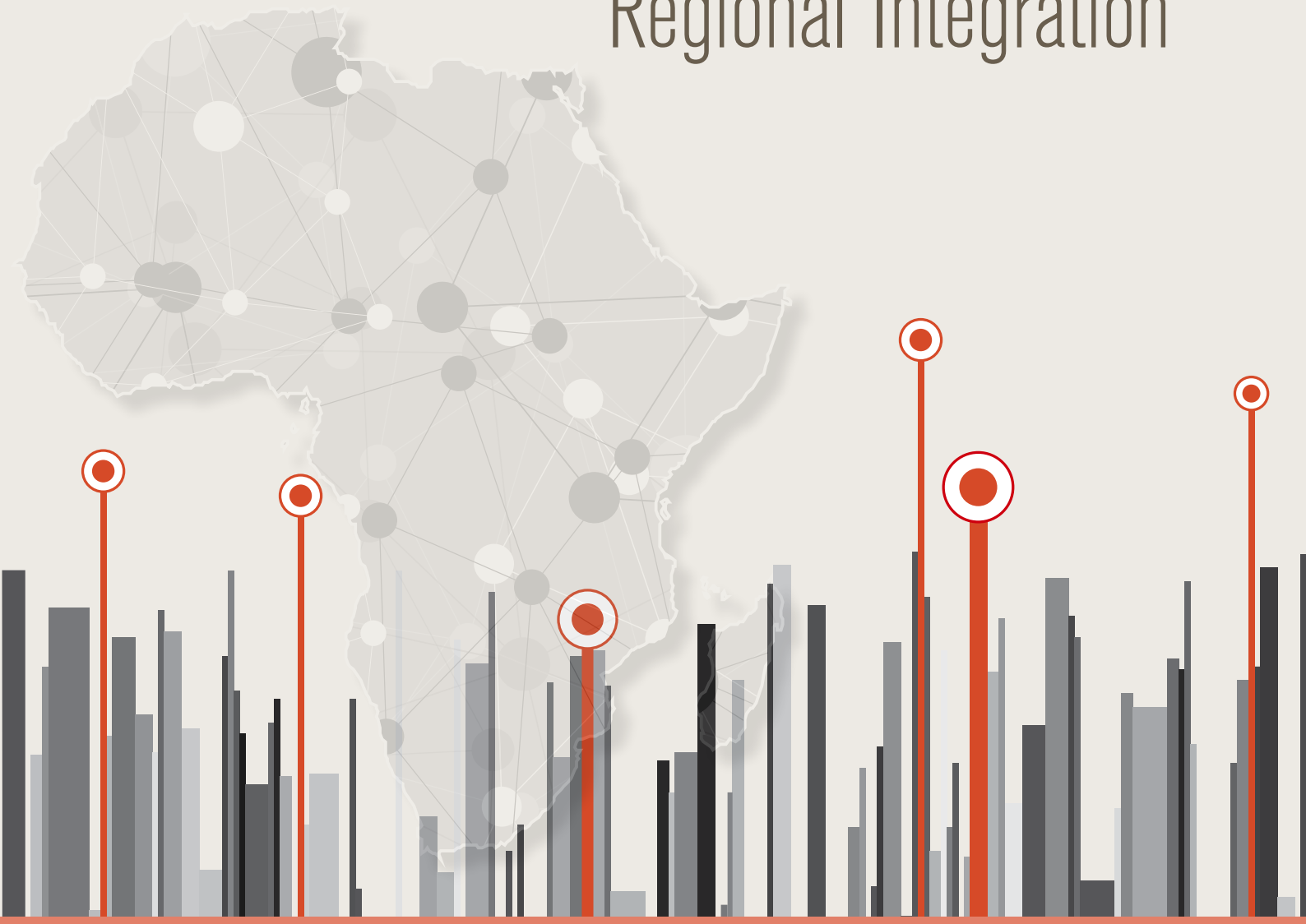
Innovation, Competitiveness and Regional Integration



ASSESSING REGIONAL INTEGRATION IN AFRICA **VII**

United Nations
Economic Commission for Africa

African Union

African Development Bank Group

Innovation, Competitiveness and Regional Integration

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Foreword

Regional integration, innovation and competitiveness interact dynamically. By bringing networks of people, institutions and markets together—the main functions that set innovation in motion—even a loose arrangement between two or more nations is bound to spur innovation and related creative activities. The cross-pollination of ideas and experiences greatly benefits innovators, who can use their enhanced knowledge to adapt and apply innovation—and to push beyond its current frontiers—contributing to competitiveness within economic blocs.

Innovation capacities are vital for diversifying and differentiating the production and trade portfolio, providing a chance to "leap-frog"—technological progress and factor efficiencies may well account for half the economic growth in dynamic economies. But evidence in this report for 15 African countries for 1995–2010 shows that growth in most of these countries was through factor accumulation, not through gains in input combinations tied to innovation. Furthermore, African industry's contribution to exports is minimal, with growth in merchandise exports still driven by commodities.

Against this backdrop, *Assessing Regional Integration in Africa VII* examines how the three elements of regional integration, innovation and competitiveness are interlinked. It explores the prospects for harnessing them within the framework of Africa's normative regional integration development model oriented to foster structural change. And it aims to shed light on the issue of raising innovation and competitiveness in the broader context of development policy and strategy in Africa.

After providing an overview of regional integration trends in Africa, the report examines the dynamic complementarities between the three elements, delineating the role of regional integration in supporting favourable conditions for innovation and how the deployment of innovative capacities can in turn enhance competitiveness and structural change.

Given the importance of the global intellectual property regime in setting a framework for regulating innovation and other creative endeavours, ARIA VII assesses the impact of the global intellectual property protection regime and examines the challenges facing African countries as "late developers." The advanced countries of today applied intellectual property protection in a very selective manner to meet their industrial and other policy objectives. And so today, the design of intellectual property rules and policies should be adaptable to African countries' changing development needs, notably through the "flexibilities" offered by the global trading regime to enhance policy space.

Looking to Asia, the report highlights India's striking advances in developing an extensive tertiary education system that offers a platform for achievements in key sectors from pharmaceuticals to informatics to space technology, and discusses that country's experience in tapping its diaspora in building a knowledge economy back home. It then reviews the remarkable transformation of countries in the Association of Southeast Asian Nations in fostering innovation and competitiveness, primarily in regional supply and value chains.

The report makes recommendations to African policy makers, suggesting they start with crafting and then effectively implementing policies anchored on human capital development, with special attention to higher education. Today's reality is that Africa's higher education system is in a parlous

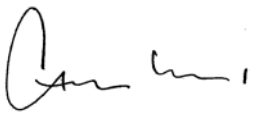
state, with frequently poor education institutions generating below-standard learning outcomes. The numbers of Africans enrolled in science, technology, engineering and mathematics disciplines at graduate level are low relative to other global regions, with especially low female participation. Underfunded and inadequately managed, Africa's tertiary institutions appear in the bottom ranks of the world's universities—only three make it to the top 400. Yet with rapid technological change, the need for these graduates is rising inexorably. Some of them will conduct research for mitigating the impacts of fossil fuel–based energy and for developing new, cleaner technologies. Reforms to higher education must also include greater alignment between education policy and science, technology and innovation policy on the one hand, and industrial policy on the other, to ensure the relevance of educational output.

The report further recommends that African leaders grasp the opportunity to negotiate an intellectual property agreement through the Continental Free Trade Area initiative. Tied to this, the decision taken by the African Union summit to establish a Pan-African Intellectual Property Organization presents an opportunity to bring about intellectual property policy coherence on the continent and a common approach to negotiating rules in trade and investment agreements with external partners.

What must be done is clear. Just as African governments have shown leadership in improving physical infrastructure and connectivity, so must they now upgrade Africa's human capital to meet modern demands and the aspirations of Agenda 2063, the long-term plan for transforming the continent. The Science, Technology and Innovation Strategy for Africa 2024 sets out a means to follow through on the Agenda, feeding into the recognition of technology and innovation as mechanisms to implement the recently adopted Sustainable Development Goals.

This important report addresses themes critical for the future of our continent. We commend its analysis and policy messages to policy makers, academia, development partners, investors and other stakeholders in Africa's development.

Nkosazana Dlamini Zuma
Chairperson
African Union Commission



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Summary, Key Messages and Policy Recommendations

Assessing Regional Integration in Africa VII (ARIA VII) reviews the relationship between regional integration, innovation and competitiveness. These three elements may not at first seem linked, and competitiveness seems more usually related to efforts to integrate national economies into regional arrangements. But closer review reveals several ways the three interact dynamically. By knitting together networks of institutions, people and markets—the essentials setting innovation in motion—even a loose connection between two or more nations is bound to facilitate innovation and related creative activities. The cross-pollination of ideas and experiences greatly benefits innovators, who can use their enhanced knowledge to adapt ideas and apply them to push beyond the current frontiers of innovation—contributing to competitiveness within the bloc.

Regional integration changes national incentive frameworks as well. In the hope of incentivizing innovation, modern free trade agreements aim to strengthen laws and regulations on the ownership of intellectual property rights. At the same time, anti-competitive and efficiency-reducing regulations and practices are targeted for reform, given the inherent tension between intellectual property rights and access to innovations. It is no surprise that the scope of the negotiations for Africa's Continental Free Trade Area, launched in June 2015, include intellectual property (IP) and competition policy with a view towards establishing common rules and approaches among African countries.

The wider consumer base provided by the regional economy translates into more demand and ultimately greater returns on any investment in innovation. In addition to facilitating access to new markets and tying them together, regional integration can also have more profound effects on consumer preferences and behaviour. Larger consumer group sizes particularly benefit niche innovators. Deep regional integration between states also enables innovators to cluster more effectively, as seen from the tremendous growth of the electronics industry in the countries of the Association of Southeast Asian Nations (ASEAN). Such clusters are boosted by joint production networks and supply chains, which allow innovators to benefit from scale economies.

The deeper the integration and the larger the community created, the greater the potential benefits for innovation. For countries in the institution-building and catch-up stage, integration with more developed partners can help to facilitate convergence through enhanced technology diffusion.

The African continent registered an impressive average economic growth exceeding 4 per cent between 2000 and 2014 (ECA, 2015). But over the long term (1975 to 2014) growth was far below the average among Asian developing countries. Africa's recent growth spurt has hardly changed the underlying orientation towards commodity dependence in national economies. Innovation capacities are therefore crucial for transforming what the continent produces and trades. Industry's contribution to exports is minimal, however, and the growth of Africa's merchandise exports is still driven by commodities rather than technological progress and factor efficiencies, which account for perhaps half the economic growth in successful economies.

Evidence in this report for 15 African countries for 1995 to 2010 shows that growth in most of these countries was through factor accumulation and not through major gains in input combinations associated with innovation. Even South Africa—a regional hegemon in the Southern African Development Community (and the continent's most scientifically and technologically advanced country—has been mired in low total factor productivity growth, achieving just 0.04 per cent growth in 2010. This could suggest that South Africa is caught in a "middle-income trap" where the advantages of "catch-up or late-comer" policies have been exhausted and it must now move to new areas driven by science, technology and innovation (STI), but that also take into account its excess labour and high unemployment.

The report examines how to harness the linkages between regional integration, innovation and competitiveness within the framework of Africa's normative regional integration development model oriented to structural change. It demonstrates that, in a virtuous circle, innovation is both a driver and beneficiary of competitiveness, endogenous growth, development and transformation.

Report structure

- **Chapter 1**— *Introduction*—brings thematic issues into focus and provides a guide to the report.

- **Chapter 2**—*Status of Regional Integration in Africa*—is a recurrent part of ARIA. It outlines trends in the progress of integration at three levels. It introduces the Africa Regional Integration Index as a tool to track and benchmark the progress of the continent's integration agenda.

- **Chapter 3**—*Regional Integration, Innovation and Competitiveness: A Theoretical Framework and Empirical Highlights*—examines the dynamic linkages between these concepts and presents empirical evidence that Africa's growth is not driven by innovation and competitiveness.

- **Chapter 4**—*Innovation and the Global Intellectual Property Regulatory Regime*—assesses the impact of the global intellectual property protection regimes, particularly focusing on the challenges facing African countries as "late developers."

- **Chapter 5**—*Africa's Science, Technology and Innovation Policies—National, Regional and Continental*) reviews and assesses the innovation ecosystem in Africa at three levels.

- **Chapter 6**—*Lessons from India and the Association of Southeast Asian Nations*—examines the experiences of India and the Association of Southeast Asian Nations in leveraging regional and public policies to promote innovation.

Key messages

Status of regional integration in Africa

African countries' commitment to integrating their economies remains unwavering. Progress continues along the dimensions of integration identified in the Abuja Treaty, even if it is uneven across regional economic communities and countries.

The Tripartite Free Trade Area and Continental Free Trade Area are major milestones in Africa's trade integration

Two key shifts in Africa's trade integration occurred in 2015. First, the Tripartite Free Trade Area Agreement between the Common Market for Eastern and Southern Africa, the East African Community and the Southern African Development Community was signed in June 2015. While much work remains to put it into effect, it nonetheless marks a huge step towards rationalizing Africa's regional trade arrangements. Second, also in June 2015, the Continental Free Trade Area negotiations were formally launched. They are expected to last until the end of 2017 and will cover trade in goods and services, investment, intellectual property rights and competition policy.

Africa's regional economic communities continue to adopt formal trade measures

Africa is making progress in establishing legal frameworks to deepen trade integration among regional economic communities. In January 2015, the Economic Community of West African States launched its customs union, which eight of the bloc's 15 member States began to implement through a common external tariff by April 2015. The Arab Maghreb Union is coming closer to launching its own free trade area. Its member States have already signed three out of the four protocols needed for the FTA, with the protocol on rules of origin remaining.

The share of intra-African trade in gross domestic product is rising but remains low against that in other regions

Intra-African imports as a share of the continent's GDP rose from around 2.7 per cent in 1995 to around 4.5 per cent in 2013, but this is low compared with regions

such as the Americas (6.7 per cent), Asia (17.9 per cent) and Europe (21 per cent). However, among the eight regional economic communities recognized by the African Union, only the Southern African Development Community (from 3.6 per cent of GDP in 1995 to 5.7 per cent in 2014) and the Common Market for Eastern and Southern Africa (from 0.8 per cent in 1995 to 1.8 per cent in 2014) have seen substantial increases in the share of intra-regional trade in GDP. The Southern African Development Community is Africa's only regional economic community among the highest-performing regional trade agreements worldwide in 2013 (sixth out of 32; Africa's other regional economic communities fall in the bottom half).

African countries have taken steps to boost trade in goods within the continent, but not enough

Several of Africa's regional economic communities have reduced tariffs on intra-regional imports to a relatively low level: out of Africa's regional economic communities with free trade areas, the East African Community has a zero average applied tariff on imports within the bloc, while the Economic Community of Central African States and the Common Market for Eastern and Southern Africa both apply tariffs averaging around 1.9 per cent. The Southern African Development Community's and Economic Community of West African State's intra-regional tariffs are higher, at 3.8 and 5.7 per cent. Common Market for Eastern and Southern Africa, East African Community, Economic Community of West African States and Southern African Development Community have all adopted measures to facilitate transport and reduce non-tariff barriers.

Rising intra-regional trade in intermediate and capital goods suggests the development of regional value chains

Africa's intra-regional trade in intermediate and capital goods grew at more than 11 per cent annually between 1999 and 2013, greatly outstripping the continent's real economic growth of 4.4 per cent. Southern and West Africa appear to be leaders on this metric.

Intra-African trade in services has untapped potential, especially as services now account for a large share of gross domestic product in some countries

Intra-African trade remains low, however, because of weaknesses in manufacturing. African countries are estimated to import around $98 billion in services from outside the continent. Lower barriers to services trade between African countries could potentially allow African firms to capture much of this business. But African countries have high barriers: 19 of 26 African countries studied fall in the bottom half of the global rankings for ease of trade in services.

Economic partnership agreements with the European Union and mega-regional trade agreements make it crucial for Africa to conclude, quickly, the Continental Free Trade Area

The economic partnership agreements are likely to undermine Africa's regional integration and cause revenue losses for countries, and mega-regional trade agreements to undermine the continent's trade performance, including through preference erosion. Implementing the Continental Free Trade Area before these agreements take effect would reverse most of these impacts.

Macroeconomic performance remains mostly sound, though the economic slowdown in China could pose difficulties for some countries

Africa's macroeconomic performance remains largely solid, but China's slowdown could be challenging for fiscal policy in some African countries. In particular, reductions in global commodity prices could pose problems for debt repayment in African countries with sovereign bonds.

Intra-African direct investment appears limited, but pan-African banks are emerging

Though data are limited on intra-African foreign direct investment, it appears that such flows represent only a fraction of Africa's GDP. However, some African banks are opening branches across the continent, suggesting a potential for greater financial integration if barriers to cross-border lending are lowered further.

Africa's regional economic communities have further liberalized movement of persons, but barriers remain

Some of Africa's regional economic communities, including the East African Community (particularly Kenya, Rwanda and Uganda) and the Economic Community of West African States have facilitated their nationals' movements among member countries. Progress in other regional economic communities is less advanced, however, and the average ratification rate for protocols on free movement of persons remains at 60 per cent.

The continent's infrastructure continues to improve

Africa is employing innovative methods to raise infrastructure finance and to drive forward strategic infrastructure projects, including cross-border transport, communications and pipeline projects. The continent is also working on energy projects. Multiple African countries have made large strides in improving road density and quality as well as internet bandwidth. The Economic Community of Central African States, Southern African Development Community and some East African countries have created single-area mobile phone networks across several countries, reducing roaming costs.

Some regional economic communities are harmonizing mining policies and standards, but not others

The East African Community, Economic Community of West African States and Southern African Development Community have taken steps in this direction, but more need to follow the Africa Mining Vision, which provides a blueprint for mining standards across the continent.

African countries are demonstrating a strong commitment to peace and security cooperation

Over 45,000 African personnel were committed to United Nations and African Union peacekeeping missions in Africa. African leaders negotiated swift returns to civilian rule after *coups d'état* in Burkina Faso and Mali. And African forces from multiple countries have made substantial progress in combating the terrorism of Boko Haram in West Africa as well as Al-Shabab in Somalia.

Regional integration, innovation and competitiveness

Regional integration is a driver and beneficiary of innovation

As the countries in the bloc grow in innovation capacities, they are likely to integrate even more with each other through investment, supply chains, trade, knowledge and mobility. Innovation drives and is driven by accompanying changes in production capacities and competitiveness. Innovation generates greater competitiveness and trade, boosting integration, growth and development.

Innovation drives growth and structural transformation through increased productivity

The increase in output growth that cannot be associated with other measurable changes (such as labour and capital) is taken as innovation, which (technological or not) contributes to growth and structural change. The most obvious manifestation of structural change is the sectoral reallocation of activities, typically with movement towards higher links in the value chain. Innovation, in various forms, raises growth through at least four channels: technological progress, investments in knowledge-based capital, multi-factor productivity growth and creative destruction.

Africa's recent growth spurt has been generated through factor accumulation and not through gains from input combinations linked to innovation

This finding applies to most of 15 African countries studied, and even South Africa—one of the 15 and the continent's most scientifically and technologically advanced country—is mired in low total factor productivity growth.

Empirical evidence suggests a positive correlation between innovation and competitiveness

Worldwide, countries at the top of the Global Innovation Index are also at the top of the Competitive Industrial Performance index. African countries have very low rankings on both indices, and on the Global Competitiveness Index. Mauritius was Africa's best performer on the Global Innovation Index in 2014 (40th out of 143

countries) and on the Global Competitiveness Index (39th out of 144 countries).

Research and development-generated intellectual property is necessary for innovation but not the only condition

Perhaps only 4 per cent of new innovations are based on research and development, and the rest on practice; the vast majority comes from routine learning and economic operations. In short, innovation is a new way of combining factors of production so that the resulting output has practical utility and commercial value, or addresses a consumer's wants differently—or both.

Innovation is a potential vehicle for technological leap-frogging

Innovation offers unique opportunities to "late-developer" countries to leap-frog: they can seize opportunities not only in emerging but also mature industries. Forerunners maybe locked in current technologies due to large sunk investment costs, but late developers are not, benefiting from entering mature industries without having to bear the research and development costs. Late developers can adopt the most up-to-date products and services, processes, organizational methods and marketing tools as part of catch-up and leap-frogging. Like other world regions, Africa has particularly benefited from innovations enabled by information and communications technology—better take-up and use is imperative.

Innovation and the global intellectual property regime

The TRIPS Agreement constricted developing countries' policy space

The Trade Related Aspects of Intellectual Property Rights Agreement under the World Trade Organization took away some policy space open to developing countries under World Intellectual Property Organization treaties. Yet it has "flexibilities" that developing countries should use in their intellectual property regimes. Least developed countries in particular have an extendable transition period to apply the agreement. However, all African countries—least developed countries and not least developed—can adopt strategies to maximize policy space in agriculture, manufacturing and public health and more broadly on access to knowledge. Historical conditions have changed but countries still have "freedom to operate."

The Sustainable Development Goals include technology transfer provisions

The Sustainable Development Goals adopted by the United Nations in September 2015 includes one goal and two targets on technology transfer through a balanced approach to intellectual property rights. While the design and operation of the proposed technology transfer mechanism has not yet been agreed, African countries should keep pushing in this area.

African countries have been active in Geneva in intellectual property rule-making

African countries have been active at the World Trade Organization and World Intellectual Property Organization in Geneva in pursuing initiatives on intellectual property rule-making, and the Doha Declaration on the TRIPS Agreement and Public Health marks a rare example of their success. Conversely, their moves on global intellectual property rules for genetic resources, traditional knowledge and folklore, and geographical indications, which can help to counter bio-piracy, have yet to bear fruit.

