil service to a semi-autonomous type of institute that generates revenue to deliver quality services to the private sector and sufficiently compensates and retains its technical staff.

2. Lessons from the pharma case study

The case study on the sectoral innovation system of the pharma sector shows that the specific institutions required for a dynamic industry mean that a substantial degree of policy implementation (and perhaps design) must be able to draw on the expertise of sectoral institutions. There must be sectoral bodies that ensure effective coordination within the sector. Currently, intrasectoral coordination is achievable by ensuring that the JSC of the NPSA-pharma strategy operates effectively.

For effective governance, the sector level bodies must also coordinate with national level STI governance bodies, in particular, NSTIC and MInT as the lead agency on STI policy. There must therefore be smooth coordination between the JSC acting as the de facto current sectoral governance mechanism, which should incorporate an M&E mechanism for implementation of the NSPA-Pharma strategy to strengthen accountability, and NSTIC along with MInT, which should have a role in monitoring the implementation of STI strategies and programmes more broadly, but may not have a high level of sector-specific knowledge and expertise. The need for NSTIC and MInT to rely on sectoral bodies for knowledge and expertise while also fulfilling a broad monitoring and evaluation role will apply for all knowledge-

intensive sectors that are highly regulated by an industry regulatory authority.

The highly regulated nature of the sector means that meeting quality standards is critical and requires national and sectoral coordination.

There must be smooth coordination of roles and responsibilities for standards between the national standards bodies and the sectoral industry regulator for pharma (EFDA). The potential for standards to force upgrading applies more generally to highly regulated sectors with high standards, particularly those involving high levels of knowledge intensity and relatively complex technologies.

Recommendations

Short term

- Define clearly the overall mandate of the Ethiopian NSTIC to play its strategic role for fostering innovation in the country, coordinating intersectoral and cross-cutting STI-related issues and activities.
- Ensure that the composition of the membership of the Ethiopian NSTIC reflects the key stakeholders of the Ethiopian NIS. Ensure that the Council meets regularly.

Medium term

- In implementing the new STI policy, identify an STI governance modality which is pragmatic in shaping institutional mechanisms for policy coordination; strategic in encouraging interactions between key actors in the NIS; and development focused but aligned with the priorities of the national development strategy. In doing so, potential lessons from best practice countries should be given greater attention.