At home, African countries need to be more strategic in harnessing intellectual property to enhance innovation and competitiveness for driving structural change and regional integration

Regional cooperation arrangements on intellectual property policy require reform. Ties between Africa's intellectual property organizations—the African Regional Intellectual Property Organization made up mainly of Anglophone countries, and the Organisation Africaine de la Propriété Intellectuelle incorporating mainly Francophone countries—and science, technology and innovation policy frameworks at national, regional and continental levels are tenuous, and the two organizations' mandates generally preclude them from helping countries to exercise their patent rights and counter intellectual property "mercantilism," including the use of flexibilities. Nor do they have links to free trade and bilateral investment agreements with external partners.

Current African Union initiatives through the Continental Free Trade Area negotiations and the effort to establish a Pan-African Intellectual Property Organization provide an opportunity for Africa's regional cooperation on intellectual property policy.

Africa's science, technology and innovation policies

Human capital investments, backed up by steps to expand tertiary education, are foundations for science, technology and innovation policies

The provision of high-quality tertiary education is still a major challenge in African countries. During the 1980s and 1990s, economic stress associated with structural adjustment programmes saw severe cuts to higher education and huge migration of qualified scientists and technologists from universities to the private sector or abroad. The tertiary education and research sector is yet to recover. African universities have very low rankings on global performance indicators such as the Quacquarelli Symonds ranking, which lists only three African universities in its top 400.

African countries are far from achieving a critical mass of research and development finance and lack monitoring and evaluation frameworks

Fiscal (and private sector) constraints mean that countries cannot mobilize or deploy the resources to improve science, technology and innovation capacity to competitive levels. And although international collaboration is helpful, the evidence does not suggest that any country has developed such capacity through development assistance. Domestic funding should play the leading role.

Management of development processes requires results-based monitoring and evaluation frameworks, which most countries lack.

Lessons from India

Provide high-quality tertiary education

Good, publicly funded colleges and universities for higher and technical education are essential, with the state guaranteeing access for poorer sections of society, as in India. The Indian Institutes of Technology, Indian Institute of Science and other similar institutes funded by the central government are the best examples of India's public education system. And the drawbacks of large-scale privatization of higher education, the Indian experience shows, must be taken into account in formulating holistic policies for higher education.

Tertiary education should produce people with skills needed for conducting location-specific research, especially in agriculture. A vocational education and training system should be set up that interacts with industry. These systems need to be aligned with market needs via private participation, curriculum development, upgraded infrastructure and performance incentives.

Encourage a bottom-up and "make-do" approach to innovation

India had no consistent policy framework on innovation until it introduced its comprehensive science, technology and innovation policy in 2013. The need for innovation and a make-do orientation helped India embark on its "frugal innovations," crafted by a few pioneering individuals rather than by the government at large.

Facilitate regional cooperation on innovation

It is important to establish regional institutes of excellence for higher education in science and technology to attract the best talent from across Africa with affordable fees. Institutes of vocational education and training must be established at intra-regional and regional levels.

Tap the diaspora

India has put in place frameworks to leverage the contribution of its diaspora. An Africa-wide initiative should tap its diaspora. The African Union has designated the African diaspora the continent's "sixth region."

Lessons from the Association of Southeast Asian Nations

A "soft" approach to regional integration

The Association of Southeast Asian Nations provides a model of country implementation of policies and action plans rather than regional frameworks, with realistic goals reflecting country characteristics. Because the

majority of association countries are in a catch-up stage and lack the capacity to innovate, they facilitate catch-up by adapting and applying existing innovations. The association envisions itself becoming the biggest purchaser of technology in the next decade.

An emphasis on trade, investment, supply-chain integration and labour mobility

Over the years the association has reinforced its economic community through trade, cooperation agreements and foreign partnerships. Regionally, it encourages innovation through collaboration in such diverse areas as capital mobility, trade, education and labour mobility.

Internal coherence and external consistency

The association's agreements with external partners rarely go beyond internationally established norms or obligations for intellectual property protection as provided by the global intellectual property regime. Association of Southeast Asian Nations countries have not established strong joint intellectual property frameworks or harmonized intellectual property institutions, but the bloc has proven that an approach based on dialogue and consensus-building works well for innovation. Members envision that intellectual property will promote efficient adoption and adaptation of more advanced technologies and continuous learning to meet ever-rising performance thresholds, and that intellectual property will foster regional dynamism, synergy and growth.

Policy recommendations

National, regional and continental

Adopt smarter policies and provide more resources for tertiary education and research

The starting point must be human capital development. Just as African governments have shown real leadership in improving physical infrastructure and connectivity, so they must now turn attention to human capital development. They should prioritize reforming higher education, with governance changes (greater autonomy and independence in government-owned higher education institutions), greater differentiation among higher education institutions in the public and private sectors, and some cost recovery. Reforms should include greater alignment among policies for education, industrial policies and science, technology and innovation.

Emphasize science, technology, engineering and mathematics

Africa's approach to science, technology and innovation should be pragmatic. The departure point is to recognize science and technology as the centrepiece throughout, as it develops readiness for technological diffusion (critical in the earlier phases of development, when a country's innovative capacities are still restricted) and technological innovations (a more prevalent mode of innovation in the long run).

Synchronize science, technology and innovation policies with country characteristics

Since the policies of different African countries have tended to look quite similar in content, there is no strong evidence to suggest that they are properly synchronized with country particularities. Indeed, to be successful, such policies should take into account the particular environment in which the interventions are undertaken—usually different from country to country.

Follow a mixed approach to science, technology and innovation policy

Countries should blend sectoral and horizontal policies, as well as governmental and non-governmental policies with private initiatives. Sectoral policies can create new sectors either through technology transfer or through endogenous science and technology efforts. They can also improve the efficiency and competitiveness of current sectors. (Horizontal, or general, science, technology and innovation policies seldom provide the impetus for creating new sectors.)

National

Evaluate science, technology and innovation governance institutions

The success of a nation's policy depends on its governance institutions and agencies. Governments should evaluate these institutions regularly, invest in them and professionalize them further.

Base science, technology and innovation policies on a detailed costing

No sectoral (indeed, no horizontal) African policies were costed before their creation to determine their feasibility and consistency with absorptive capacity. Basing future science, technology and innovation policies on detailed costing will enable governments to make difficult trade-offs among possible options.

Get more women into science, technology, engineering and mathematics

Women make up less than 20 per cent of the science, technology, engineering and mathematics workforce in Africa, and very few women pursue postgraduate science, technology, engineering and mathematics courses. Governments should address the hindrances to increasing their presence, including cultural biases and attitudes towards women in science, technology and innovation, gender discrimination, and a working environment that fails to consider the needs of young mothers. They should also set up scholarship programmes to encourage women to take graduate courses in science, technology, engineering and mathematics disciplines.

Review science, technology and innovation policy regularly

The pace of technological change is rapid, but few African countries have regular (or even frequent) reviews of science, technology and innovation policy. This is a mistake. Countries should review their science, technology and innovation policies at least once every three years.

Strengthen private, regional and international partnerships for science, technology and innovation

Governments should continue promoting a wide range of private, regional and international partnerships in science, technology and innovation. While national interests must remain central, governments should align their science, technology and innovation policies with their regional economic community's frameworks and to the African Union's Science, Technology and Innovation Strategy for Africa. They should expand partnerships through South–South cooperation while maintaining and strengthening traditional relationships with countries of the North.

Reduce dependence on aid

In pursuing partnerships with non-African entities, African governments should cut their dependence on aid and technical assistance in their science, technology and innovation policies.

Engage the national diaspora

Governments should set policies and the means to implement them to ensure that science, technology and innovation initiatives benefit from the diaspora's "brain gain"—knowledge transfer, philanthropy and networks to provide technical know-how and investment capital. The diaspora can have significant impact as a source of investors, mentors, sources of talent and catalysts for policy change.

Regional economic communities

Share research infrastructure

Regional economic communities should share their member States' research infrastructure, as few countries have modern facilities. Modern research is expensive—a challenge especially for least developed countries—but shared in this way it can be used by countries individually or region-wide. Previous examples include the Desert Locust Organization of Eastern Africa and the Pan-African Rinderpest Campaign.

Set up research areas

As practised in the European Union, the regional economic communities should establish regional research areas (as building blocks of an African research area) to integrate the science, technology and innovation resources of their member States. They will enable transfer of technology and skills, allow efficient use of scarce resources, enhance the competitiveness of research institutions and improve their attractiveness to external collaborators.

Cost and fund joint research programmes

The regional economic communities should mobilize and cost regional science, technology and innovation programmes of joint research and innovation, and seek funding for them. They should reduce the dependence on external sources for financing of their policy choic-

es. They should identify science, technology and innovation programmes to be designated as community programmes funded from community budgets and to serve as clearinghouses for joint programmes executed by some of their member States cooperatively. This will reduce transaction and search costs for researchers in the member States. The regional economic communities should also introduce common standards for quality and processes, such as a West or East African pharmacopeia for drug manufacturers.

Establish anchor institutions

The regional economic communities should emulate the East African Community by setting up regional science, technology and innovation anchor institutions (as building blocks of a future African Union anchor institution). They could be modelled on the science, technology and innovation arm of the United Nations Educational, Scientific and Cultural Organization. They would develop joint programmes and manage Africa's pan-African centres of excellence, such as the proposed Pan-African University of Science and Technology and the Pan-African Institute of Technology.

Expand prizes

Many regional economic communities have established prizes and awards to recognize excellence in science, technology and innovation. These efforts should be expanded to include private firms whose research and development innovation have regional dimensions and improve competitiveness.

Pan-African

The African Union is a main agenda-setter for the continent. The Lagos Plan of Action, the New Partnership for Africa's Development and the African Union/New Economic Partnership for Africa's Development Consolidated Plan of Action for Science, Technology and Innovation have served to propel science, technology and innovation to the centre stage of the African transformation discourse. The Science, Technology and Innovation Strategy for Africa 2024 is deepening that conversation, developing indicators on improved policy making. The African Union science awards at summits are helping to raise awareness and popularize science on the continent.

Ensure better funding for science, technology and innovation

The African Union Commission's organs for science, technology and innovation and the New Economic Partnership for Africa's Development should be better funded by African governments and the private sector. To achieve reasonable independence, they should rely less on external sources. Additional funding will enable Africa's science, technology and innovation and intellectual property organizations to address and mitigate their capacity and capability shortfalls. The African Union Commission leadership itself should seek to mobilize funds for science, technology and innovation from Africa's emerging multinational corporations and philanthropic bodies.

Set up a continental anchor institution

The African Union should create a continental science, technology and innovation anchor institution, with regional economic community anchor institutions as building blocks, working with the New Economic Partnership for Africa's Development Office for Science, Technology and Innovation. The institution will be financed solely by member States' assessed contributions and be responsible for managing the proposed Pan-African African Science and Technology Innovation Fund. With the Pan-African Intellectual Property Organization and the African Union Commission's Department of Human Resources, Science and Technology, this anchor will set the continent's science, technology and innovation agenda and priorities.

Intellectual property rules should be adaptable

The advanced countries applied intellectual property protection in a selective manner at earlier stages of development to meet their industrial and other policy objectives. Today, too, intellectual property rules and policies should be adaptable to countries' changing needs.

Maximize policy space in the global intellectual property regime

African countries need to establish intellectual property policies and laws appropriate to their development challenges. They should consider adopting differential standards of intellectual property protection within the flexibilities of the TRIPS Agreement.

The African Group in Geneva should continue its intellectual property rule-making initiatives

The African Group should continue engaging with the World Intellectual Property Organization Intergovernmental Committee on intellectual property and Genetic Resources, Traditional Knowledge and Folklore for text-based negotiations for an international legal instrument. At the World Trade Organization, it should continue to engage with the TRIPS Council and related bodies, including extending the register on geographical indications and technology transfer.

Negotiate an intellectual property agreement through the Continental Free Trade Area and establish the Pan-African Intellectual Property Organization to bring about intellectual property policy coherence

The Continental Free Trade Area negotiations and efforts to establish the Pan-African Intellectual Property Organization should use mechanisms to safeguard TRIPS flexibilities. The Pan-African Intellectual Property Organization mandate must be consistent with the aspirations of Agenda 2063. A Continental Free Trade Area agreement on intellectual property could provide the basis for establishing a common approach to negotiation of intellectual property rules in trade and investment agreements with external partners. A pan-African approach to intellectual property policy can provide the basis for cooperation and pooled resources to build the capacities required for intellectual property governance, administration and adjudication.

Chapter 1
Introduction

The positive relationship between innovation and improved national competitiveness is widely understood, but not much is known about the channels and mechanisms through which they drive (or are driven by) regional integration. Regional integration does not seem to have direct impacts on innovation capacities, which are crucial for transforming what the continent both produces and trades.

But competitiveness is more usually related to efforts to integrate economies, and its drivers include assets such physical infrastructure, scale economies, factor efficiencies, the business environment, geographical connectivity and cultural ties. Increased productivity and better integration of supply chains engendered by freer investment and trade regimes, both within an economic bloc and between blocs and external partners, are among the expected outcomes from measures to enhance competitiveness within a regional integration context.

Indeed, the explicitly stated objectives for regional integration are typically to boost trade by integrating markets for goods and services (hence the prevalence of trade-driven regional integration schemes), to facilitate movement of capital (investment markets) and to facilitate the movement of labour (labour markets). Equally important objectives include easing the movement of people and inter-connecting hard and soft infrastructure.

Deeper reflections, however, reveal several ways in which regional integration, innovation and competitiveness interact. Due to the creation of networks between people and institutions—the main constituents that set innovation in motion—even a loose connection between two or more nations is bound to facilitate innovation to some extent. The cross-pollination of ideas and experiences greatly benefits innovators, who can use their enhanced knowledge to adapt and apply innovation, as well as push beyond the current frontiers, contributing to competitiveness within the bloc.

Moreover, membership in a regional integration arrangement shapes national regulatory and incentive frameworks along several dimensions including taxes, factor costs, knowledge sharing and intellectual property rights. In the hope of incentivizing innovation, modern free trade agreements aim at strengthening laws and regulations protecting intellectual property rights. At the same time, anti-competitive and efficiency-reducing regulations and practices are targeted for reform, given the inherent tension between intellectual property rights and access. It is no surprise that the scope of Africa's Continental Free Trade Area negotiations includes intellectual property and competition policy with a view to establishing common rules and approaches among African countries.

The larger market provided by the regional economy means more demand and ultimately greater returns on any investment in innovation. Beyond facilitating access to new markets and tying them together, regional integration can have profound effects on consumer preferences and behaviour. Larger consumer groups especially benefit niche innovators. Deep regional integration between states also enables innovators to cluster in more effective ways, as seen from the spread and exponential growth of the electronics industry in the countries in the Association of Southeast Asian Nations. Such clusters are augmented by joint production networks and supply chains, which allow innovators to benefit from scale economies.

Regional integration further benefits innovation by facilitating access to finance: freer movement of capital, fewer restrictions on ownership, and fiscal and other incentives for joint ventures are some of the biggest benefits.

The deeper the integration and the larger the community created, the greater the potential benefits for innovation. For countries in the institutional-building and catch-up stage, integration with more developed partners can help to facilitate convergence through enhanced technology diffusion.

Africa needs to realize these benefits to boost its economic growth, for although it registered quite impressive growth of more than 4 per cent from 2000 to 2014, over the long term (1975 to 2014) its growth was far below the average of Asian developing countries. Furthermore, the contribution of the industrial sector to the continent's exports is minimal, and the growth of Africa's merchandise exports continues to be driven by commodities—not the technological progress and factor efficiencies that are responsible for perhaps half the economic growth in successful economies.

Assessing Regional Integration in Africa VII (ARIA VII) examines how regional integration, innovation and competitiveness are interlinked in the African context and how countries can harness their links in a model that fosters structural change.

Besides providing the traditional overview of regional integration trends in Africa, the report examines the dynamic complementarities between innovation, competitiveness and regional integration. It delineates the role of regional integration in supporting favourable conditions for innovation, and how the deployment of innovative capacities can in turn enhance competitiveness and structural change. It demonstrates that, in a virtuous circle, innovation is a both a driver and a beneficiary of competitiveness—processes closely related to endogenous growth, development and transformation.

After this introduction, the report has the following chapters:

- **Chapter 2**—*Status of Regional Integration in Africa*—is a recurrent part of each report. It outlines trends in the progress of integration at three levels. It introduces the Africa Regional Integration Index as a tool to track and benchmark the progress of the continent's integration agenda.

- **Chapter 3**—*Regional Integration, Innovation and Competitiveness: A Theoretical Framework and Empirical Highlights*—examines the dynamic linkages between these concepts, and presents some empirical evidence.

- **Chapter 4**—*Innovation and the Global Intellectual Property Regulatory Regime*—assesses the impact of the global intellectual property (IP) protection regimes, particularly focusing on the challenges facing African countries as "late developers."

- **Chapter 5**—*Africa's Science, Technology and Innovation Policies—National, Regional and Continental*—reviews and assesses the innovation ecosystem in Africa at three levels.

- **Chapter 6**—*Lessons from India and the Association of Southeast Asian Nations*—examines the experiences of India and the Association of Southeast Asian Nations in leveraging regional and public policies to promote innovation.

Chapter 2
Status of Regional Integration in Africa

This focuses on the major shifts in African regional integration since ARIA VI, published in 2013.[1] The chapter covers developments in trade, macroeconomic policy and financial integration, free movement of persons, infrastructure integration, mining, agriculture, peace and security, and health.

Much of the quantitative analysis in this chapter is based on data collected for the Africa Regional Integration Index, a joint project between the African Development Bank, the African Union Commission and the Economic Commission for Africa (ECA). Full details on the index are available from the publication The *Africa Regional Integration Index* (edition I), and its website, from which the entire dataset of the index can be downloaded. The index is designed to measure African countries' progress in meeting their commitments under Africa's regional integration frameworks, such as Agenda 2063, the Treaty Establishing the African Economic Community (the Abuja Treaty) and the Boosting Intra-African Trade initiative of the African Union, among others. The indicators for the index include:

- Trade integration, including sub-dimensions on tariff liberalization and on trade facilitation and logistics.
- Productive integration (that is, integration into regional value chains).
- Macroeconomic policy convergence.
- Free movement of persons and labour markets, including sub-dimensions on implementation of free movement of persons protocols and on general measurement of movement of persons.
- Regional infrastructure and interconnections, including sub-dimensions on transport, energy and information and communications technology (ICT).

The review in this chapter largely tracks these dimensions.

During the period under review, Africa's commitment to regional integration was tested by such challenges as the Ebola virus disease outbreak in some countries of West Africa, intensified terrorist activities in Somalia, Nigeria and Kenya, and conflicts in Burundi, the Central African Republic and South Sudan. The chapter shows that despite these challenges, African countries continue to make progress in integrating their economies.

Trade integration

Trade integration plays a major role in enhancing structural transformation and inclusive growth across the continent (ECA, 2015). All eight regional economic communities recognized by the African Union—AMU, the Community of Sahel-Saharan States (CEN-SAD), COMESA, EAC, ECCAS, ECOWAS, the Inter-Governmental Authority on Development (IGAD) and SADC[2]—consider the free movement of goods and services to be a priority area for integrating their member countries. Trade is also included in the African Union Minimum Integration Programme (2009) and Agenda 2063 (2015), with free movement of goods and services and greater intra-African trade among the objectives.

This section examines trends in formal trade followed by a review of intra-African trade data and progress on liberalizing tariffs, on facilitating trade, and on removing non-tariff barriers. It also briefly looks at regional value chains, at trade in services, and at Africa's trade with the rest of the world.

Formal trade arrangements

Since ARIA VI, Africa's regional economic communities have made further advances in liberalizing trade.

AMU

At the time of writing (October 2015), AMU has nearly concluded negotiations on the AMU Free Trade Area but still has to finalize provisions on rules of origin. Working groups from AMU member States are discussing how to harmonize national customs nomenclatures and proce-

dures, trade regulations and norms, and standards for goods and services. In December 2014, AMU Ministers of Trade created a working group on the Boosting Intra-Africa Trade initiative and on AMU member States' negotiations for the Continental Free Trade Area (AMU, 2015).

ECOWAS

The ECOWAS customs union, which came into force in January 2015, applies a common external tariff at the following rates:

- Zero per cent on essential social goods, covering 85 tariff lines.
- 5 per cent on goods of primary necessity, raw materials, capital goods and specific inputs, covering around 2,100 tariff lines.
- 10 per cent on intermediate goods, covering around 1,400 tariff lines.
- 20 per cent on final consumer goods and goods not specified elsewhere, covering 2,200 tariff lines.
- 35 per cent on specific goods for economic development, covering 130 tariff lines (Kwakye, 2015; ECOWAS Commission, 2015a).

ECOWAS has created mechanisms to ensure that member States implement the common external tariff:

- A customs valuation mechanism, to ensure that all member States apply the same system of customs valuation.
- Regulations to ensure that inputs for the manufacture of zero-rated products do not face tariffs significantly above those placed on the final product.
- Safeguard, trade, defence and anti-dumping measures. These include supplementary protection measures allowing member States to deviate from the common external tariff for a maximum of 3 per cent of the tariff lines identified in it.

The ECOWAS Commission has built capacity in member States to help implement this tariff (ECOWAS Commission, 2015a). By the end of April 2015, eight of ECOWAS's 15 member States had begun (ECOWAS Commission, 2015b).[3]

COMESA

As part of the conclusion of negotiations on the Tripartite Free Trade Area (box 2.1) between COMESA, EAC and SADC, the Democratic Republic of the Congo and Ethiopia committed to join COMESA's Free Trade Area in the next three years.

Box 2.1.

The Tripartite Free Trade Area Agreement

A key advance was that representatives of most of the 26 member States of COMESA, EAC and SADC, with a combined GDP of $1.2 trillion in 2013 (UNCTADStat, 2015), signed the Tripartite Free Trade Area Agreement on 10 June 2015 in Sharm-el-Sheikh, Egypt. It aims to liberalize 100 per cent of tariff lines (with general, specific and security exceptions). Sixty to 85 per cent of tariff lines are to be liberalized upon entry into force of the Agreement, while the remaining 15 to 40 per cent will be negotiated over five to eight years. The Agreement has several other notable features:

- While tariff offers have not yet been finalized for all countries, the five members of EAC and five members of the Southern African Customs Union, along with 10 members of COMESA, made tariff offers of 100 per cent liberalization on a reciprocal basis.
- Existing COMESA, EAC and SADC mechanisms for removing non-tariff barriers will be consolidated into a single mechanism.
- Rules of origin determine which products qualify for tariff preferences and will form a list of rules specific to particular products under the provisions of the Tripartite Free Trade Area. Rules of origin for 25 per cent of product types have already been agreed on.
- The Agreement includes anti-dumping, countervailing and safeguard measures to address dumping, subsidies and import surges. The technical details will be finalized by mid-2016.
- The Agreement provides for a dispute settlement body and specifies its powers, which include establishing panels and an appellate body and

Continued

Box 2.1.

The Tripartite Free Trade Area Agreement (continued)

monitoring implementation of their rulings and recommendations.

- Quantitative restrictions on imports (quotas) will be eliminated.
- The Agreement includes commitments to trade facilitation and facilitation of transit trade; protection of infant industries; and balance-of-payments–related provisions.
- It has provisions for enhancing cooperation between national customs authorities.
- The second phase of the negotiations will last until June 2017 and will cover services, competition policy, intellectual property rights, movement of business persons and other trade-related matters.
- The Agreement will enter into force after the remaining technical steps have been completed and it has been ratified by at least 14 member States. This is expected to occur during 2016.

Potential economic gains from the Tripartite Free Trade Area

Recent ECA analysis (Mold and Mukwaya, 2015) suggests that the Tripartite Free Trade Area will have substantial effects on intra-regional trade within Eastern and Southern Africa, possibly with gains of around $8.5 billion, or a one-third increase from its current level. Most of the gains would come via improved terms of trade in industrial goods, which promise to boost industrial productivity, because African manufacturing firms usually show substantial increases in productivity after they begin to export. The paper also forecasts welfare increases of around $2.4 billion. These estimates do not include potential gains if the Tripartite Free Trade Area were to be extended to cover trade in services—COMESA, EAC and SADC member States are negotiating that aspect.

Many commentators expected a more ambitious trade liberalization outcome through the Tripartite Free Trade Area, particularly on the tariff reductions that are yet to be finalized. Much work, including that on rules of origin, has to be finalized to put the agreement into effect. Still, June's signing is a huge step to rationalizing Africa's regional trade arrangements and promoting freer trade between African countries, and a key milestone for Africa's integration (Luke and Mabuza, 2015).

Four of the eight major regional economic communities have free trade areas in operation (COMESA, EAC, ECOWAS and SADC) and two, customs unions (EAC and ECOWAS). ECCAS has a free trade area but implementation has yet to hit full throttle: ECCAS member States have on average reduced only 34 per cent of tariff lines on intra-ECCAS tariffs to zero and the region has the lowest share of intra-regional trade in terms of gross domestic product (GDP) of any of Africa's five subregions (ECA and African Union Commission, 2015a; UNCTADStat, 2015). Implementation of COMESA's customs union is similarly limited. According to the Abuja Treaty, all regional economic communities should establish REC-level Free Trade Areas and customs unions by the end of 2017.

Continental Free Trade Area

June 2015 also saw the formal launch of negotiations for the Continental Free Trade Area. Negotiations are expected to last until the end of 2017 and will cover trade in goods and services, investment, intellectual property rights and competition policy (Luke and Sodipo, 2015). African Union member States have set out the objectives for the negotiations:

- An agreement to address the challenges posted by multiple and overlapping memberships of regional economic communities.
- Reservation of the *acquis* (building on what has already been agreed through existing agreements).
- Variable geometry (different countries may reduce tariffs at different speeds), flexibility and special and differential treatment.
- Most-favoured-nation treatment (countries must extend the preferences that they grant under the Continental Free Trade Area to all African countries equally).

- National treatment (once import tariffs have been paid, goods and services from other African countries will be treated the same as domestic goods and services by domestic regulations and internal taxes).

- Reciprocity.

- Decisions in the negotiations to be taken by consensus (unanimity).

- Adoption of a detailed Indicative Roadmap on the Negotiation and Establishment of the Continental Free Trade Area.

The African Union Commission has mobilized around $18 million to support the negotiations, including funds for a dedicated Continental Free Trade Area Unit with the required expertise. The African Union Commission is coordinating an assessment of how member States and regional economic communities need to develop their negotiating capacity (African Union, 2015, 2015a). As shown in ARIA V, the Continental Free Trade Area is expected to bring wide economic benefits to Africa, via deeper regional integration and higher incomes and GDP (ECA, African Union Commission and African Development Bank, 2012).

Intra-African trade in goods

To measure trade integration of African countries, an obvious starting point might be the absolute value of a country's trade in goods with other African countries, but this is not perfect because populous countries, with large economies, may trade heavily with the rest of Africa but the volume may be only a small fraction of their total trade—they trade because of their size, not openness. For this reason, the ratios of intra-African imports and exports to GDP are examined as primary indicators of trade openness.

Intra-African trade as a share of GDP is low relative to that of other regions: intra-continental imports are estimated to be 4.3 per cent of Africa's GDP, against 6.7 per cent in the Americas, 17.9 per cent in Asia and 21 per cent in Europe (UNCTADStat, 2015). Still, intra-African trade in goods as a share of GDP has risen sharply since around 2000 (info 2.1).

A high level of intra-African exports and imports indicates that a country has taken important steps to keep trade barriers with other African countries low (see info 1 and figures 2.1 and 2.2). Otherwise, the cost of trading would tend to render the country's products uncompetitive in other African markets and to reduce the proportion of a country's income spent on imports from the rest of Africa.

Countries in southern Africa appear to have the highest shares of intra-African trade in GDP: the nine with the highest shares of intra-African imports to GDP are all members of SADC, although this could be due to their proximity to South Africa and because they are members of the SADC Free Trade Area, which generates trade with South Africa as the regional hegemon.

To investigate whether this is true, the African Trade Policy Centre at ECA examined the proportion of these countries' intra-African trade accounted for by trade with South Africa. It found that, for some of the countries with the highest shares of intra-African exports to GDP (such as Swaziland, Lesotho and Zimbabwe), most of these exports were indeed to South Africa. However, for some of the other SADC member countries with similarly high shares on this metric, such as Namibia and Zambia, this was not the case, suggesting that trade between SADC countries and South Africa partly, but not entirely, explains the strong performance of SADC countries in intra-African exports.

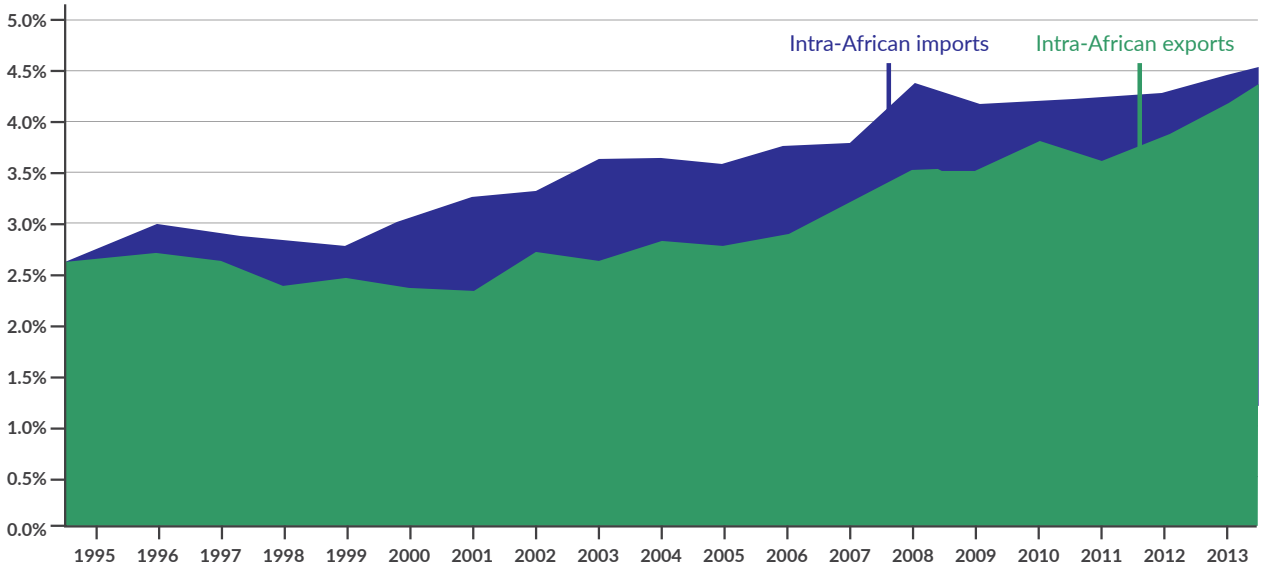
ECA also examined SADC countries' scores vis-à-vis South Africa in the UNCTAD merchandise trade complementarity index, which measures how closely the distribution of exports of the exporting country (across various product lines) matches the imports of the importing country. A higher score indicates a higher degree of complementarity that should contribute to greater trade between the two countries. Here it found that the complementarity between SADC countries' exports and South Africa's imports is not particularly high, suggesting that the complementarity of SADC countries' exports with South Africa's imports may not explain the high degree of trade between the two sides.

On SADC countries' imports from South Africa as a share of their GDP, many of the countries with the highest shares of intra-African imports to GDP (such as Lesotho, Swaziland, Namibia, Botswana, Zimbabwe and Zambia) have the majority of those imports coming from South Africa. Furthermore, the complementarity of SADC countries' imports with South Africa's exports, as meas-

Info 2.1—Intra-African trade

Intra-African trade as a share of GDP is low relative to that of other regions. Intra-continental imports are estimated at 4.3 per cent of Africa's GDP, against 6.7 per cent in the Americas, 17.9 per cent in Asia and 21 per cent in Europe. Still, intra-African trade in goods as a share of GDP has risen sharply since around 2000.

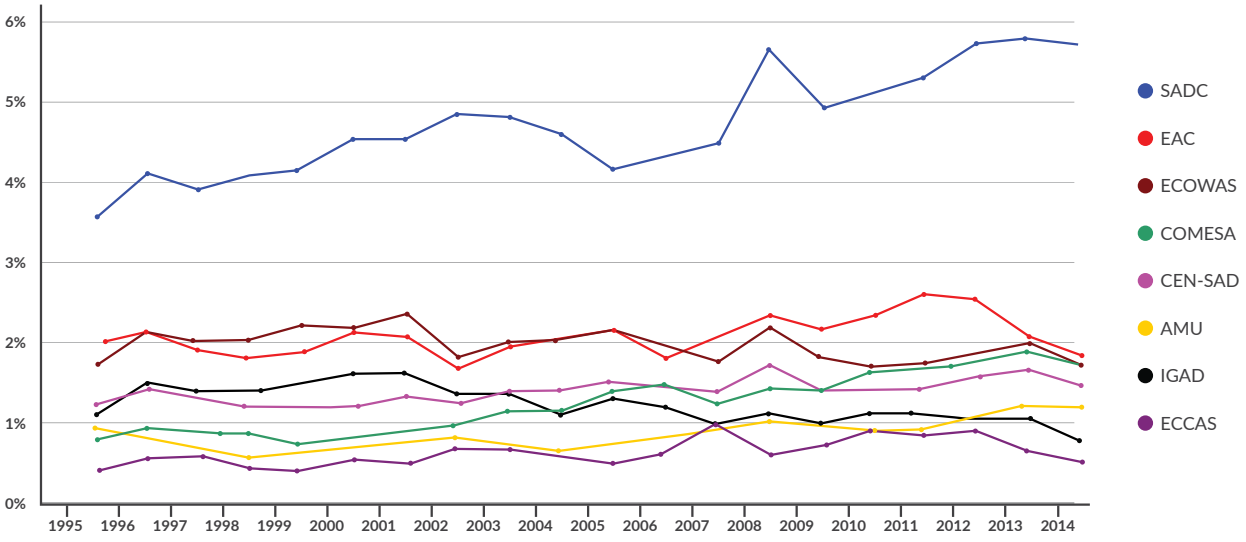
Growth in share of intra-African trade in Africa's GDP, 1995–2013



Source: ECA.

Among the eight AU-recognized RECs, SADC consistently has the highest share on intra-REC imports, even though it does not have the lowest intra-REC average applied tariffs. Thus other factors, such as trade complementarity, may explain the pattern of trade within SADC.

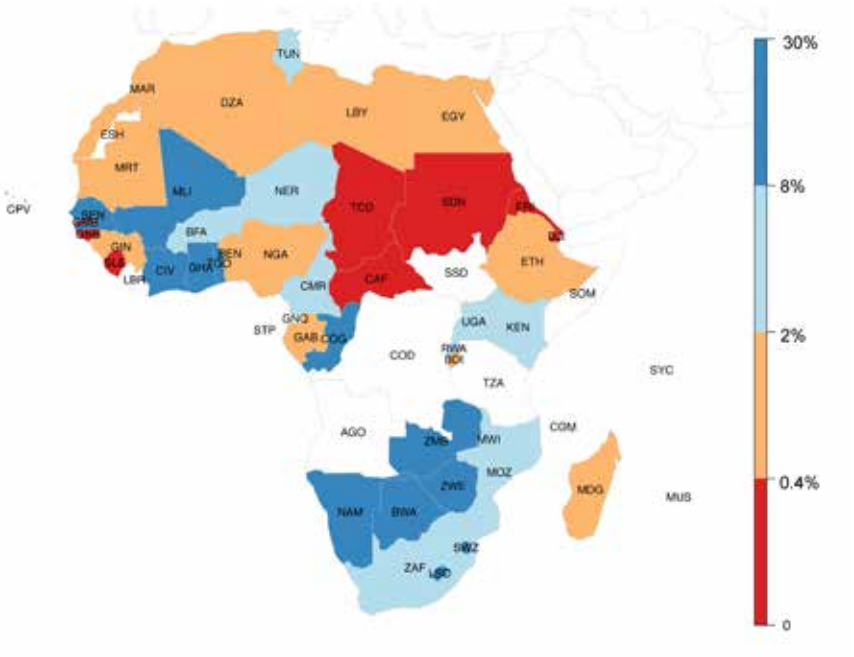
Intra-REC imports as a share of GDP, 1995–2014



Source: ECA. Calculations based on UNCTADStat, 2015.

Figure 2.1.

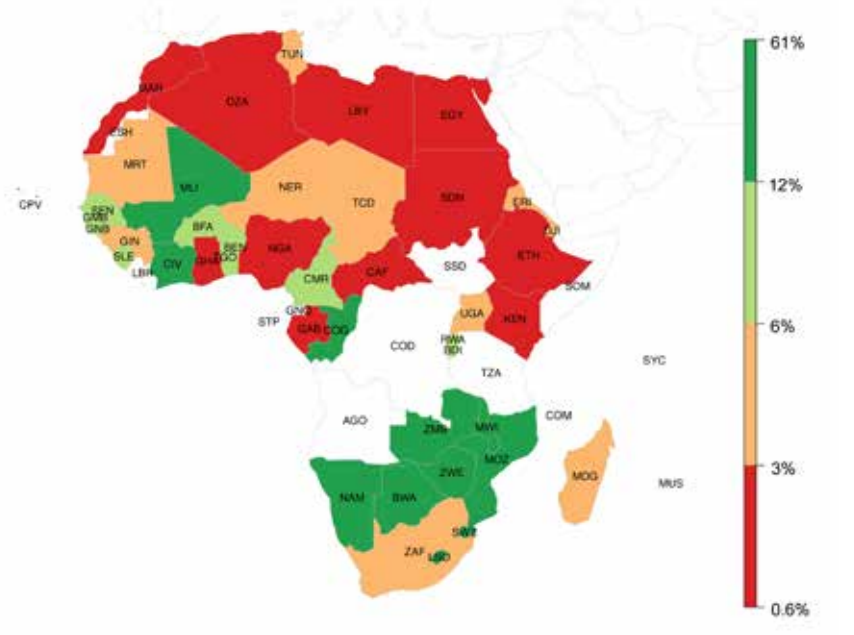
Intra-African exports as a share of GDP, including re-exports, 2013



Source: ECA calculations based on UNCTADStat (2015).

Figure 2.2.

Intra-African imports as a share of GDP, including re-exports, 2013



Source: ECA calculations based on UNCTADStat (2015).

ured through the above UNCTAD index, is relatively high, which could indicate that Southern Africa's high performance on intra-African imports stems from SADC countries' imports from South Africa, in turn due to the complementarity between South African exports and SADC countries' imports.

Intra-regional economic community trade

Some of Africa's regional economic communities perform strongly against other regional integration blocs worldwide (figure 2.3). SADC in particular, with intra-regional imports of 6.6 per cent of GDP, has the fifth-highest ratio worldwide among 32 regional blocs. Others, however, perform quite poorly and can be found in the bottom third of the regional blocs considered on this measure.

Among the eight African Union-recognized regional economic communities, SADC has consistently the highest share on this metric (see info 1), even though it does not have the lowest intra-regional economic community average applied tariffs. Thus other factors, such as trade complementarity (above), may explain the pattern of trade within SADC.

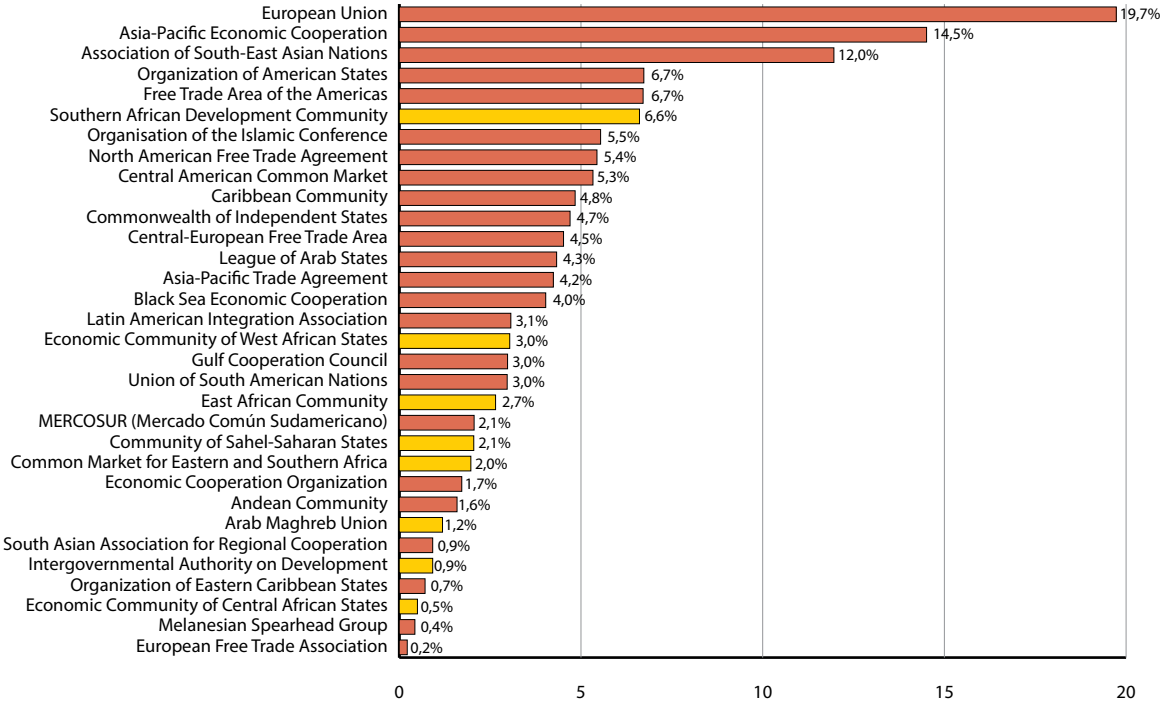
Tariff liberalization

Tariffs are an important determinant of intra-regional trade because they increase the price of imported goods. Through frameworks like Agenda 2063 and the BIAT initiative, African countries are committed to reducing tariffs on African products, among regional economic communities and at continental level. Where a country has a low share of intra-regional imports in GDP despite low tariffs on intra-regional imports, this may point to low demand for other regional countries' goods or non-tariff barriers, or both.

This review begins by examining the average applied tariffs on intra-regional economic community imports, calculated using data (on preferential tariffs on such imports disaggregated at six-digit product level and by partner country) from the International Trade Centre's Market Access Map database. A weighted average of these tariffs is then created using bilateral import

Figure 2.3.

Intra-regional imports as a share of regional GDP, 2013



Source: ECA calculations based on UNCTADStat (2015).

data (also disaggregated at the six-digit level) from UN Comtrade to weight each tariff according to its share in the country's imports from the regional economic community in question. The data here refer to the most recent year that both tariff and trade data were available for a given country.

Libya consistently applies a zero tariff on imports from the regional economic communities of which it is a member.[4] Mauritius also applies zero tariffs on imports from SADC and an almost-zero tariff on imports from COMESA. All EAC members have a zero average applied tariff on imports from other members of that grouping. The large variations in average applied tariffs between different regional economic communities may reflect which regional economic communities have established Free Trade Areas and the extent of tariff liberalization (info 2).