Notes

- ¹⁶ Weaving is a method or process of interlacing two yarns of similar materials so that they cross each other at right angles to produce woven fabric. Knitting is a method of constructing fabric by interlocking series of loops of one or more yarns.
- ¹⁷ Source: <http://ethemb.se/wp-content/uploads/2013/07/Cotton-Production-Ginning-in-Ethiopia.pdf>
- ¹⁸ Source: www.indexmundi.com/agriculture/?commodity=cotton&graph=yield
- ¹⁹ This is the finding of a recent collaborative research project initiated by University College London (UCL), the Ethiopian Development Research Institute (EDRI), the University of Reading and Quantum Global Research Lab (Switzerland) that examined innovation systems and activities in the cement, leather and textiles sectors in Ethiopia. A field survey was conducted in the three sectors. In the textiles sector, all integrated textile facilities were included in the survey, as well as a sample of garment manufacturers. The survey questionnaires asked firms about the extent of product and process innovations undertaken in the preceding three years (2013–2015). The main results are presented in Wakeford et al., 2017.
- ²⁰ The companies possessed by the DBE include Ayka Addis, Else Addis, ETUR Textile, Angles Textile, MNS, Adam Textile and Arbaminch Textile.
- ²¹ *Addis Fortune*, a local weekly newspaper, has an interesting article on this: “The Turkish Dilemma” by Fasika Tadesse in *Addis Fortune*, 16 February 2019. Source: <https://addisfortune.news/the-turkish-dilemma/>
- ²² The pharma industry includes the production of final medicines and formulations, active pharma ingredients, excipients, medical supplies and pharma packaging.
- ²³ Pharma is classified as high-tech, although the generic segment of the industry is less complex than originator drugs and requires a lower level of R&D and capabilities.
- ²⁴ This belief is borne out by the experience of diverse cases from many countries. It is also borne out in pharma in Ethiopia by the case of Sino-Ethiopia (Africa) Associates Private Limited Company in the production of empty hard gelatin capsules; see UNCTAD, 2011.
- ²⁵ Also relevant is the National Drug Policy of 1993.
- ²⁶ The African Union Commission collaborated with international agencies including WHO and UNIDO to establish the Pharmaceutical Manufacturing Plan for Africa (PMPA) and the business plan for the accelerated implementation of the PMPA (PMPA-BP) for building pharmaceutical production capacity in Africa as a part of strengthening health systems in the continent. Ethiopia is one of the early countries to translate the regional-level PMPA into a national plan for local pharma production as a high national priority.
- ²⁷ The strategy was developed through the collaboration of MOH and MOI with input from various other national agencies, and support from WHO. Updated in 2018, the strategy comprises 10 strategic objectives and a five-year action plan covering 2015–2020 with activities, outputs, key performance indicators and target years. The strategy was updated following a review of the pharma industry by EIC that met approval by the Ethiopian Investment Board (EIB). EIB oversees EIC and is chaired by the Prime Minister.
- ²⁸ LDC members of the WTO are not obliged to observe product patents and the protection of undisclosed pharmaceutical test data until 2033 (or they cease to be an LDC). Many of the LDCs that acceded to the WTO recently were provided with the full benefit of the flexibilities provided for existing LDC WTO members.
- ²⁹ Based on information from the Food, Beverage and Pharmaceuticals Industry Development Institute.
- ³⁰ The Ethiopian Food, Medicine, Health Care Administration and Control Authority (EFMHACA) collaborated also with WHO and United States Pharmacopeia/Promoting the Quality of Medicines (USP/PQM) in preparing the GMP road maps.
- ³¹ EFDA is responsible for issuing market authorization certificates for imported drugs, and testing them for conformity with national standards.
- ³² Scimago database. Available at: www.scimagojr.com, accessed 24 July 2019.
- ³³ Based on data from section 25.2. Available at: <https://planipolis.iiep.unesco.org/en/2009/proclamation-no-6502009-higher-education-proclamation-5519>
- ³⁴ Data on the sales of pharma firms to the private market versus EPSA was not available to make an authoritative estimate possible.
- ³⁵ Bioequivalence studies are not required for drug approval in Ethiopia.
- ³⁶ In some cases, the top leadership involves a strong, charismatic and visionary leader who inspires and mobilizes key stakeholders in the country to work towards a common national mission. The experiences of countries such as Malaysia, Singapore and to some extent the Republic of Korea fall into this category. In other cases, it involves a development-oriented ruling party in government, the so-called developmental States, for example, China, Mauritius, Thailand etc. (Ohno, 2011).
- ³⁷ The fact that the current Prime Minister of Ethiopia, HE Dr. Abiy Ahmed, was a former Minister of Science and Technology (MOST) and that he has expressed on several occasions his own conviction on the importance of developing an innovative culture and technological leap-frogging means that the top leadership in the country is able to provide the vision and strategic direction necessary to move the STI agenda forward. When the Prime Minister met “Sophia”, the humanoid robot, which has been programmed by young Ethiopians to speak Amharic, he declared that “Ethiopia will increase support to nurture an innovation eco-system and create opportunities for our best and brightest”.



Summary of the recommendations

On paper, Ethiopia has most of the policies, regulations, background studies and road maps necessary to kick-start a successful process of technological learning, innovation and technological upgrading. However, there is a serious implementation gap across public institutions either because of capacity constraints or misallocation of efforts and resources. Ethiopia also needs to build its productive capacities to add value, produce a wide range of products, diversify the economy and generate income.

This STIP Review provides a detailed set of recommendations to address these key issues. The following list consolidates and summarizes these recommendations:

Governance

1. Strengthen and increase the effectiveness of the Ethiopian National Science, Technology and Innovation Council (NSTIC) by:
 - (a) defining clearly the overall mandate and authority of the Council and enhancing its strategic role in fostering technological learning and innovation in the country, coordinating intersectoral and cross-cutting STI-related issues and activities;
 - (b) ensuring that the composition of the membership of NSTIC reflects the key stakeholders of the Ethiopian National Innovation System;
 - (c) ensuring that the Council is serviced by a dedicated secretariat to be established within MInT; and
 - (d) ensuring that the Council meets regularly and conducts regular monitoring and evaluation of progress in the implementation of STI policies.