Even within the regional economic communities that have Free Trade Areas (such as COMESA, ECCAS, ECOWAS and SADC) many tariff lines are not yet fully liberalized. Info 2.2 displays the proportion of fully liberalized tariff lines (a zero-rated tariff) in seven of the eight regional economic communities.[5]

Non-tariff barriers and gains in trade facilitation

Recent literature argues that removing non-tariff barriers and implementing trade facilitation reforms in Africa will greatly boost trade integration and growth (ECA, African Union Commission and African Development Bank, 2012b; ECA and African Union Commission, 2015b; ECA and African Union Commission, 2015c; ECA, 2014). Such reforms include simplifying customs procedures, harmonizing the opening hours of border posts, introducing one-stop border posts and removing road blocks along intra-regional transport routes.

The following extract from ECA and African Union Commission (2015) details some of the progress in eliminating non-tariff barriers in regional economic communities:

> At the latest update, under its NTB [non-tariff barrier] time-bound elimination programme, EAC [EAC] had removed 78 NTBs (though 4 new ones had been added). On average, only 4.2 NTBs [non-tariff barriers] remain per EAC [EAC] member country (EAC, 2015).
>
> Within COMESA, at the last count the REC had removed 220 out of 225 reported NTBs (COMESA, 2015a).
>
> More broadly within the Tripartite [Agreement], the Tripartite Non-Tariff Barriers Reporting, Monitoring and Elimination Mechanism had, at the latest count, resolved 406 out of a total of 492 registered complaints about non-tariff barriers (Tripartite, 2015).
>
> [S]ixteen out of nineteen COMESA countries use the [Automated System of Customs Data Management] electronic customs system (COMESA, 2015b).
>
> Within UMA, progress in trade facilitation and removal of non-tariff barriers appears to be limited and there could be further progress (ECA, 2013).
>
> The Tripartite and ECOWAS have made significant progress in implementing transport facilitation measures. Within ECCAS progress has been more limited.

Transport facilitation measures adopted at regional economic community level for goods and persons have moved ahead (table 2.1).

On the ease of trading across borders in 2015 (taken from the World Bank's Doing Business indicators), Mauritius and Morocco scored the highest among African countries. (Swaziland was the highest-scoring landlocked African country.)

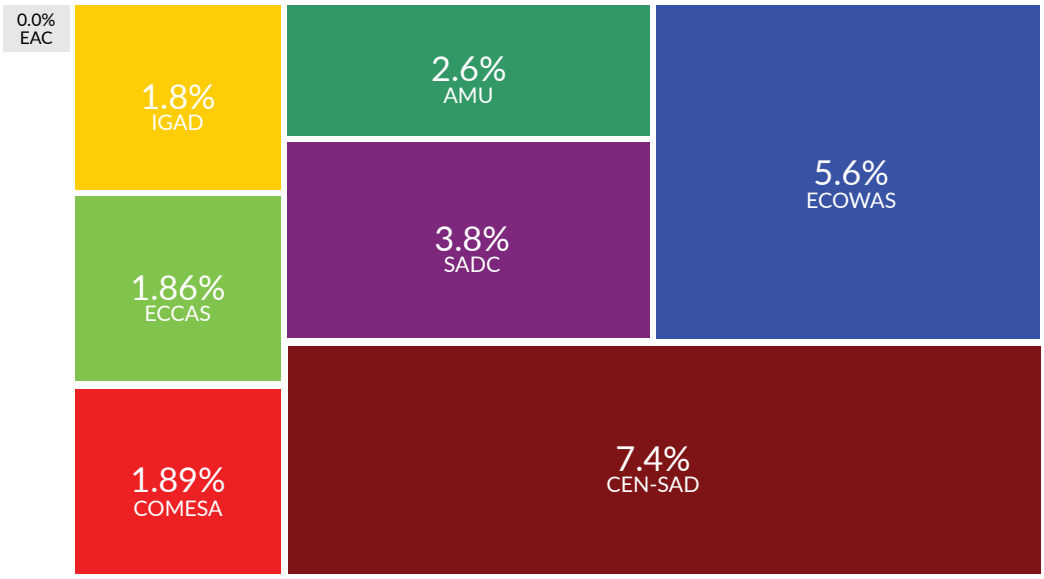
Regional value chains

Stronger regional value chains help Africa to realize its economic aspirations, particularly structural transformation and inclusive growth (ECA, 2015), allowing it to retain more value added in its production processes. Because higher value-added activities are often associated with faster productivity growth and enhanced export competitiveness, this may lead to a virtuous circle: greater productive integration boosting competitiveness, intensifying exports to countries outside of Africa, leading to greater demand for the same intermediate inputs from Africa, leading to further productivity gains … and so on. Industrial development has been shown

Info 2.2—Applied tariffs across RECs

All EAC members have a zero average applied tariff on imports from other members of that grouping. The large variations in average applied tariffs between different RECs may reflect which RECs that have established free trade agreements and the extent of tariff liberalization.

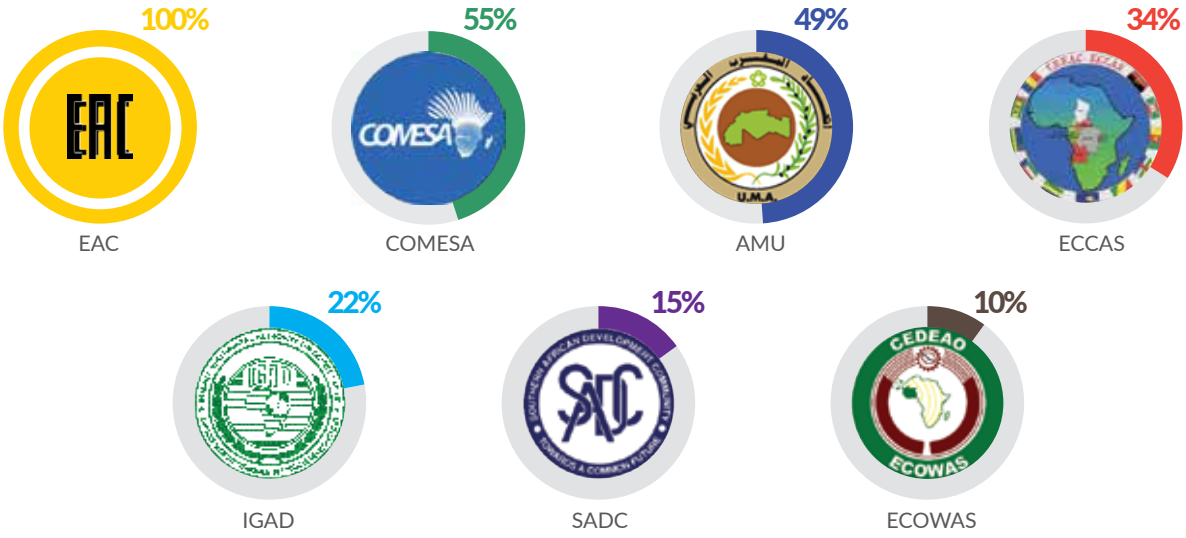
Average applied tariff by REC members on imports from other members of that REC



Source: ATPC calculations based on ITC, 2015; UNSD, 2015.

Even within RECs that have free trade agreements—such as COMESA, ECCAS, ECOWAS and SADC—many tariff lines are not yet fully liberalized.

Share of fully liberalized tariff lines (%)



Source: ECA and AUC, 2015.

Table 2.1.

Transport facilitation measures undertaken by regional economic communities

Issue	East Africa (EAC/ COMESA)	Southern Africa (SADC)	West Africa (ECOWAS)
Vehicle load and dimensions control (axle load and gross vehicle mass (GVM) limits)	Yes	Yes	Yes—Inter-State Road Transport
	Axle load	Axle load	Axle load
	GVM	GVM	GVM
	Weighbridges installed	Weighbridges installed	
Road transit charges	Harmonized among the three regional economic communities		
Carrier licence and transit plates			
Third-party motor insurance	Yellow Card	Yellow Card (of COMESA)	ECOWAS Brown Card scheme (Convention A/P1/5/82) and CIMA Code
Road customs transit declaration document	COMESA Customs Declaration Document	Single Administrative Document	ECOWAS Interstate Road Transit Scheme—Convention A/P4/5/82 and Supplementary Convention A/SP.1/5/90
Road checkpoints	Significant reduction		ECOWAS Interstate Road Transport—Convention A/P.2/5/82
Regional customs bond	Customs Bond Guarantee Scheme, harmonized among the 3 regional economic communities		Customs Agreements on Inter-State Road Transit (TRIE Convention)
One-stop border posts	15 envisaged; 7 under development	Chirundu One-stop border post pilot; other One-stop border post projects in the North-South Corridor	At least 12 envisaged
ICT for vehicle tracking and fleet management			

Note: The only measure adopted by ECCAS is harmonized third-party vehicle insurance (the ECCAS Orange Card).

Source: Valensisi, Lisinge and Karingi (2014); ECA and African Union Commission (2015).

to support inclusive and sustainable growth (ECA and African Union Commission, 2013) and is a goal in the African Union's Minimum Integration Programme and Agenda 2063.

A key aspect in expanding and tightening Regional value chains is trade in intermediate and capital goods, although volume of trade in these goods is not a perfect indicator of regional value chains' development, as they are not always used to produce other goods. For example, the United Nations Conference on Trade and Development (UNCTAD) classifies the meat of bovine animals as an intermediate good (see Country Profile Product Metadata for UNCTAD SOP2), yet such meat can be used to produce ready meals and consumed directly. Thus some trade in intermediate goods (as defined for this report) may fail to show a value chain across countries and simply show that a country is importing finished goods. That said, a broad range of African countries had no data from official sources on the value of intermediate goods used for further value addition. Therefore, the value of trade in intermediates defined in terms of whether the product could be used for further production (and already had value added) was seen as the next best alternative.

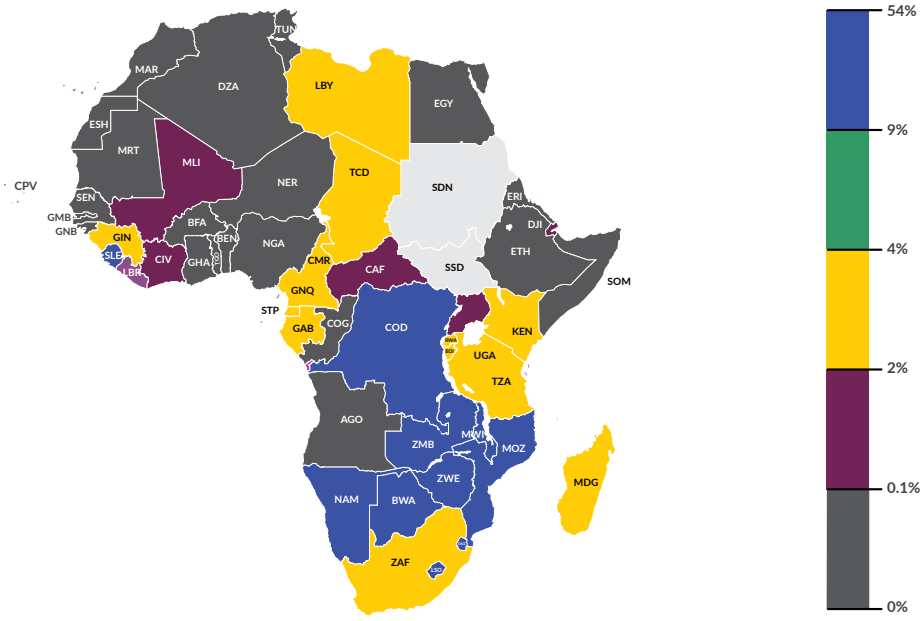
Info 3 shows the imports and exports of intermediate and capital goods of each country with the rest of Africa as a share of GDP. Of the eight African Union-recognized regional economic communities, SADC has by far the highest median share of intermediate imports in followed by ECOWAS, suggesting that intra-SADC production networks may be stronger in these two regional economic communities than elsewhere.

Intra-African trade in intermediate and capital goods increased at an average annual rate of 11.2 per cent in real terms between 1999 and 2013, outstripping real growth (4.4 per cent).

Info 2.3—Trade in intermediates and in services

Of the eight AU-recognized RECs, SADC has by far the highest median share of intermediate imports in GDP, followed by ECOWAS, suggesting that intra-SADC production networks may be stronger in these two RECs than elsewhere.

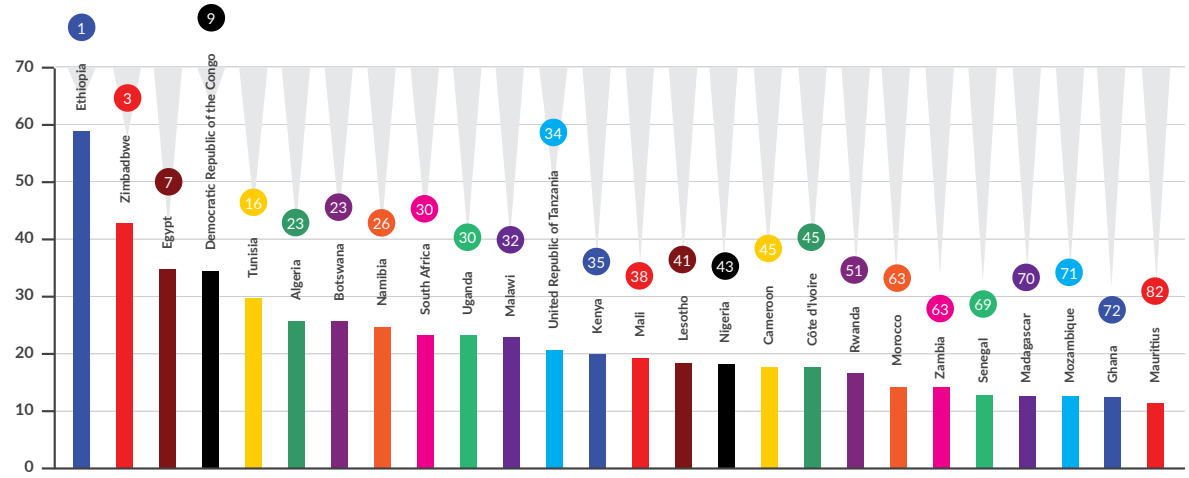
Intra-African imports of intermediate and capital goods as a share of GDP, 2013



Source: ECA calculations based on UNCTADStat, 2015.

African countries' policies on trade in services do not seem to be particularly favourable compared with policies in the rest of the world. Most African countries with data rank in the top (more restrictive) half of the World Bank's 104-country Service Trade Restriction Index.

The higher the rank, the more the restrictions on trade in services



Note: Rankings of the 104 countries on the World Bank Service Trade Restriction Index are shown above the country names.

Trade in services

It is hard to make precise inferences about intra-African trade in services because African countries do not generally publish services trade data disaggregated by partner country, but one can put forward patterns and trends. In 2014, Africa imported $183 billion in services and exported $106 billion. As imports exceeded exports, Africa must have imported the excess from outside the continent (otherwise, these flows would have been included in recorded exports). This $77 billion imported-services deficit represents business that could be captured by African firms if barriers to intra-African trade in services were lowered. Imports from outside the continent were particularly strong in transport services, at $41 billion (UNCTADStat, 2015; Luke, 2015).

ECA attempted to estimate an upper bound for intra-African trade in services. First, it took Africa's total reported exports of services and subtracted imports of services from Africa reported by non-African partners. It then performed a similar calculation, taking Africa's total imports of services and subtracting services exports reported by the continent's trading partners. The lower of these two estimates—$85 billion in 2013—was considered a rough upper band (Luke, 2015).

African countries' policies on trade in services do not seem to be particularly favourable compared with policies in the rest of the world. Most African countries with data rank in the top (more restrictive) half of the World Bank's 104-country Services Trade Restrictions Index (see info 2.3).

Trends in trade with the rest of the world

After negotiating for 12 years, African countries have recently made progress towards signing economic partnership agreements with the European Union, though only a handful have started provisionally applying them.[6] Most other countries are still conducting "legal scrubbing"—preparing them for signature before ratifying them.

The economic partnership agreements are reciprocal but asymmetrical agreements between the European Union and African countries, as the European Union must grant immediately 100 per cent free market access to African countries, whereas African economies are required only to progressively make free of duties not less than 75 per cent of their imports from the European Union. The agreements are expected to deliver benefits to both sides but the gains for Africa are expected to be concentrated in just a few non-industrial sectors, such as rice, milk, sugar and meat, and to accrue mainly to African non-least-developed countries. Gains for the European Union would be more generalized, largely owing to initial asymmetrical protection structures. The projected increase in Africa's exports to the European Union would also come at the expense of intra-African trade, and African governments would suffer a sharp drop in tariff revenues (ECA, 2015). Nevertheless, efforts from the European Union to provide compensation to African countries under the Economic Partnership Agreements Development Programme should be acknowledged. These are expected to offset at least some of the possible costs of the economic partnership agreement reforms.

African countries would, however, be better off if they established the Continental Free Trade Area before fully implementing economic partnership agreement reforms, which would largely preserve the trade gains for Africa and the European Union from the Economic Partnership Agreements. Moreover, possible negative impacts (from the Agreements without the Continental Free Trade Area) would be more than offset. With the Continental Free Trade Area already in place intra-African trade would expand considerably, especially if trade facilitation measures were adopted and non-tariff barriers lowered. Any losses in tariff revenues would be negated thanks to trade gains. The largest share of trade benefits for African economies would be felt in industrial products, offering positive perspectives for Africa's industrialization and structural transformation (ECA, 2015).

Africa's imperative to establish the Continental Free Trade Area and tackle non-tariff barriers as fast as possible is further underlined by current negotiations on "mega-regional" trade agreements, such as the Trans-Atlantic Trade and Investment Partnership, the Trans-Pacific Partnership and the Regional Comprehensive Economic Partnership, in which no African countries participate. The impact of preference erosion (a major outcome for Africa when these agreements come into force) will probably be softened if the Continental Free Trade Area is already in place (ECA, 2015).

Informal trade

The informal sector forms a large portion of African economies (ECA and African Union Commission, 2014). Data, however, are scant, and collection presents multiple challenges. Some African countries have started to produce informal trade statistics, but coverage is still insufficient for meaningful analysis here.

Economic trends

Macroeconomic policy convergence will support Africa's integration by contributing stability and predictability to macroeconomic conditions, reducing commercial risk and encouraging cross-border trade and investment. Macroeconomic stability will also reduce the risk of recession, which otherwise could threaten to spill across borders. Once Africa achieves a monetary union, as foreseen in the Abuja Treaty, this aspect will be particularly important (Organization of African Unity, 1991). Several regional economic communities have already agreed to converge their policies.

Over the last two years inflation generally continued to decline in Africa, reflecting prudent monetary policies, decreasing global prices for oil and other commodities, and good harvests, although some countries experienced a sharp rise due to currency depreciation and responded with tighter monetary policy.

Inflation in Africa as a whole is projected at 6.9 per cent in 2015 and 6.7 per cent in 2016. In Southern Africa, inflation was 6.2 per cent in 2014 and is projected at 6 per cent in 2015. The equivalent figures for North Africa are 7.2 per cent and 7.1 per cent. Egypt is expected to have the highest inflation in North Africa at 10.1 per cent (ECA, 2015).

Africa's fiscal deficit widened in 2014 from 2013 on government infrastructure spending and lower revenues from oil and other commodities. Several African countries, including Nigeria, Senegal and South Africa, cut non-essential expenditure, inefficiency and waste in the public sector. Revenue collection is expected to increase in some countries, such as Ethiopia and Rwanda, as they reform their tax systems. Africa's fiscal deficit is projected to fall from 2014 to 2015 and to maintain that trend in 2016 (ECA, 2015).

Among subregions, fiscal deficits were expected to narrow from 2014 to 2015: in North Africa from 6.6 per cent of GDP to 5.8 per cent, in Southern Africa from 4.2 per cent to 3.7 per cent and in West Africa from 5.2 per cent to 4.3 per cent. By country, Botswana's budget surplus was forecast to be 1.2 per cent of GDP in 2015; Nigeria's fiscal deficit was projected to be 2.1 per cent of GDP, in part due to lower oil revenues. Senegal's fiscal deficit was expected to fall from 5.1 per cent of GDP to 4.1 per cent on spending reductions. Egypt, Ghana and Tanzania were forecast to have higher fiscal deficits in 2015, with deficits forecast to be 8 per cent (Egypt), 10.7 per cent (Ghana) and 7 per cent (Tanzania). Kenya's fiscal deficit was projected to decrease (ECA, 2015).

The continent's current account deficit widened from 2013 to 2014 owing to falling export earnings and rising imports of capital goods. Private capital inflows are expected to have climbed during 2015 due to an improved business environment and stronger economic management (ECA, 2015).

Most African currencies were projected to depreciate against the US dollar in 2015, particularly the Kenyan shilling, on global monetary policy tightening, as was the CFA franc. The South African Rand, by contrast, was projected to appreciate (ECA, 2015).