Policy coherence

2. Ensure that the next five-year plan highlights and integrates the shift in policy focus from technology transfer to technological learning and innovation.
3. Create a joint MInT, MOTI and EIC committee to coordinate the alignment and integration of the STI policy with the broader industrial policy objectives and identify necessary policy instruments and incentives to engage the private sector.

Sectoral institutions

4. Ensure that sectoral support institutions are provided with adequate resources, including skilled personnel and the right types of equipment and machinery needed to support enterprises in technology transfer, technological learning and innovation.
5. Assess, in close cooperation with representatives of the private sector, the range of technical support provided by the sectoral support institutions and ensure that they meet the technical needs of local enterprises.
6. Sectoral support institutions should monitor technological learning and upgrading by enterprises and at the sector level.

Technology transfer

7. In view of the importance of imported technologies as sources of technological learning and innovation in Ethiopia, monitor technology flows into the country by strengthening the capacity of EIC and MInT to screen and track the types of technologies entering the country, and their applications.
8. Encourage greater cooperation among R&D institutions and between these institutions and local enterprises, which are essential requirements for enhancing the effectiveness of the National Innovation System.
9. While FDI can be an important channel of technology transfer, the link between FDI-related technology transfer and technological learning and upgrading in the domestic economy is not as automatic as is often assumed. Therefore, incentives towards FDI should be designed cautiously and incorporate provisions on the role of FDI in technology transfer and knowledge linkages.
10. Establish within MInT support programmes that provide extension services on innovation and productivity improvements to targeted SMEs. Such services could also provide information on new technologies, and how to adopt them, in order to increase productivity and competitiveness.

Innovation

11. Develop a strategy to keep up with new technologies, particularly digital technologies, and at the same time, build a strategy for

deepening the knowledge base in agriculture and manufacturing, applying innovations that have already transformed economies elsewhere.

- 12 Introduce tax incentives for innovations and technological upgrading that take place through inter-firm collaboration and introduce new products and/or processes that contribute to productive capacity-building.

Capacity-building

- 13 Improve policy implementation by strengthening implementation capacity in essential institutions in the system, and address the high turnover of technical professional personnel, and policy personnel, by improving the supply of skills in relevant areas.

Sectoral innovation system

- 14 Replicate in other priority sectors the “intensity of learning” applied to develop the successful and internationally competitive floriculture industry of Ethiopia, by supporting technological development in local enterprises and the strengthening of the National Innovation System.
- 15 Design new incentive schemes to encourage investment in the subsectors of the value chain, including by extending incentives for indirect exporters of priority sectors.
- 16 Increase the productivity of primary sectors that are in the upstream of the value chains of priority export sectors.

Education

- 17 Focus on raising the quality of education, on practical training and soft skill development, and in assessing the right balance between the training of highly skilled specialists that a modern industrial sector needs (which is costly, often concentrated in a few disciplines such as science and engineering) and training at the technical and school level (which are essential and if absent, reduces the overall capacity of the National Innovation System to stimulate technological learning across sectors).
- 18 Review the current apprenticeship programme and explore incentive schemes such as tax breaks for enterprises accepting and training apprentices.
- 19 Sectoral research institutions should design programmes that enable university and TVET

lecturers to spend time in companies observing production-level technical activities.

- 20 Identify the skill needs for the development of the priority industry through closer collaboration between firms, selected universities acting as centres of excellence and key agencies. Use this exercise to identify the disciplines that should be further developed at secondary and tertiary levels, and to plan for programmes at specific universities and other education and training institutions.

Quality infrastructure

- 21 At a national level, improve through targeted public expenditure and fiscal incentives, the quality of the physical and human capital infrastructure, including by establishing laboratories for testing and quality control, as a means of improving the availability and quality of innovation services for firms.
- 22 Link the standards with the STI policy and use them as a basis to promote technology transfer and innovation. A typical example in this regard is the initiative the Government has taken to build industrial parks with zero liquid discharge.