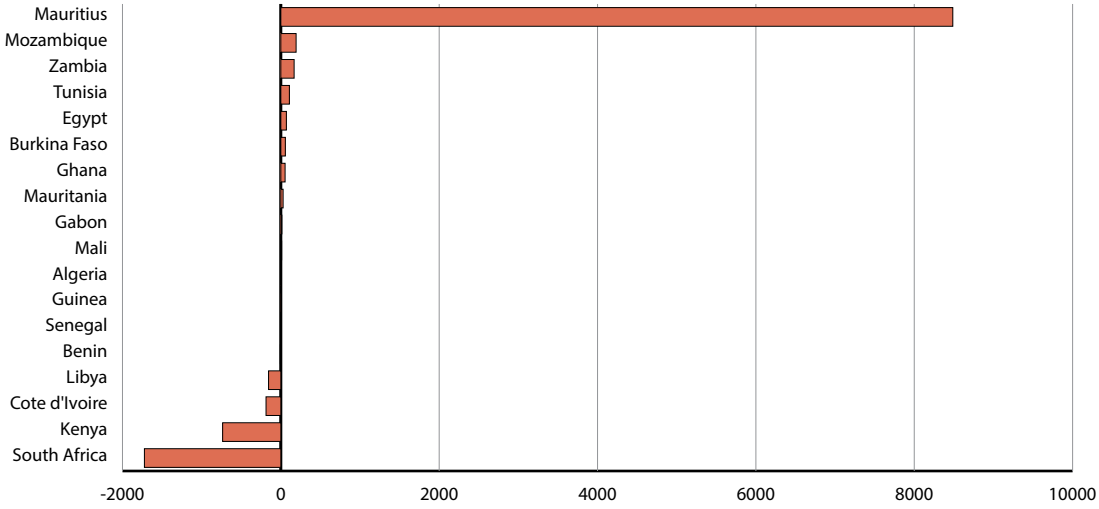
The current economic slowdown in China could pose problems for African countries, given the extent China imports goods from Africa (see, for example, ECA and African Union Commission, 2014). China's status as the world's first or second largest economy (depending on the data used) means that its deceleration could also further lower global commodity prices, which hit African exports more, and thus African currencies, possibly causing difficulties in debt servicing and repayment for African countries with dollar-denominated sovereign bonds.

Financial integration

African financial integration—facilitating financial flows among countries—is an important part of wider integration because it allows finance from across the continent to be allocated to where it is most productive and allows African investors to enhance their returns. As some recent literature on foreign direct investment has shown, financial integration would also support knowledge, technology transfer and innovation among

Figure 2.4.

Intra-African outward direct investment flows, latest year[7] ($ million)



Source: International Monetary Fund Coordinated Direct Investment Survey database (2015).

African countries, supporting advances in productivity and spurring development. Agenda 2063, for example, notes that African Union member States aim for an Africa in 2063 with "free movement of…capital… [leading to] significant increases in…investments amongst African countries" (African Union Commission, 2015a).

Figure 2.4 shows intra-African outward direct investment. A negative value shows that a country has reduced the value of its total direct investment position, either because the investments have declined in value or because investors from that country have withdrawn investments. The weight of Mauritius, despite its small economy, suggests that much foreign investment to Africa may be routed through that country to take advantage of its favourable tax regime and its status as an offshore financial centre.

In recent years, African banks have expanded into multiple countries on the continent, marking financial integration (table 2.2).

African countries have also made progress in changing policy and infrastructure frameworks to facilitate cross-border financial transactions. For example, South Africa, Namibia, Lesotho and Swaziland adopted the SADC Integrated Regional Electronic Settlement System in 2013 (UNCTAD, 2015b).

Recent progress in the development of Africa's continental financial institutions has included the launch of African Development Bank's Africa50 Fund to provide support to finance Africa's infrastructure needs, including through mobilizing resources from Africa (African Development Bank, 2013b). Currently, Africa is estimated to have a financing gap of $50 billion per

Table 2.2.

African banks in multiple African countries, 2013

Name	Number of African countries where the bank is present	Headquarters	Majority ownership
Ecobank	32	Togo	South Africa
United Bank for Africa	19	Nigeria	Nigeria
Standard Bank Group	18	South Africa	South Africa
Banque Sahélo Saharienne pour l'Investissement et le Commerce	14	Libya	Libya
Attijariwafa Bank	12	Morocco	Morocco
Habib Bank Limited	5	Pakistan	Tanzania

Note: A representative office does not classify a bank as "present" in a country.

Source: UNCTAD (2015a).

year for its infrastructural needs (African Development Bank, 2015c). The Africa50 Fund will focus on energy, transport and mining infrastructure but will also fund projects in ICT and water and sanitation (African Development Bank, 2015b). The Fund has raised $830 million in share capital from 20 African countries; its medium-term capitalization is expected to be $3 billion (African Development Bank, 2015a).

In North Africa, the member States of AMU were expected to inaugurate the Maghreb External Trade Bank in Tunis by the end of 2015 (AMU, 2015).

Free movement of persons and the right of establishment

All Africa's regional economic communities consider free movement of persons a priority integration area (African Union Commission, 2010a). Not only a goal in its own right, it supports other aspects of regional integration such as trade in services, as it allows service providers to deliver services on-site (in the case of business services, for example) and allows recipients to travel to the providers abroad (education, medical care or tourism, and so on). Increased trade in services also has the potential to encourage Africa's industrialization (ECA, 2015). And allowing labour to be re-allocated to where it is most productive may greatly increase Africa's output (ECA, African Union Commission and African Development Bank, 2012a). Under Agenda 2063, free movement of persons is part of Africa's vision for its future (table 2.3).

Since ARIA VI, few new regional or continental agreements have emerged, although several countries have taken steps:

- Kenya has reformed its national immigration laws to facilitate free movement of persons within EAC.
- Kenya and Rwanda have abolished fees for work permits for nationals of EAC countries.
- Kenya, Rwanda and Uganda have each agreed to allow nationals of these three countries to enter their territories with only their national ID card.

Table 2.3.

Measures on free movement of persons by regional economic community

Regional economic community	Countries having implemented freedom of movement protocol	Common passport	Universal tourist visa	Right of establishment (for business)
AMU	3 out of 5	No	No	No
CEN-SAD	Unclear	Visa waived for diplomats and certain professions	No	Right of residence (not ratified)
COMESA	Only Burundi has ratified	No	No	No
EAC	3 out of 5	Yes	Kenya, Rwanda and Uganda have launched a universal tourist visa for these three countries. It is planned that other EAC members will also join the universal tourist visa	Yes; 2 out of 5 ratified; Kenya, Rwanda and Uganda have agreed to let nationals of the three countries establish themselves in either of the other two
ECCAS	4 out of 11	Travel books, cards, special airport arrival facilities	In progress	Yes (4 out of 11 implemented)
ECOWAS	All 15	Yes, travellers' cheques	No	Yes
SADC	7 out of 15	Yes, but visa still required in South Africa and Zimbabwe after 90 days	In progress	No
West African Economic and Monetary Union	All 6	Harmonized with ECOWAS	No	Yes

Note: The West African Economic and Monetary Union (WAEMU) is not one of the eight African Union–recognized regional economic communities but is included because of plans to merge the organization with ECOWAS (recognized by the African Union) and because its members have harmonized their common passport with ECOWAS.

Source: Brookings Institution (2012, 2014; ECA, African Development Bank and African Union Commission (2013); ECA and African Union Commission (2015).

- Mauritius, Rwanda and Seychelles have removed visa requirements for nationals of other COMESA member States, while Zambia has waived visas for travellers on official business (Business Daily, 2015).

The average ratification rate for regional economic community protocols is around 60 per cent[8] among regional economic communities (broken down by country in info 2.4).

Little progress has been made on the proportion of members ratifying their regional economic community's protocol on free movement of persons.[9]

Infrastructure integration

Africa's infrastructure deficits have been estimated to cost the continent up to 2 percentage points of annual economic growth (African Union Commission, 2015b). African leaders committed in Agenda 2063 to speed up action to connect the continent through world-class infrastructure, including interconnectivity between island states and the mainland. They also committed to mobilizing financial resources to implement major projects in transport, energy and ICT. These moves are in line with the goals of the Programme for Infrastructure Development in Africa to bring together and merge various continental infrastructure initiatives. (African Union Commission

African countries and regional organizations are indeed taking steps to accelerate implementation, nationally and regionally, in particular in the context of Programme for Infrastructure Development in Africa's Priority Action Plan. Major challenges are tied to weak national ownership, finance, technical capacity and institutional arrangements.

African countries have made commendable strides towards closing the infrastructure deficit, funding nearly half ($46.7 billion out of $99.6 billion) the total in 2013. Most have raised their budget for infrastructure in recent years: while overall government budgets in Africa increased by 3 per cent over 2011–2013, those for infrastructure climbed by 8 per cent. That for energy grew by 5 per cent, for water 11.7 per cent and for ICT and transport 1 per cent. Several countries in 2012 apportioned large shares of their budget to infrastructure: Cabo Verde, 44 per cent; Namibia, 39 per cent; Uganda, 28 per cent; and South Africa, 24 per cent (ICA, 2014).

Signs are increasing of high-level political leadership in mobilizing resources for regional infrastructure. For instance, President Macky Sall of Senegal convened the Dakar Financing Summit for Africa's Infrastructure in June 2014. The Summit aimed to build and strengthen innovative synergies between the public and private sectors for mobilizing pan-African financial investments for infrastructure. The Dakar Agenda for Action, which seeks to leverage public–private partnerships for infrastructure, was the main outcome.

The Summit was a follow-up to a study on mobilizing domestic resources for financing Africa's development in 2013 undertaken by the Planning and Coordinating Agency of the New Partnership for Africa's Development and ECA with other partners. The study provided several options, including promoting infrastructure bonds and African-owned private equity funds, and establishing sovereign wealth funds and public-private partnerships. Such innovative approaches are some of the institutional strategies to close the infrastructure gap (box 2.2).

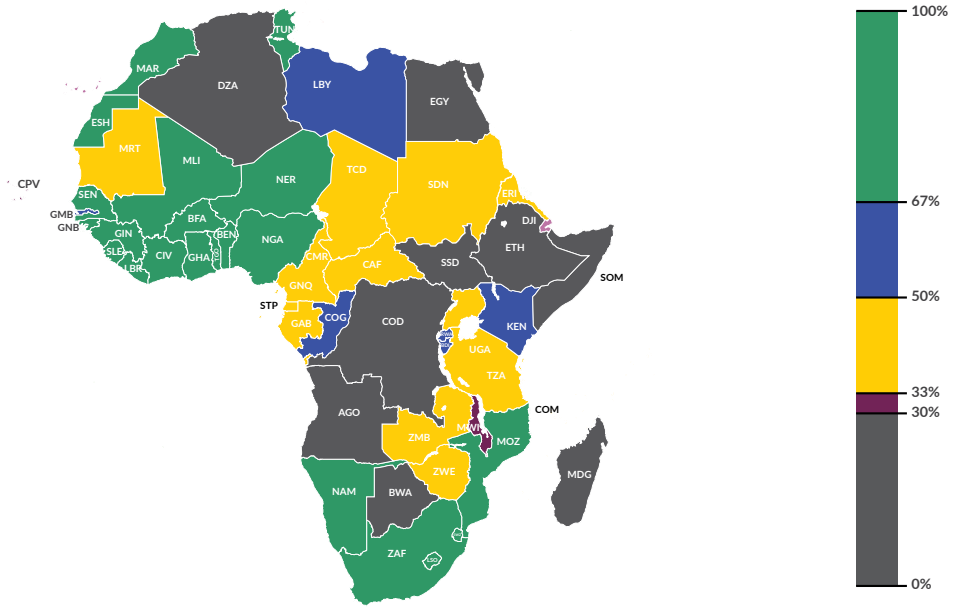
The New Economic Partnership for Africa's Development Presidential Infrastructure Champion Initiative illustrates the increasing level of Africa's ownership and leadership of its infrastructure projects. PICI was endorsed by the African Union Assembly of January 2011 to accelerate implementation of prioritized subregional and regional infrastructure projects—through "political championing." The Presidential Infrastructure Champion Initiative has nine projects (with champions in brackets):

- Missing Links of the Trans-Sahara Highway (Algeria).

Info 2.4—Who's ratifying protocols on the free movement of persons

The average ratification rate for REC protocols is around 60 per cent.

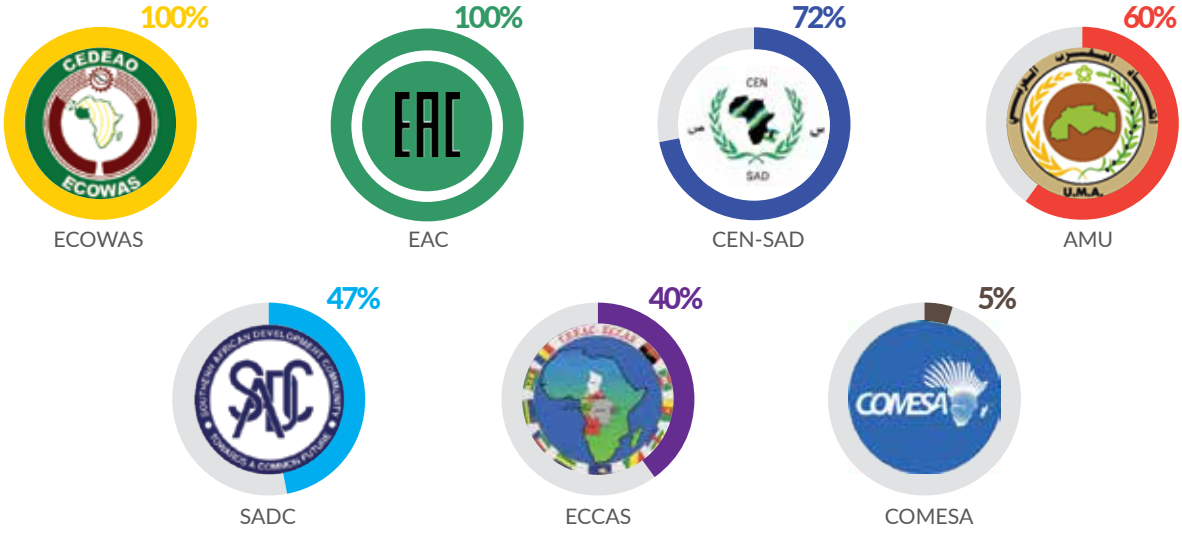
Proportion of REC-level free movement of persons protocols ratified, by country



Source: Brookings Institution, 2012 and 2014; ECA, AfDB and AUC, 2013; ECA and AUC, 2015.

Little progress has been made on the proportion of members ratifying their REC's protocol on the free movement of persons.

Share of member countries of each REC ratifying the protocol on free movement of persons



Note: IGAD is not included because it does not have a protocol on free movement of persons.
Source: ECA, AfDB and AUC, 2013; ECA, AUC and AfDB, 2012.

Box 2.2.

Innovative approaches to financing infrastructure projects

Regional cooperation is emerging across Africa, with the regional economic communities playing a central role. They obtain funds from development partners, notably the African Development Bank, on behalf of member States who sign an intergovernmental agreement indicating their commitment to push through with a project. The funds support the preparatory phase of projects, including feasibility studies and detailed design. The terms of reference for consultants to undertake studies or advisory services are approved by all member States concerned. Committees made up of representatives of the member States are involved in supervising the preparatory work and reviewing the reports. This model has been applied successfully by ECCAS, ECOWAS and EAC. It has also been applied by COMESA through the COMESA/EAC/SADC Tripartite Project Preparation and Implementation Unit.

At national level, African governments are adopting innovative approaches. A good example is Kenya where a PPP is financed by domestic banks (with loans guaranteed by the government) and implemented by Kenyan firms.

- Optic Fibre Link between Algeria and Nigeria via Niger (Algeria).
- Dakar–Ndjamena–Djibouti Road/Rail Project (Senegal).
- Nigeria–Algeria Gas Pipeline Project (Nigeria).
- Kinshasa–Brazzaville Bridge (Road/Rail) Project (Republic of Congo).
- ICT Broadband and Fibre Optic Link to Neighbouring States (Rwanda).
- North–South Corridor Road/Rail Project (South Africa).
- Navigational Route between Lake Victoria and the Mediterranean Sea (Egypt).
- Lamu Port–Southern Sudan–Ethiopia Transport Corridor Project (Kenya).

The champions have shown leadership by committing or mobilizing financial resources, providing platforms for dialogue among countries and improving the focus of projects. Algeria, Nigeria and Egypt have committed resources for the projects that they are championing. South Africa has undertaken studies to identify gaps in knowledge on the North–South Corridor and, as Chair of the Presidential Infrastructure Champion Initiative, has organized meetings, of senior officials of the countries concerned at technical and political levels, that provide updates on projects. Senegal has prioritized the Dakar–Bamako rail project as the first phase in the Dakar–Ndjamena–Djibouti Road/Rail project.

On technical capacity, the New Economic Partnership for Africa's Development Planning and Coordinating Agency established the Programme for Infrastructure Development in Africa Technical Advisory Facility in 2014 to boost capacity among countries and regional economic communities to prepare transnational infrastructure projects. The key mandate is to provide experts to develop Programme for Infrastructure Development in Africa projects to the level where feasibility studies can be undertaken. It focuses on providing small grants to support early project-preparatory activities.

The Abidjan–Lagos Corridor provides a good example of efforts to strengthen legal frameworks and institutional arrangements. The Heads of State and Government of Benin, Côte d'Ivoire, Ghana, Nigeria and Togo signed a treaty for modernizing the corridor in March 2014. This entails expanding the existing road into a six-lane dual-carriageway linking the five countries. The treaty establishes a supra-national corridor management organization and a $50 million seed fund to accelerate works. The ECOWAS Commission is spearheading efforts.

Roads

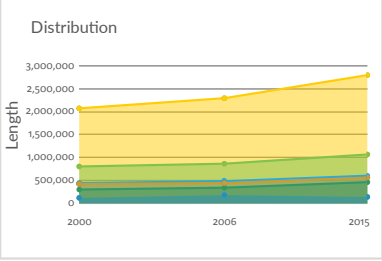
Africa has made progress in expanding and improving the quality of its road networks in recent years, although this is not generally acknowledged due, partly, to the paucity of data. The size of the road network in Ethiopia, for example, increased from 26,550 km in 1997 to 85,966 km in 2013 (an increase of 224 per cent). As a result, the road density per 100 square km of the country increased from 2.4 km in 1997 to 7.8 km in 2013. The

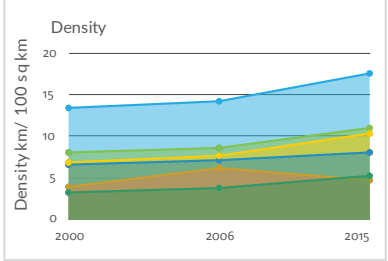
Info 2.5—The length and density of road networks

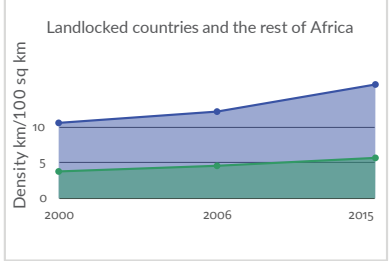
The length of Africa's road networks increased from 2,064,613 km to 2,299,070 km between 2000 and 2006 and from 2,299,070 km to 2,803,144 km between 2006 and 2015. Southern Africa has the longest network of any of the African subregions, followed by East, West, North and Central Africa.

Africa's road density increased by 11.3 per cent between 2000 and 2006 and by 35.6 per cent between 2006 and 2015. Southern Africa also has the highest road density, followed by West Africa, East Africa, North Africa and Central Africa.

Africa's landlocked countries appear to have both a lower road density and to be progressing more slowly than their coastal peers. Their road density grew by 47 per cent between 2000 and 2015 compared with 51 per cent for the continent as a whole. This still represents a significant improvement in landlocked countries, which face special challenges related to their isolation and lack of access to the sea.







CENTRAL EASTERN NORTH SOUTHERN WEST TOTAL

LANDLOCKED COUNTRIES REST OF AFRICA

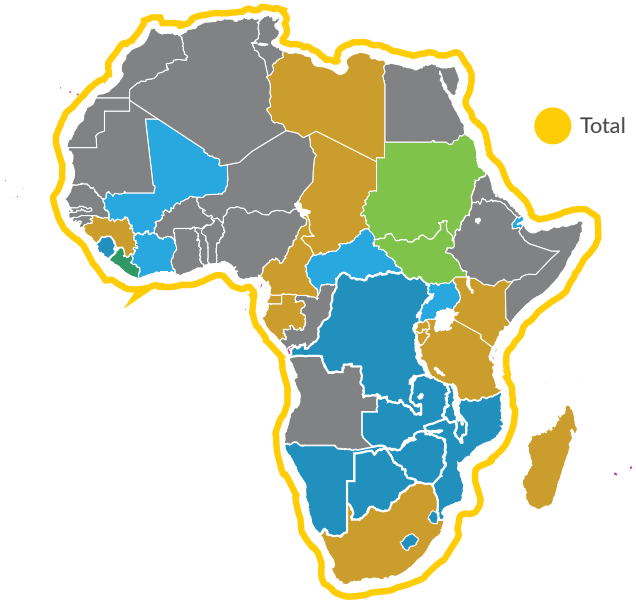


Table 2.4.

Growth rate of Africa's road network

Subregion	Length (km)			Percentage change		
	2000	2006	2015	2000–2006	2006–2015	2000–2015
Central	115,677	186,475	141,287	61.20	-24.23	22.14
Eastern	445,018	476,558	595,874	7.09	25.04	33.90
North	292,790	347,451	451,450	18.67	29.93	54.19
Southern	801,751	853,676	1,055,682	6.48	23.66	31.67
West	409,377	434,910	558,851	6.24	28.50	36.51
Total	206,4613	2,299,070	2,803,144	11.36	21.93	35.77

Source: Compiled by authors from Central Intelligence Agency of the United States of America (2015) and Ethiopian Road Authority (2013).

Table 2.5.