Finance

- 23 Support local producers with access to finance on a timely basis by improving the operation of granting of commercial bank letters of credit and approvals from NBE.

R&D

- 24 MInT should explore how the newly established innovation fund could support R&D activities in local enterprises that have the potential to build in-house R&D capability.
- 25 Introduce an R&D tax credit in specific R&D areas of high priority to incentivize firm-level R&D in those areas.

Production linkages

- 26 Establish a centre for promotion and facilitation of linkages between foreign and local firms.
- 27 Maximize industrial parks’ potential for linkages by allowing local firms to operate within the parks, even if they are unable to export directly, but export indirectly by providing inputs to export-oriented foreign firms in the park.
- 28 Apply local content requirements, where appropriate, to encourage foreign firms to source from local suppliers.

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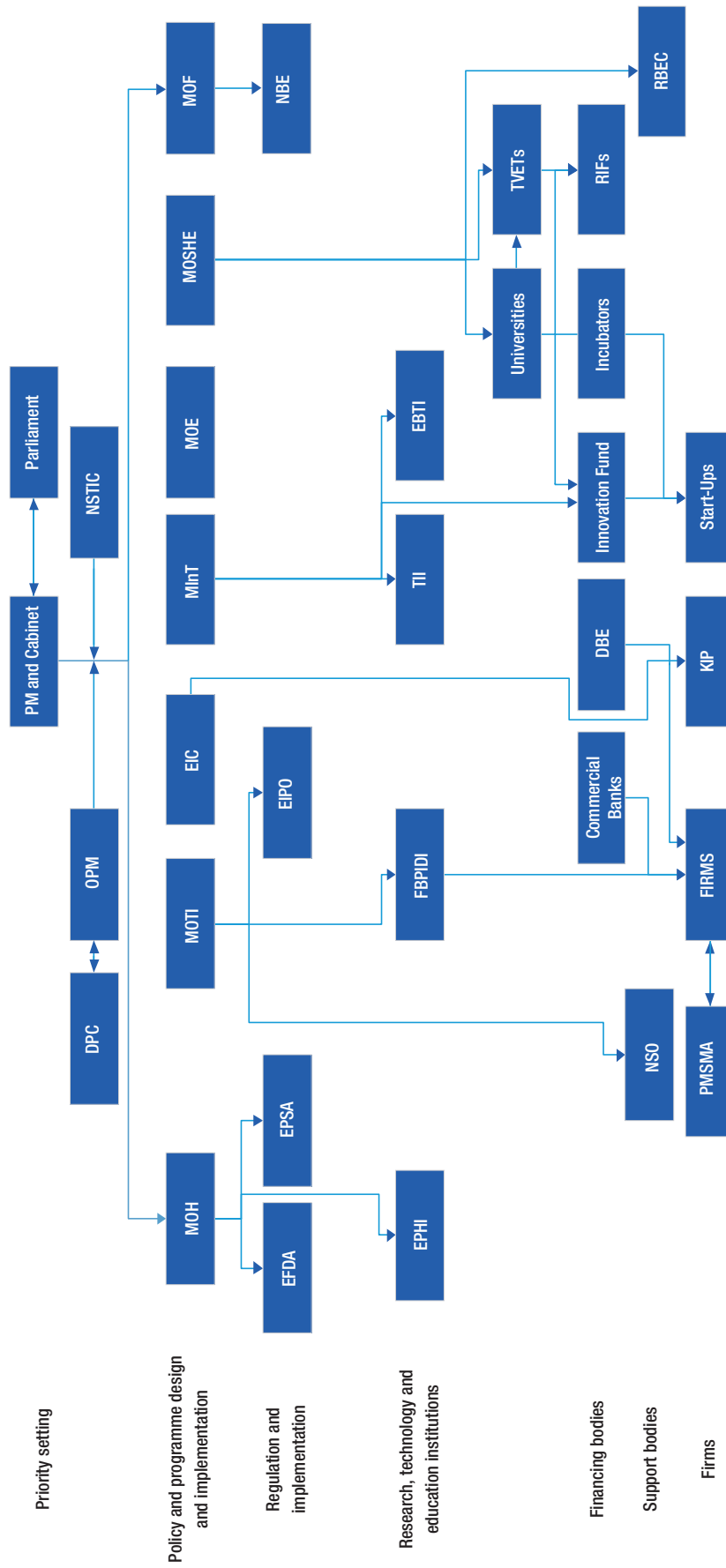
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Annex I. The pharma innovation system of Ethiopia