Improvement in Africa's road density

Subregion	Density (km/100 sq. km)			Percentage change		
	2000	2006	2015	2000–2006	2006–2015	2000–2015
Central	3.83	6.17	4.68	61.10	-24.15	22.19
Eastern	6.59	7.05	8.05	6.98	14.18	22.15
North	3.15	3.74	5.21	18.73	39.30	65.40
Southern	13.35	14.22	17.58	6.52	23.63	31.69
West	8.01	8.51	10.93	6.24	28.44	36.45
Total	6.84	7.61	10.32	11.26	35.61	50.88

Source: Compiled by authors from Central Intelligence Agency of the United States of America (2015) and Ethiopian Road Authority (2013).

Table 2.6.

Improvement in paved roads

Subregion	Paved roads (per cent)			Changes		
	2000	2006	2015	2000–2006	2006–2015	2000–2015
Central	11.57	10.37	8.05	-1.20	-2.32	-3.53
Eastern	6.83	6.42	7.62	-0.42	1.20	0.79
North	65.40	63.14	74.19	-2.26	11.04	8.78
Southern	14.11	20.98	21.05	6.87	0.07	6.94
West	23.55	21.85	14.05	-1.70	-7.80	-9.50
Total	22.06	24.76	25.77	2.70	1.01	3.71

Source: Compiled by ECA from Central Intelligence Agency of the United States of America (2015).

proportion of the road network in good condition there also shot up from 22 per cent in 1997 to 70 per cent in 2013. Countries with the highest proportion of paved roads were, in descending order, Lesotho, Zambia, Seychelles, Comoros, Egypt and Rwanda.

The length of Africa's road network increased by 11.4 per cent from 2,064,613 km to 2,299,070 km between 2000 and 2006 and by 21.9 per cent from 2,299,070 km to 2,803,144 km between 2006 and 2015. Southern Africa has the longest network of any of the African subregions, followed by East, West, North and Central Africa (info 2.5 and table 2.4). Africa's road density increased by 11.26 per cent between 2000 and 2006 and by 35.61 per cent between 2006 and 2015. Southern Africa also has the highest road density, followed by West Africa, East Africa, North Africa and Central Africa (info 5 and table 2.5). Africa's landlocked countries appear to have both a lower road density and to be progressing more slowly than their coastal peers (info 5). Their road den-

sity grew by 47 per cent between 2000 and 2015 compared with 51 per cent for the continent as a whole. This, notwithstanding, still represents a significant improvement in landlocked countries, which face special challenges related to their isolation and lack of access to the sea.

Africa has the highest risk of death from road traffic injury globally (24.1 per 100,000 population); Europe has the lowest (10.3). The African Road Safety Action Plan for 2011 to 2020 was adopted in 2011 to address this challenge in the framework of the United Nations Decade of Action for Road Safety.

Inland waterways

Egypt is spearheading construction of a navigable waterway linking Lake Victoria in Uganda and the Mediterranean Sea through the River Nile, as part of the Presidential Infrastructure Champion Initiative. The pre-feasibility study of the transport corridor has been completed and efforts are considering feasibility studies. Phase 1 of the project will comprise the section from Lake Albert in Uganda to Khartoum in Sudan; the section from Gambela in Ethiopia to the White Nile in South Sudan; and the section from Khartoum to Aswan in Egypt. Phase 2 will cover the section from Lake Victoria to Lake Albert, and the section between the Blue Nile in Ethiopia and the Main Nile in Sudan. One of the project's components is to establish navigation management training centres in some of the footprint states, based on the Egyptian experience.

Multimodal transport

The corridor approach to regional transport development is well established in Africa. Multimodal options are increasing, exemplified by the Lamu Port–Southern Sudan–Ethiopia Transport Corridor Project. Its construction was launched in March 2012 at the site of Lamu port in Kenya. The initiative—Lamu Port; the Lamu Port–Southern Sudan–Ethiopia Transport Corridor Project railway; the Lamu Port–Southern Sudan–Ethiopia Transport Corridor Project highway; oil pipeline; oil refinery; resort cities; and Lamu Airport—has an estimated investment cost of $16.4 billion. The detailed engineering designs for three berths and associated infrastructure have been completed for Lamu port and funds are in hand to start construction. About 365 km of the Lamu Port–Southern Sudan–Ethiopia Transport Corridor Project road in Kenya and Ethiopia has been completed; work is ongoing on several other sections. The construction of the Lamu Port–Southern Sudan–Ethiopia Transport Corridor Project railway is on course, the Kenyan government having signed a memorandum of understanding with the China Civil Engineering Construction Corporation in October 2014. The railway's preliminary design and feasibility study have been completed.

Railways

African countries are revamping their railway networks, including those with a regional dimension. For instance, construction is underway on the Djibouti–Ethiopia railway, while Kenya is making progress on the Mombasa–Nairobi railway, the first phase of a standard-gauge project that will connect Kenya, Uganda, Rwanda and South Sudan (Government of Kenya, 2015). Construction of the 609-km line began in 2013 and is expected to be completed in 2018. The West African Economic and Monetary Union is spearheading the construction of the Dakar–Bamako rail project, part of The Presidential Infrastructure Champion Initiative and at the phase of preliminary studies.

One of the flagship projects of Agenda 2063 is to connect all African capitals and commercial centres through the Africa Integrated High Speed Train Network, incorporating existing networks. Many countries have national projects: for example, construction of the Abuja–Kaduna rail line in Nigeria started in 2011 and was completed in 2014, and in Ethiopia, a new railway line is being built between Awash and Woldia, and is expected to be completed in 2015.

Energy

Given the importance of energy access for industrialization, and of the latter for regional value chains in Africa and ultimately continental development, energy is critical to regional integration. The Programme for Infrastructure Development in Africa supports cooperation on energy infrastructure.

The Programme for Infrastructure Development in Africa remains the flagship for revamping and modernizing infrastructure, including energy, where it aims to provide modern energy for all African households, businesses and industries by developing efficient, reli-

able, cost-effective and environmentally friendly infrastructure to help eradicate poverty and ensure vigorous sustainable development. Programme for Infrastructure Development in Africa's Priority Action Plan has 15 energy projects for a cost of $40.3 billion (excluding the Nigeria–Algeria Gas Pipeline).

Numerous cross-border energy initiatives are driven mainly by regional economic communities or bilateral agreements between countries. Increasingly, and in response to the international trends, they support responsible and cleaner energy, often renewable or efficient sources.

The Africa Clean Energy Corridor initiative aims to increase deployment of renewable energy substantially, reducing carbon emissions and dependence on imported fossil fuels, and leading to more sustainable and climate-resilient growth. Regional demand for electricity is expected to more than double in the next quarter century. The initiative aims to meet half of total electricity demand from clean, indigenous, cost-effective renewable resources by 2030. Its action agenda was endorsed by ministers representing 19 countries of the Eastern African and Southern African power pools in January 2014. Implementation will enable countries in the initiative to fully consider cost-effective renewable power options and develop enabling frameworks to attract investment.

Several African regional economic communities have adopted masterplans on how to increase generation capacity and energy access. For example, the ECOWAS Renewable Energy Investment Initiative—set up by the ECOWAS Centre for Renewable Energy with financial institutions and other private companies—aims to mitigate financial barriers to investment in medium and large renewable energy projects and businesses in ECOWAS. It assists member countries to make use of their renewable energy potential by providing support to develop a technical and economically feasible pipeline of projects and to attract the interest of investors and financiers. Other regional economic communities have similar initiatives.

Evidence of cooperation among countries on developing oil and gas pipelines is substantial:

- A feasibility study on a pipeline to carry natural gas from Mozambique to South Africa and other neighbouring SADC member countries and to Mozambican towns en route (SacOil, 2014).
- Further development of the West Africa Gas Pipeline that transports cheaper and more environmentally friendly gas from Nigeria to Benin, Ghana and Togo (World Bank, 2015; *Oil & Gas Financial Journal*, 2015).

Box 2.3.

The Grand Ethiopian Renaissance Dam

Ethiopia is constructing a hydroelectric dam to export electricity to other regional countries. The dam will have an installed capacity of 6,000 megawatts and will produce an estimated 15,000 gigawatt hours a year (Salini Impregilo, 2015; Ethiopian Electric Power Company, 2015). This is roughly equal to Ethiopia's entire current electricity consumption, suggesting that much of this electricity will be exported to other countries, especially as Ethiopia is constructing other hydroelectric power stations (Massachusetts Institute of Technology, 2015b). Djibouti and Kenya already have agreements on trade in energy with Ethiopia, and Kenya has committed to purchase 400 megawatts of energy from Ethiopia. Eritrea, South Sudan and Uganda, too, could benefit from the dam's electricity.

Coordination will be required between Egypt and Ethiopia on the operations of this dam and Egypt's Aswan High Dam, to ensure equitable access to Nile waters, especially when reservoirs are being filled or drought is prolonged (Massachusetts Institute of Technology, 2015a).

The dam's financing is unusual: Ethiopia and its diaspora are financing most of the cost through diaspora bonds, local bonds and revenues from electricity sales (Government of Ethiopia, 2015a; The Africa Report, 2015). China is providing a loan to finance building of power transmission lines from the dam to the town of Holeta (Government of Ethiopia, 2015b).

The Ethiopian government aims to complete construction of the main dam by June 2016, while the entire project is scheduled for completion by the end of February 2017 (Government of Ethiopia, 2015a; Salini Impregilo, 2015).

- Construction of the Horn of Africa Pipeline that will transport jet fuel, diesel and gasoline from the Port of Djibouti to Ethiopia, expected to be fully operational in the first quarter of 2018 (Black Rhino Group, 2015).

- Construction of a heated oil pipeline from Uganda to the Indian Ocean, serving Kenya, South Sudan, Uganda and possibly Ethiopia en route. The project is expected to be completed in 2020 (Kuo, 2015; World Bank, 2015a).

- Work on the Trans-Sahara Gas Pipeline, expected to transport gas from the Niger Delta to Europe (Corner, 2014).

Total net imports of intra-African electricity increased by around 2.5 per cent a year between 2007 and 2011. Based on the most recent data, Morocco, Zimbabwe, Burkina Faso and Libya are the largest net importers per capita. Production-wise, the continent's capacity (in megawatts) increased by around 3.7 per cent a year between 2007 and 2011. Per capita production capacity rose by around 1 per cent a year on average between 2008 and 2011.[10]

Communications

Greater internet connectivity allows Africans from across the continent to sell online services to one another and to support social and cultural integration. Internet bandwidth per capita in Africa grew at an average of 57 per cent annually between 1995 and 2013, slowing to 39 per cent between 2012 and 2013. Kenya has the largest bandwidth per capita, followed by Morocco, Seychelles, Mauritius and Tunisia.[11] In mobile telecoms, African governments are taking steps to reduce the cost of roaming through closer cooperation (box 2.4).

Partners in Africa's infrastructure

China is the biggest investor in African infrastructure. Its lending to African countries, excluding North Africa, was estimated at $13.4 billion in both 2012 and 2013. Most of this was on transport, particularly railway projects in East Africa. Premier Li Keqiang underscored his country's interest in a speech at the African Union Commission in May 2014, where he announced China's desire to scale up its direct investment in Africa to $100 billion and stressed that China would deepen its involvement in regional infrastructure projects. He also emphasized that China would assist Africa in building the high-speed railway network.

Box 2.4.

Cooperation to reduce roaming charges

Numerous studies have highlighted the positive impact that the mobile sector has for economic growth and total factor productivity. In Africa, however, roaming charges are high and vary widely. To reduce their cost, governments and regional economic communities are trying out innovative measures to apply the local mobile rate to a user even when abroad. This entails the "home and away" roaming concept that eliminates all international mobile roaming charges for post- and pre-paid customers, and outbound and inbound calls.

Regional frameworks of countries that have agreed to waive or manage roaming charges and other surcharges for such traffic have been adopted. In 2010, ECCAS launched a project to bring roaming rates closer to local rates within the region. In 2014 following the directives of Head of States, SADC adopted home and away roaming using the "Roam Like at Home" principle (for voice, messaging and data) within the region.

In January 2015, Kenya, Uganda, Rwanda and South Sudan launched the East African "One Area Network" for mobile operators. This seeks to harmonize regional calling rates and lower costs between partner states. East Africa has moved much faster than other subregions on this, and the One Area Network's launch has boosted voice traffic within the region and cut business costs. Some estimates suggest mobile phone traffic grew 935 per cent in three months after the launch, when calling costs were cut by over 60 per cent. Given this success, policy makers are seeking to extend the arrangement to mobile data and mobile money transfers.

Table 2.7.

Top investors in Africa's infrastructure, 2013

Country/Institution	$ million
China	13,443
United States	7,008
World Bank Group	4,533
African Development Bank	3,565
France	2,542
European Commission	1,628
Islamic Development Bank	1,604
Japan	1,515
Development Bank of Southern Africa	1,155
European Investment Bank	1,077
United Kingdom	1,068
Germany	1,031
Banque Ouest Africaine de Développement	876
India	761
Arab Fund for Economic and Social Development	614
Organization of the Petroleum Exporting Countries Fund for International Development	363
Kuwait Fund for Arab Economic Development	360
Saudi Fund for Development	182
Republic of Korea	175
Canada	147
Arab Bank for Economic Development in Africa	102
East Africa Development Bank	92
Abu Dhabi Fund for Development	71
ECOWAS Bank for Investment & Development	60

Source: The Infrastructure Consortium for Africa (2014).

Africa's traditional partners have continued to fund infrastructure projects, but their investment is now nowhere near China's (table 2.7). In 2013, the European Union and France committed $1.6 and $2.5 billion, while the United Kingdom and Germany committed $1 billion each. The United States committed $7 billion to the energy sector via its multi-year Power Africa Initiative (box 2.5). In 2013, donor commitments to Africa's regional infrastructure projects were estimated at $3.7 billion, of which $887 million (24 per cent) went to Programme for Infrastructure Development in Africa projects. That year, the European Union doubled its commitments to such projects to $456 million. Similarly, the African Development Bank's commitment increased by 38 per cent (from $327 million in 2010 to $1.1 billion in 2013) while that of the United Kingdom increased by 50 per cent (the Infrastructure Consortium for Africa, 2014).

Box 2.5.

The United States Power Africa Initiative

The Power Africa Initiative is an effort by the United States government to encourage private investment in Africa's energy infrastructure via the private sector and technical cooperation with African governments on reforming electricity sector regulations. It aims to increase production capacity by 30,000 megawatts across the continent, focusing on more environmentally friendly generation.

The initiative facilitates contracts with the private sector that are expected to add 4,100 megawatts to Africa's electricity generation capacity. It is working on other projects that could add a further 20,000 megawatts (United States Agency for International Development, 2015). The initiative has secured a total commitment of around $35 billion to finance investments in Africa's energy infrastructure, building on an initial commitment of $7 billion from the United States government (United States Agency for International Development, 2015). Power Africa also supports regional energy moves, including the West Africa and East Africa power pools United States Agency for International Development.

The African Development Bank ($3 billion), the private sector ($20 billion), the Swedish government ($1 billion) and the World Bank Group ($5 billion) committed the remaining financing (United States Agency for International Development, 2015). That government, through the Swedish International Development Cooperation Agency, is also supporting regional energy cooperation through capacity building and institutional support to the Southern Africa Power Pool, East Africa Power Pool, and the Nile Equatorial Lakes Subsidiary Action Program United States Agency for International Development.

In September 2014, the New Economic Partnership for Africa's Development signed a memorandum of understanding on cooperation with Power Africa, allowing them to work together better on the African Power Vision and its regional and other transformational energy projects (United States Agency for International Development, 2015).

Mining and the Africa Mining Vision

Regional economic communities' efforts to harmonize mining codes have increased, emphasizing the need for transparent regulatory frameworks and efficient administrative systems, including one-stop shops for mineral licensing. Most regional economic communities, notably ECOWAS, SADC and EAC (box 2.6), have taken initial steps towards harmonizing national policies, laws and regulations and to developing common standards to create a uniform business environment for investors.

The ECOWAS Mineral Development Policy, confirmed by ECOWAS Ministers in June 2011, was developed as a regional initiative. It was preceded by the 2009 ECOWAS Mining Directive, which has been gazetted by a number of countries. The Policy envisions exploiting minerals as a key element of industrialization-driven structural transformation. It also accepts the need for far-reaching reforms in overall governance of the mineral economy and greater accountability of firms and governments, as well as an end to discrimination against artisanal and small-scale mining.

In 2006, SADC adopted a Framework for the Harmonization of Mining Policies Standards and Regulatory Frameworks. This comprises policy guidelines in key areas of the SADC mineral economy: mineral development issues such as mineral rights, value addition and artisanal and small-scale mining; and the macroeconomic and business climate (tax, governance, environmental management and social issues, and so on).

Challenges for implementation at subregional level include regional economic community secretariats' lack of capacity to support national roll-out; a grounding in moral suasion, not law; loosely defined time-bound activities; few national monitoring and evaluation (M&E) frameworks; and generally slow domestication of the Africa Mining Vision. Regional economic communities can build stronger constituencies to support accountability in pursuing reforms.

Box 2.6.

Mining in EAC

In its development strategy 2011/2012–2015/2016, the EAC articulated its desire to harmonize mineral policies and mining regimes. The strategy calls upon member States to take measures to promote development of strategic regional industries/value chains including extractive and mineral processing, petrochemicals and gas processing, and iron and steel.

The strategy notes that lack of coordination in promoting and developing value chains along regional dimensions and the absence of regional frameworks for establishing and supporting investments in strategic regional industries hamper development of industries in which the region has a comparative advantage.

Strategic regional industries/value chains, particularly in extractive-mineral value-adding industries, are anticipated to spur growth of downstream industries, build backward and forward linkages across the region, and position the region on the path to sustainable growth, but policy and legislative frameworks need to be harmonized first.

Having recognized the challenges, the African Mining Development Centre (see main text) is supporting EAC in reviewing these frameworks for its mineral sector. Support includes analysis of the frameworks for EAC member States, and collaboration with member States to review and align their frameworks with the Africa Mining Vision. Kenya and Uganda have already benefited from technical support from the Centre. The United Republic of Tanzania is an Africa Mining Vision country with arrangements to provide continuing technical support.

The Africa Mining Vision advocates a "transparent, equitable and optimal exploitation of mineral resources to underpin broad-based sustainable growth and socio-economic development" and was adopted by African Heads of States and Government in 2009. It provides a strategy for the vital role of mining and minerals in assisting African countries achieve their development goals (box 2.7).

Much progress has been made with the Africa Mining Vision's roll-out. The African Minerals Development Centre was launched by the African Union Ministers Responsible for Mineral Resource Development in December 2013 to provide strategic operational support for the Africa Mining Vision and its Action Plan. Its mission is to work with member States and their national and regional organizations to promote the transformative role of mineral resources in the development of the continent through increased economic and social linkages.

Using tools such as the Country Mining Vision guidebook,[12] the Centre provides technical advice to member States to improve their mineral-resource policies; establish appropriate institutional, legal and regulatory frameworks; and invest in human resources, research and development (R&D; box 2.8), and geological and geophysical data critical for managing mineral resources well. Its work has achieved several goals:

- Harmonized policies at national, subregional and continental levels;
- Improved capacity of African states and regional economic communities to mainstream minerals sector development into national programmes;

Box 2.7.

The Africa Mining Vision

The Vision describes the features of the future minerals sector:

- A knowledge-driven African mining sector that catalyses and contributes to the broad-based growth and development of, and that is fully integrated into, a single African market through:
  - Downstream linkages into mineral beneficiation and manufacturing.
  - Upstream linkages into mining capital goods, consumables and services industries.
  - Sidestream linkages into infrastructure (power, logistics, communications and water) and skills and technology development.
  - Mutually beneficial partnerships between the state, the private sector, civil society, local communities and other stakeholders.
  - A comprehensive knowledge of its mineral endowment.
- A sustainable and well-governed mining sector that effectively garners and deploys resource rents and that is safe, healthy, gender and ethnically inclusive, environmentally friendly, socially responsible and appreciated by surrounding communities.
- A mining sector that has become a key component of a diversified, vibrant and globally competitive industrializing African economy.
- A mining sector that has helped establish a competitive African infrastructure platform, through the maximization of its propulsive local and regional economic linkages.
- A mining sector that optimizes and husbands Africa's finite mineral resource endowments and that is diversified, incorporating both high-value metals and lower-value industrial minerals at commercial and small-scale levels.
- A mining sector that harnesses the potential of artisanal and small-scale mining to stimulate local and national entrepreneurship, improve livelihoods and advance integrated rural social and economic development.
- A mining sector that is a major player in vibrant and competitive national, continental and international capital and commodity markets.

Source: African Union Commission and ECA (2009).

- Enhanced capacity for mineral policy assessment and analysis and for negotiating mineral contracts;
- Strengthened R&D capacity and stronger linkages and diversification in the minerals sector; and
- Enhanced capacity for revenue collection, management, transparency, accountability and community engagement.

Box 2.8.

Mintek's role in R&D

Mintek—the Council for Mineral Technology of South Africa—is a research, development, testing and evaluation public institution active in multiple African countries with huge mining operations where its core technologies and services are needed. It provides process and control, equipment and technologies, and research on economic and regional studies. In 2014 alone, Mintek sold products to or provided services to industry in Burkina Faso, Côte d'Ivoire, Ghana, Kenya, Malawi, the United Republic of Tanzania, Zambia and Zimbabwe.

Mining is not environmentally friendly, employing harsh chemicals, consuming huge amounts of energy and excavating massive amounts of land. Mintek has been at the forefront of developing bioleaching technologies for base metals and sulphide ores over the past 30 years, leading to proprietary technologies. These biotechnology-based processes have replaced or reduced the use of some of the most polluting chemicals, such as cyanides. Mintek's current work on mine regeneration, and recovery of polluted land and water from mining, could help ensure sustainable use of natural resources.