Source: UNCTAD.

Notes: DPC Development Planning Commission; OPM Office of the Prime Minister; NSTIC National STI Council; MOH Ministry of Health; MOTI Ministry of Trade and Industry; EIC Ethiopian Investment Commission; MinT Ministry of Innovation and Technology; MOSHE Ministry of Science and Higher Education; MOF Ministry of Finance; EFDA Ethiopian Food and Drug Administration; EPSA Ethiopian Pharmaceutical Supply Agency; EIPO Ethiopian Intellectual Property Office; NBE National Bank of Ethiopia; EPHI Ethiopian Public Health Institute; FBPIDI Food, Beverage and Pharmaceuticals Industry Development Institute; TI Technology and Innovation Institute; EBTI Ethiopian Biotechnology Institute; DBE Development Bank of Ethiopia; RIFs Research and Innovation Funds; NSO National Standards Organization; RBEC Regional Bioequivalence Center; PMSMA Pharmaceutical and Medical Supplies Manufacturers Association; KIP Kilinto Industrial Park.

Annex II. Policy and strategy documents relating to the pharma industry in Ethiopia

National Health Policy	<p>It provides general strategies for the supply, distribution and pricing of essential drugs. It also established support for an effective system of drug administration and control, and developing the capacity to monitor drug safety, efficacy and quality. It called for incentives for LPP and the conditions for the transfer and further development of appropriate technologies. It also proposed coordinated research on modern and traditional drugs in line with the country's medical problems and its capacity.</p>
Growth and Transformation Plans GTP I (2010–2015) and GTP II (2015–2020)	<p>Under GTP I, an objective was to increase the availability of pharma at an affordable price and of a satisfactory condition (FDRE and NPC, 2010: 93). Under the GTP II the general objective of health sector development is to ensure the equitable provision of accessible and quality health services.</p>
Ethiopian Industry Development Strategic Plan 2013–2025 (EIDSP)	<p>The EIDSP includes pharma development under the general heading of chemicals, with little specific attention. Food and biotechnology, which share with pharma some activities and regulation, receive more specific attention in the plan.</p>
Fourth Health Sector Development Plan (2010–2015) (HSDP4)	<p>HSDP4 aimed to increase the availability of quality pharmaceuticals at an affordable price and in a sustainable manner, and to achieve improved rational drug use (Gebre-Mariam et al., 2016).</p>
First Health Sector Transformation Plan (2015–2020) (HSTP1)	<p>The pharma industry is one key part of the health sector, and several the goals in HSTP1 relate to the promotion of local pharma production (FDRE, 2015b: 84).</p>
Updated National Strategy and Plan of Action for Pharmaceutical Manufacturing Development in Ethiopia (2015–2025) 2018 (NSPA)	<p>NSPA-Pharma is a detailed plan for the development of pharma manufacturing. The vision of NSPA-Pharma is to transform the Ethiopian pharma industry into a fully GMP compliant, competitive and innovative industry that meets the national needs of essential medicines and serves the African market by 2025.</p>
Pharmaceutical Technology Roadmap (PTRM)	<p>The PTRM is a strategic planning document for product and technology development for pharma in the country in the coming decade.</p>
The GMP Roadmap (2013–2018)	<p>The GMP Roadmap is a plan to bring the pharma industry into full WHO GMP compliance within a defined time frame (EFMHACA, 2013).</p>
Pharmaceutical Traceability Strategic Plan	<p>Promotes traceability of production in the industry, including raw materials.</p>

Source: UNCTAD.