The hallmark of Mintek's success is its close collaboration with industry, in partnerships forged through highly skilled and experienced staff. The average industrial experience of a scientist at Mintek is four years. To keep its workforce skilled, about 55 members of staff were enrolled in postgraduate training (master's degree and higher) in 2013/2014.

Peace and security

African countries have established extensive cooperation in peace and security matters:

- Multinational African forces regained control of most of the territory of Somalia from the terrorist group Al-Shabab.
- African countries contribute 45,828 personnel to United Nations peacekeeping operations in Africa (United Nations, 2015).
- African countries have authorized multinational forces to combat Boko Haram, including crossing borders in pursuit of the terrorist group without needing to seek further confirmation.
- IGAD has been the main mediation forum between the parties to civil conflict in South Sudan.
- The African Union has taken over leadership of international peacekeeping efforts in the Central African Republic through the African-led International Support Mission there. By the end of February 2014, the force's African contingent amounted to 6,000 troops (African Union Commission, 2015c).
- Regional leaders helped to persuade leaders of a military *coup d'état* in Burkina Faso in 2015 to step down and return the country to civilian rule.
- ECOWAS and the African Union achieved joint success in similar circumstances in Mali in 2012.

African countries are cooperating on health. One example is the Ebola virus disease outbreak. Once the outbreak was confirmed, a consortium of scientists in Sierra Leone, Nigeria, the United Kingdom and the United States quickly sequenced and published the full genome of 98 samples. These data were among the first to signal that the virus was changing or adapting rapidly, a development that could have an impact on diagnosis, treatment and outbreak management (Gire, 2014).

After the International Conference on Africa's Fight against Ebola, African countries have made commitments to support strengthening of health systems in the most affected countries, including human resources and infrastructure (African Union Commission, 2015d).

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Chapter 3

Regional Integration, Innovation and Competitiveness: A Theoretical Framework and Empirical Highlights

This chapter explores the conceptual linkages between regional integration, innovation and competitiveness and revisits innovation and competitiveness as concepts. It then summarizes the empirical evidence, showing that Africa's growth is not driven by innovation and competitiveness.

Conceptually linking regional integration, innovation and competitiveness

To appreciate these three elements and their role in sustained economic growth, it is essential to understand the processes linking them. The starting point is formal[13] and informal institutions[14] (info 3.1 and box 1), which drive regional integration (box 2). Regional integration in turn enhances the framework conditions—formal and informal institutions and market opportunities—of the bloc (box 3), under which economic actors leverage knowledge generated through research and development (R&D) and through routine learning and practice of economic activities (box 4) to innovate (box 5).

From a static-effect perspective, regional integration enlarges markets, reduces the costs of doing business, and eases trade and investment flows. Economic entities (firms, entrepreneurs) can exploit economies of scale and of scope—necessary conditions for innovators to commercialize their intellectual property (IP) assets embedded in knowledge generated through R&D and through non-R&D routine learning and economic activities. Apart from enabling innovators to introduce new organizational models, processes, products and services to the market, innovation—when combined with sound public policies—stimulates factor productivity.

In the medium to long term, the static effects of regional integration are complemented by dynamic effects, triggered by the mobility of capital and people. The modalities underlying these flows influence the spread of knowledge and skills, enhancing innovative capacities and contributing dynamism to the innovation ecosystem. Technology, for instance, enables economic actors to exploit economies of scale (to increase production quantities) and of scope (to diversify production), and to capture value better through downstream movements along the value chain contributing to structural change in production capacities.

Ongoing interactions between both local economic agents (such as individual entrepreneurs, the gamut of enterprises from micro to large, institutions that generate and disseminate knowledge and skills) and external change agents (such as foreign firms, similar institutions to previously, development agencies) contribute to innovation activities and capacities(box 5).[15] This is vital, as the competitiveness of economic entities (at all levels—firm, country, region, and so on), and by extension their ability to meaningfully integrate into value chains require the application of the necessary knowledge and technological capabilities. Tapping external change agencies is also a powerful way to spur technological change through such channels as foreign direct investment, trade and other forces that generate knowledge and innovation.

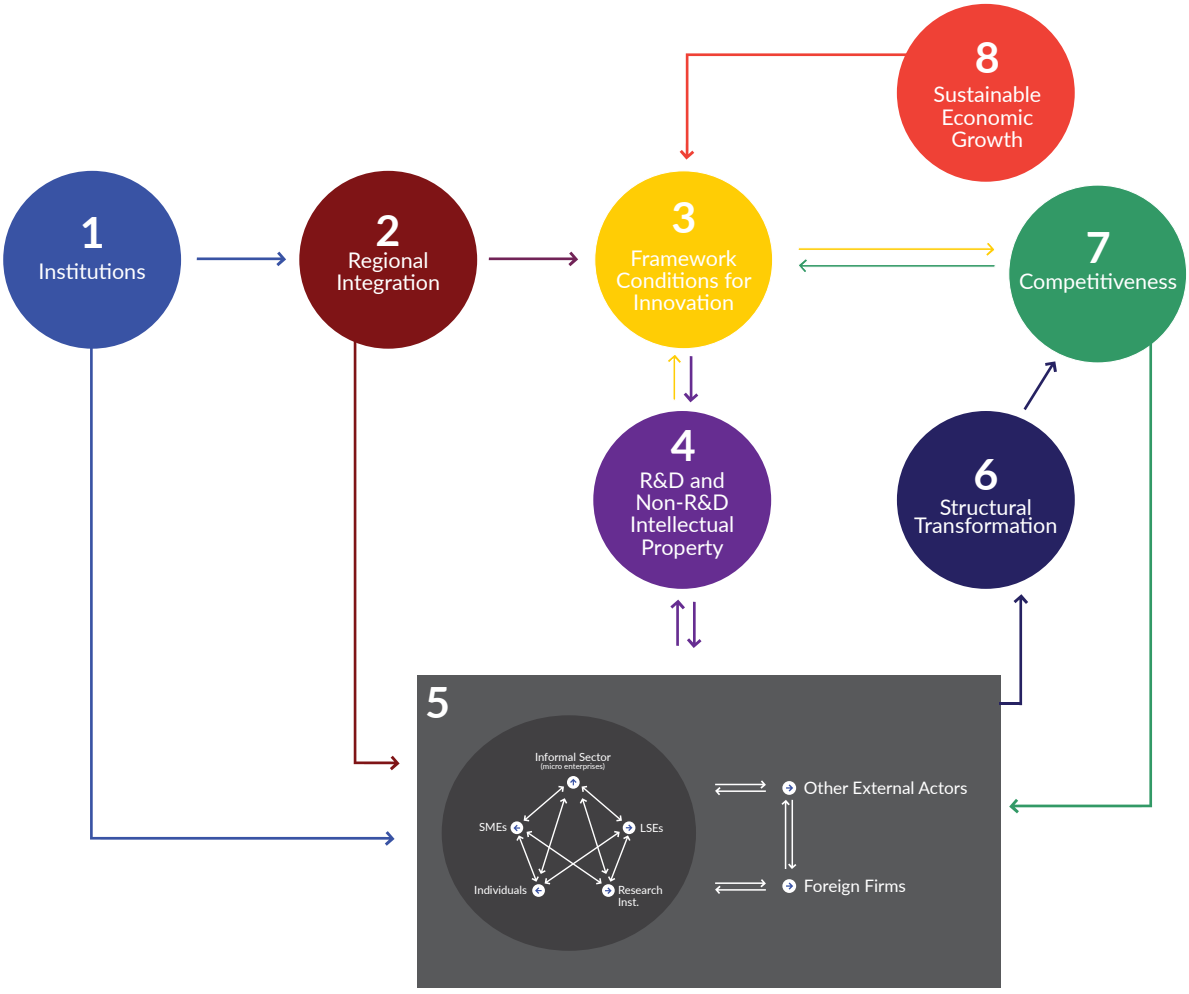
The exploitation of innovative potential linked to the static and dynamic effects of regional integration contributes to structural transformation (box 6), enhancing competitiveness (box 7) and generating growth (box 8). This underlines the significance of access to and use of technological innovations (internally generated and acquired from external innovators) in driving growth. This model assumes that other supportive policies and capacities are in place.

In practice, the most obvious manifestation of structural change is sectoral allocation, typically characterized by movement towards higher levels of the value chain (higher-value downstream activities). The ongoing process of structural transformation provides a platform

Info 3.1—From institutions to sustainable economic growth

Formal and informal institutions drive regional integration. Regional integration in turn enhances the framework conditions for innovation—formal and informal institutions and market opportunities—for economic actors to leverage the knowledge generated through research and development (R&D) and through routine learning and practice of economic activities.

A simple dynamic-linkage model from institutions to sustainable economic growth



Source: Based on Matambalya et al. (2015). Note: SMEs = small and medium-size enterprises. LSEs = large-scale enterprises.

for further gains in competitiveness (box 7). Increasing levels of competitiveness enable the economy to be set on a trajectory of sustainable economic growth and development (box 8).[16] (The arrows pointing in both directions indicate relations and interactions that are mostly dynamic.)

The figure also illustrates how the informal, micro, small and medium-sized enterprises that dominate African economic activities are brought into the dynamic process. They are affected by interactions with endogenous large enterprises and research institutions on the one hand and exogenous actors, like transnational corporations and development partners, on the other. The interactions among these actors are essential for domestic and international knowledge spillovers.

In a nutshell, then:

- Regional integration is both a driver and beneficiary of innovation. It enables favourable framework conditions for innovation (captured by the effects link-

ing boxes 2, 3 and 4). Moreover, when members of a bloc grow in innovative capacities, they are likely to integrate even more with each other through investments and production (value chains), trade and knowledge mobility, and so on (as captured by the dynamic effects linking boxes 2 and 4).

- Innovation is both a driver and beneficiary of structural change in production capacities and the competitiveness that this transformation triggers (captured by the dynamic effects linking triangles 5, 6 and 7). All things equal, by influencing the structural make-up of the economy, innovation generates higher levels of competitive production and trade, which in turn stimulate economic growth and development.

Intuitively, as innovative capacities grow, competitiveness is enhanced. Competitiveness and innovation scores from a sample of 19 countries, including 10 from Africa, supports this hypothesis (info 3.2): all African countries with very low Global Innovation Index (GII) scores are concentrated at the bottom of the Competitive Industrial Performance (CIP) index scores (discussed further below).

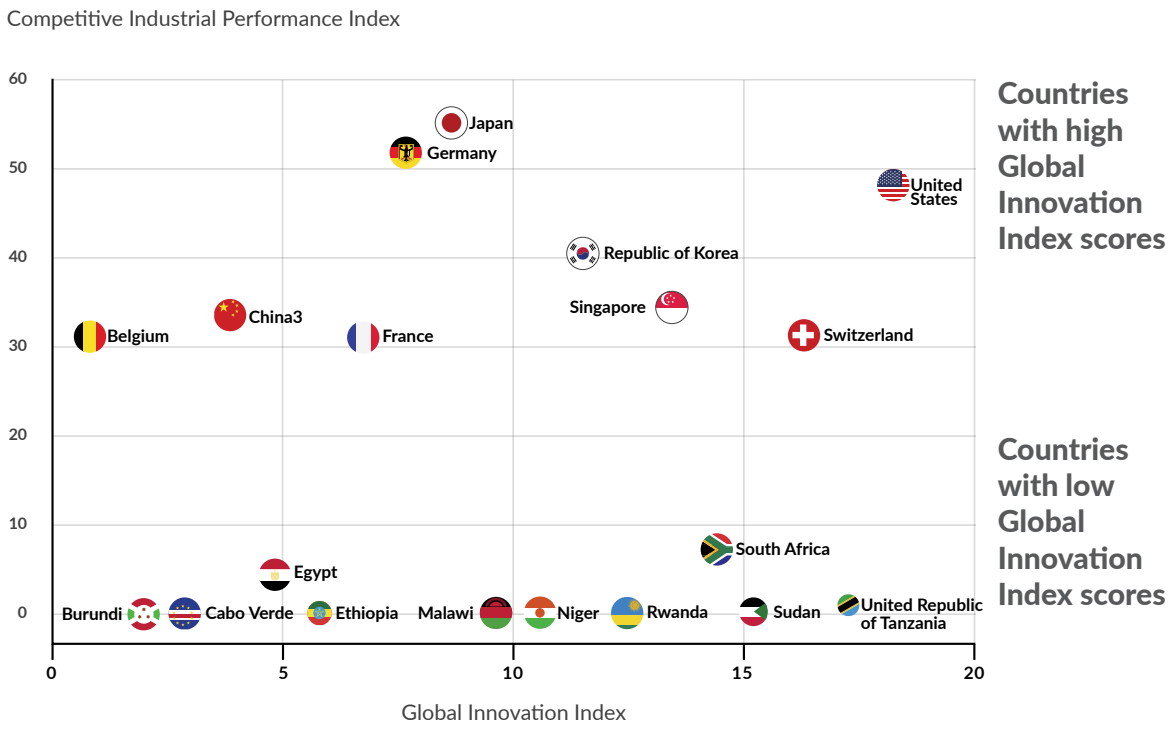
Empirical assessments show that innovation (in all its manifestations) affects economic growth through at least four channels:

- *Technological progress embodied in physical capital.* Recent Organisation for Economic Co-operation and Development (OECD) estimates attribute around 0.35 percentage points of annual average GDP growth between 1995 and 2013 to investment in information and communications technology (ICT)capital (OECD, 2015a).

- *Investments in knowledge-based capital (KBC).*[17] According to Corrado et al. (2012), for 1995 to 2007, KBC accounted for around 0.5 percentage points and 0.9 percentage points of annual average GDP growth in the European Union and the United States, respectively.

Info 3.2—As innovative capacities grow, competitiveness is enhanced

All African countries with very low scores on the Global Innovation Index are concentrated at the bottom of the Competitive Industrial Performance index.



Source: Based on UNIDO 2013; Cornell University, INSEAD and WIPO (2014).

- *Multifactor productivity growth.* Multifactor productivity growth mirrors increased efficiency in the use of factor inputs (labour, physical capital), and other measurable changes that are largely attributed to (different types of) innovation. In Organization for Economic Cooperation and Development (2015a), multifactor productivity accounted for over 0.7 percentage points of annual average GDP growth between 1995 and 2013 (equivalent to about one-third of total GDP growth).

- *Creative destruction caused by innovation.* New firms enter the market, sometimes growing quickly and thus increasing their market share, replacing other firms with low productivity. Another recent Organization for Economic Cooperation and Development study (2015b) shows the importance of resource reallocation in driving aggregate productivity growth.

These four channels jointly are responsible for at least 50 per cent of observed economic growth rates. The actual share depends on a country's level of economic development, phase in the economic cycle, supportive policies and capacities, and so on (Organization for Economic Cooperation and Development, 2015a).[18]

Revisiting innovation and competitiveness as concepts

Towards a contemporary understanding of innovation: the need to contextualize

Despite being a relatively old concept[19] and often used in scientific and layperson's language, a definition of *innovation* is elusive. Beyond the common denominator of reference to novelty, definitions tend to be contingent and divergent, leading to multiple definitions of the concept in the literature.[20] Three crucial considerations guide how we conceptualize the term:

- Innovations take place in different market contexts and may thus take different paths. This context-specificity has, in recent years, been demonstrated by the co-existence of *classical* and *frugal innovations*, both serving contemporary development needs.[21] The robustness of these two quite different approaches to innovation show that successful innovation means correctly responding to the target market's signals.

- Considering the range of innovation opportunities and applications in a late-development context, a contemporary understanding of the term must include a broader concept of novelty.

- A balanced definition of innovation that transcends frontier technological progress should focus on at least two issues: *context* of the innovation and *specificity* of the market opportunities.

Given all these factors, we here define the concept in a broadened and more appropriately inclusive way:

> Innovation is a new way of combining factors of production (that is, natural raw materials, intermediate inputs, physical labour, human capital), so that the resulting output: (i) has practical utility and commercial value, and (ii) differently and/or more appropriately addresses a consumer's wants. The novelty is manifested by either a new way of combining factors of production, or differently and/or more appropriately addresses a consumer's wants, or both. Moreover, because markets are not fully integrated (such as in terms of purchasing power, demand for product sophistication and quality), the novelty can be context specific (comparing two markets at different levels of development with different purchasing power, demand for product sophistications and quality, and so on), or context neutral (when markets are fully integrated in all aspects). Hence, the new combination of factors of production to generate new solutions for the market can address universal (context-neutral) needs or context-specific market needs.

This definition connects innovation and entrepreneurship,[22] both motivated by business opportunity and both involving a combination of factors of production to bring new solutions (tangible products, services, processes, and so on) to the market. It includes translating technology and knowledge into new usable outputs (goods, services, and so on). And most important, it captures innovation in all its manifestations. For countries that are late developers, it puts innovation in the right context.

Characterizing innovation

Table 3.1 presents some basic characterizations. Innovative ideas are the point of departure, although they must in practice be developed and turned into concrete solutions, like new goods or services, processes, or business models.

Innovations can also be multidimensional with one or more simultaneous manifestations. Likewise, innovations are multidisciplinary, often involving dynamic interplay.

A working definition of competitiveness

Although *competitiveness* is widely used in the scholarly literature and in everyday life, the concept does not have a clear-cut and universally accepted definition. Several (in-context) definitions exist, and allude to a raft of emphases: factor productivity and in particular total factor productivity, diversity of levels (enterprise, sectoral, country, regional, continental, global, and so on), and relationships with such factors as innovation, entrepreneurial acumen, human capital, institutions including policies, locational qualities, market access, and natural endowments).[23]

However, for a development perspective, and for this report, we adopt the following definition:

> Competitiveness is the ability of economic agents that are exposed to competition (internal and external) to produce goods and services that address customer wants and to meet the tastes of target markets (local, national, regional, continental or global), while simultaneously providing "decent" employment, generating and sustaining increasing levels of income.

This definition recognizes the context-specificity of markets and competitiveness. Thus a firm targeting a high-end market may need *frontier technologies* to achieve its goal; alternatively, a firm targeting the bottom of the pyramid market can achieve the same goal using *frugal innovations* (see box 6.1).

Table 3.2 presents a simplified summary of the key linkages between competitiveness, innovation and sustainable economic growth in four instructive groups of theories from various branches of economics:

Table 3.1.

Basic characterizations of innovation

By type	
Innovation	**Possible practical manifestations**
(Tangible) product innovation or service innovation	Introducing new or better tangible products, or new or better services to the market The improvement could be in functional characteristics, technical abilities, ease of use or any other dimension
Process innovation	Introducing new ways (technological or organizational) of producing goods or services
Organizational innovation (also: social innovation)	Creating new organizations Introducing new business practices (including new business models) Introducing new ways of running organizations (essentially, new management processes) Introducing new organizational behaviour
Marketing innovation	Developing new marketing methods that are improved in several dimensions related to the product (design, packaging, promotion, pricing and so on)
By other criteria	
Innovation	**Description**
Degree of newness	Innovations can range from incremental (improvement)a to radical (also basic or fundamental)b
Form of innovation	Continuous and iterative process or discontinuous (and radical) process
Content of innovations	Different combinations of knowledge, expertise and technology
Source of thrust-driving innovation	User-driven innovation Employee-driven innovation

a. This involves improving existing goods, services, processes, business models and so on.

b. This involves developing goods, services, processes and so on that did not exist previously.

Source: Authors' summary.

Table 3.2.

Key linkages between competitiveness, innovation and sustainable economic growth—four groups of theories

1.1. Country-based trade theories: orthodox mercantilism	
Key assumptions	**Competitiveness drivers**
• Hoarding precious stones and exercising restrictive import policies are sources of competitiveness	• Government policy to ensure trade surplus (orthodox mercantilism)
1.2. Country-based trade theories: classical mercantilism	
Key assumptions	**Competitiveness drivers**
• Competitiveness arises from the edge in capacities to produce various goods and services	• Domestic production support measures • Export subsidies • State-trading enterprises • Knowledge and technology monopoly
1.3. Country-based trade theories: classical trade theory	
Key assumptions	**Competitiveness drivers**
• Division of labour triggers inter-country technological differences • Inter-country technological differences lead to inter-country productivity differences • Factors of production (such as labour) are perfectly mobile across sectors, within a given country • Trade is based on absolute cost advantage in the production of goods and services (Adam Smith) • Trade is based on comparative advantage (David Ricardo)	• Specialization, leading to economies of scale and inter-country productivity differences (Adam Smith) • Market expansion due to trade (Adam Smith) • Economic growth (driven by trade) • Production technology differences across countries, leading to differences in comparative labour productivity (David Ricardo) • Production technology differences across sectors, leading to differences in comparative labour productivity (David Ricardo)
1.4. Country-based trade theories: neoclassical trade theory	
Key assumptions	**Competitiveness drivers**
• Same technology (perfect information) across countries • Perfect competition (due to constant returns to scale and full divisibility of factors of production)	• Constellation of factor endowment (labour and capital)
2. Firm-based trade theories	
Key assumptions	**Competitiveness drivers**
• Key theories in this group include country similarity, global strategic rivalry, imperfect competition, product differentiation, Porter's competitive advantage of nations, product life cycle, scale economies • International trade flows are explained by many factors (see competitiveness drivers) • Technology is an explicit and endogenous factor of production; with imperfect mobility (across firms, countries) • Factors of production (such as labour) are perfectly mobile across sectors, within a given country	• Policy • Localized technologies • Skilled labour • Specialized infrastructure • Networks of factor markets (suppliers) • Product quality • Positioning of products in product life cycle • Product differentiation • Brand names
3. Investment theories	
Key assumptions	**Competitiveness drivers**
• Key theories in this category include ownership advantage theory, internationalization theory and eclectic theory • Competitiveness is driven by various factors	• Ownership of productive assets (ownership advantage theory) • Costs associated with market access and market entry (internationalization theory) • Cost advantage, ownership advantage, internationalization advantage (eclectic theory)
4.1. Development theories: Keynesian theory	
Key assumptions	**Competitiveness drivers**
• The existence of the following linear relationship: • Income → savings → investments → production → economic growth • Existence of market imperfectness cannot be corrected by the market • Economic growth is circular, characterized by ups and downs • Labour and capital are complementary factors of production	• Capital intensity • Government (interventionist) policy • Government spending • Investment

4.2. Development theories: modernization theory	
Key assumptions	**Competitiveness drivers**
• Evolutions of science and technology are driven by changes in both economic and social spheres • Exogenously driven development in developing countries is through interactions with developed countries • Western-style capitalism is the only pathway to development	• Science and technology
4.3. Development theories: neoliberal theory	
Key assumptions	**Competitiveness drivers**
• Market is a better allocator of resources than the government	• Private sector • Aid and learning from developed capitalist countries
4.4. Development theories: endogenous growth theory (new economic growth theory)	
Key assumptions	**Competitiveness drivers**
• Long-run growth emanates from economic activities that create new technological knowledge • Accumulation of knowledge generates increasing returns • Sustainable growth relies on activities determined by forces internal to the economic system that facilitate the creation of new technological knowledge	• Innovativeness and technological progress in the economic system, which rely on R&D (expenditure, personnel), human capital development (investments, levels of education) and effectiveness of knowledge dissemination
4.5. Development theories: dependency theory	
Key assumptions	**Competitiveness drivers**
• Development in developing countries has been stifled by mercantilist relations with developed countries	• A relationship between countries, free of mercantilist notions
4.6. Development economics theories: Rostow's stage theory of development	
Key assumptions	**Competitiveness drivers**
• Development occurs through stages • The market cannot work	• Country particularities mean that there are certain social and political pre-conditions for development
4.7. Development economics theories: Myrdal's hypothesis of circular and cumulative causation	
Key assumptions	**Competitiveness drivers**
• The development achievement of countries differs • Economic policy is a key tool for managing development process and address the international and interregional development gaps	• Structural transformation from primary sector (such as agriculture, mining) to higher value-added sectors • Trade openness • Investment openness (foreign direct investment, foreign development funds)

Source: Compiled by authors from various sources (see chapter references).

- *Country-based trade theories* assert the reliance of economic welfare on the production of goods and services that position a country favourably in the international trading system.

- *Firm-based theories* use several additional factors (related to firm resources and products, technology localization, specialized infrastructure) to explain the determinants of trade flows.

- *Investment theories* associate competitiveness with international investments inflows.

- *Development theories* introduce several other issues for understanding the process of development, including the role of the state, science and technology, culture, trade, foreign direct investment and aid.

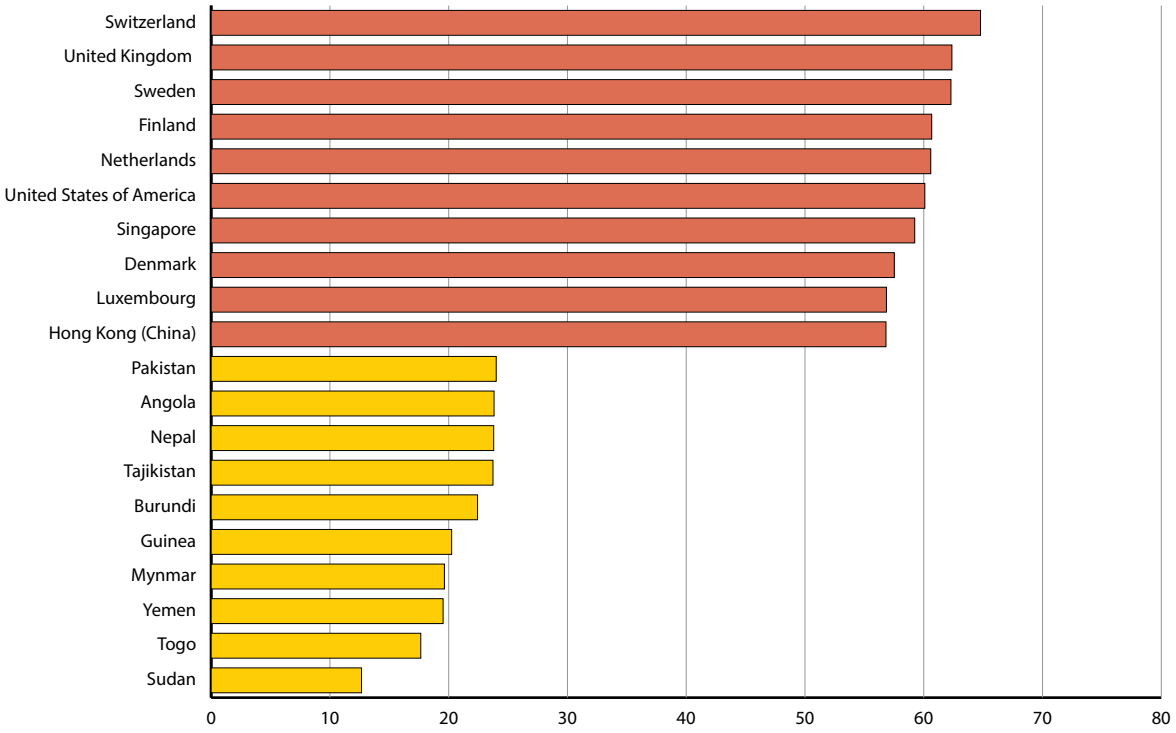
Africa's innovation and competitiveness performance

Africa does not perform well on many measurements of innovation and competitiveness. For innovation, two useful measurements are the above-described Global Innovation Index, co-produced by the World Intellectual Property Organization (WIPO), Cornell University and the Institut Européen d'Administration des Affaires, and the Networked Readiness Index, compiled by the World Economic Forum.

The Global Innovation Index is divided into pillars, further divided into subpillars, each composed of individual indicators (for 81 in total). The pillar scores are calculated as the weighted average of subpillar scores, while subpillar scores are calculated as the weighted average of individual indicators. The five pillars of the *input subindex* are institutions, human capital and research,

Figure 3.1.

Global Innovation Index scores in 2014—top 10 and bottom 10



Source: Based on Cornell University, Institut Européen d'Administration des Affaires and WIPO (2014).

infrastructure, market sophistication and business sophistication. The limitation of this approach is that they present prevailing conditions for innovations, (that is, elements of the national economy that enable innovative activities), rather than innovation as such. The two pillars of the *output subindex* (knowledge and technology outputs, and creative outputs) are more helpful, because they present the results of innovative activities within the economy.

According to the latest (2014) Global Innovation Index rankings of the performance of 143 countries and economies around the world, including 33 from Africa (figure 3.1), many developing countries are performing impressively. Asian countries are doing particularly well: Singapore and Hong Kong (China) are in the top 10, followed by China (29th), and Malaysia (33rd). Africa's innovation record is, however, subdued. Its best performer, Mauritius, was 40th, and 5 of the 10 countries that scored the lowest were African—and only 11 African countries appeared in the top 100.

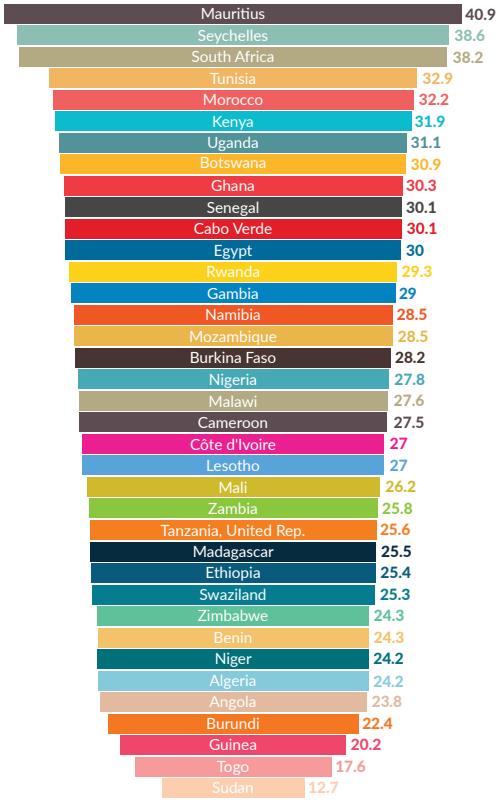
Of the 33 African countries ranked in 2014, rank improvement was recorded for 17, with Côte d'Ivoire showing the biggest improvement (20 places) and Mauritius improving by 13 places compared to 2013. Five countries (Burkina Faso, Gambia, Malawi, Mozambique and Rwanda) joined the status of "innovation learner" economies (that is, developing countries outperforming their peers in their respective income groups).[24]

The Network Readiness Index measures the propensity for countries to exploit the opportunities offered by ICT, an innovation enabler. The Index is a composite of three components: the environment for ICT offered by a given country (market, political, regulatory and infrastructure environment), readiness of the country's key stakeholders (individuals, businesses and governments) to use ICT; and stakeholders' actual use of ICT. From a late-development perspective, the Network Readiness Index is especially useful given the endless possibilities that arise from applying ICT. The Network Readiness Index 2014 rankings are for 148 countries, but only seven are African, the highest ranked being Mauritius (48th), Seychelles (66th) and South Africa (70th). All these results underline the need for more robust science, technology and innovation STI policies (chapter 5).

Info 3.3—Africa's innovation record is subdued

Africa's best performer, Mauritius, was 40th, and 6 of the 10 countries that scored the lowest were African (and only 11 African countries appeared in the top 100).

GII scores in 2014



Source: Based on Cornell University, INSEAD and WIPO (2014).

Some competitiveness indexes, despite inherent limitations, give clues about Africa's performance in the global economy. Two of the more rigorous are the Competitive Industrial Performance index and the Global Competitiveness Index Global Competitiveness Index.

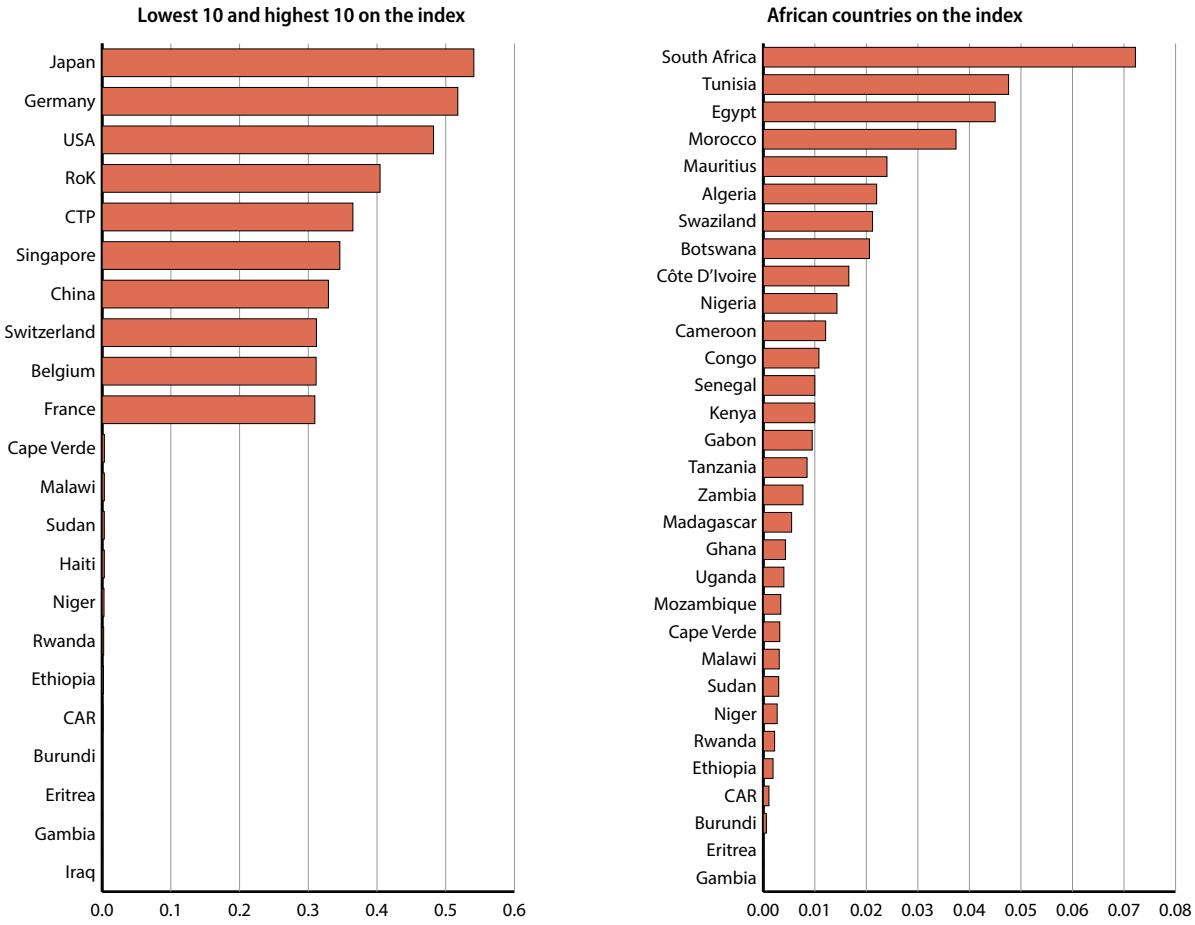
The Competitive Industrial Performance index is one of the better indexes with a bearing on innovation. Produced by the United Nations Industrial Development Organization, its focus is on countries' capacity to produce and export manufactured goods competitively—a key concern for Africa's structural transformation. In the 2013 computations this composite index covered 133 countries. Among the 12 lowest-ranked countries, 10 were African (figure 3.2 left panel). When African countries are ranked, South Africa is ranked highest with a score of 0.0722 (41 globally)—the only country considered industrialized—followed by Tunisia (58th), Egypt (62nd) and Morocco (66th).

Are African countries catching up or falling behind on industrial competitiveness? A sober response is "falling behind." Even de-industrialization is appearing—this in a continent that has not yet taken off industrially.

Categorizing products by the technology used to produce them (high, medium, low) helps indicate innovation-driven competitiveness. But here, too, the news is not good: most African countries' manufactured goods exports (to the degree it has them) use low technology (United Nations Industrial Development Organization, 2013).

Figure 3.2.

Country scores on Competitive Industrial Performance Index, 2013



Source: Based on United Nations Industrial Development Organization (2013).

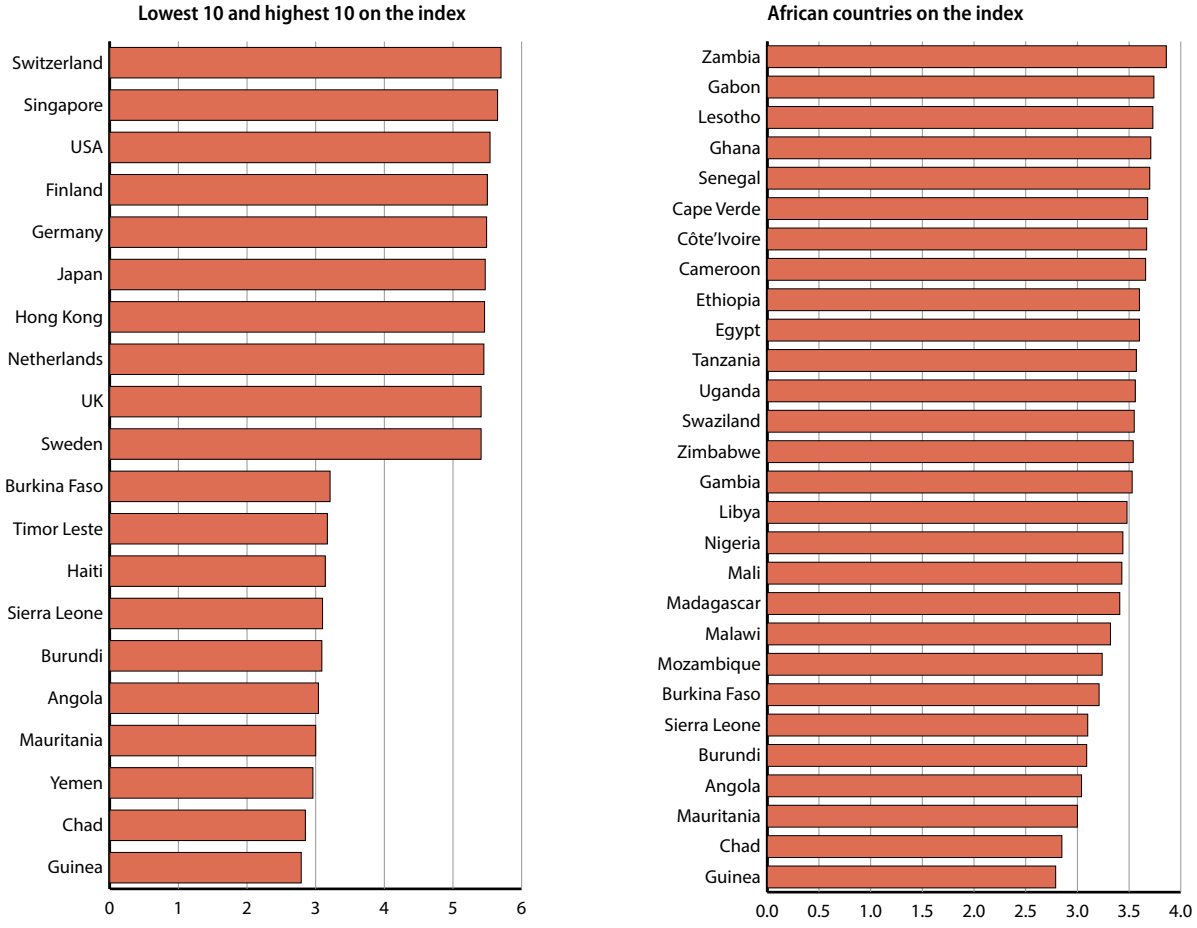
Globally, 144 countries were ranked in the 2014–2015 edition of the Global Competitiveness Index. Most of the top positions are occupied by European and Asian countries, most of the bottom slots by African countries (the bottom two and seven of the last 10) (figure 3.3). From Africa, 38 countries were ranked in the 2014–2015 Global Competitiveness Index. The highest ranked was Mauritius at 39, globally. At the other end, African countries occupy the last two positions, and makeup seven of the bottom 10. Using both indexes (Competitive Industrial Performance index and Global Competitiveness Index), 15 African countries are among the bottom global 10.[25]

Most African countries (23 out of 37) are still stuck at the first of three stages of economic development (table 3.3)—their economies are factor driven and they lack the conditions to catapult them onto the path of structural transformation. Not a single African economy is innovation driven.

Africa's growth is not, therefore, driven by innovation and competitiveness. The evidence on Africa's innovation and competitiveness is consistent with the evidence that Africa's recent growth spurt was relatively weak, driven mainly by a favourable commodity market environment. The continent as a whole registered economic growth rates faster than 4 per cent from 2000 to 2014, but over the long term (1975 to 2014), Africa's growth was far below the average of Asian developing countries (figure 3.4), where innovation and competitiveness play a far greater role. After peaking in 2005, Africa has been growing much more slowly.

Figure 3.3.

Country scores of Global Competitiveness Index, 2014–2015



Note: Lowest 10 scores (equivalent to ranks 144 to 135) and highest 10 Global Competitiveness Index scores (equivalent to ranks 1 to 10). Global Competitiveness Index scores by 38 African countries (equivalent to highest rank of 39 for Mauritius, and lowest rank of 144 for Guinea).

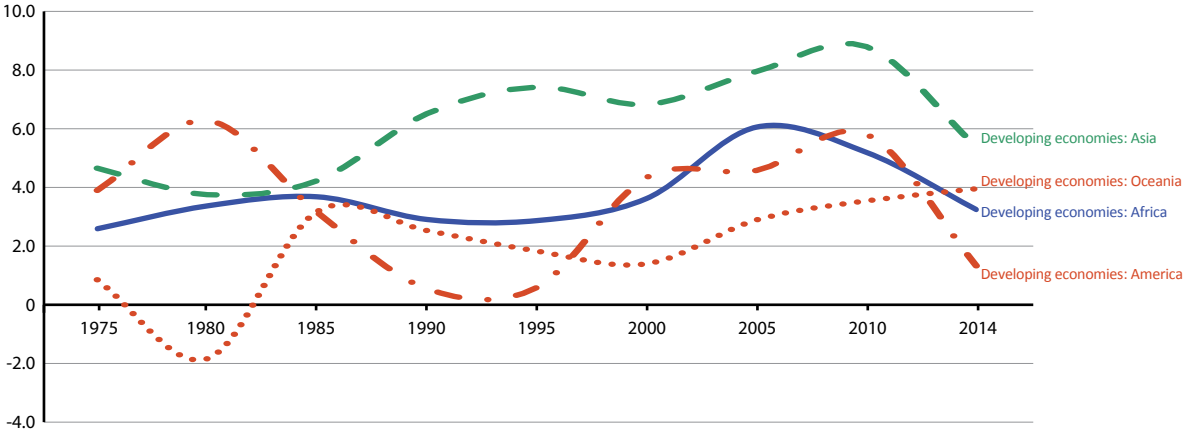
Source: Based on WEF (2015).

Innovation capacities are crucial for the continent to diversify and differentiate—transform—what it produces and trades. Manufactured goods contribute minimally to merchandise export growth, which is still driven by commodities (figure 3.5).

Another undesirable feature of Africa's economic ecosystem that is linked to lack of structural transformation is that African countries flood the market with the same traditional commodities and force down the prices of these goods, lowering profits (Spence, 2011). Transforming the product portfolio is vital to counter this.

Figure 3.4.

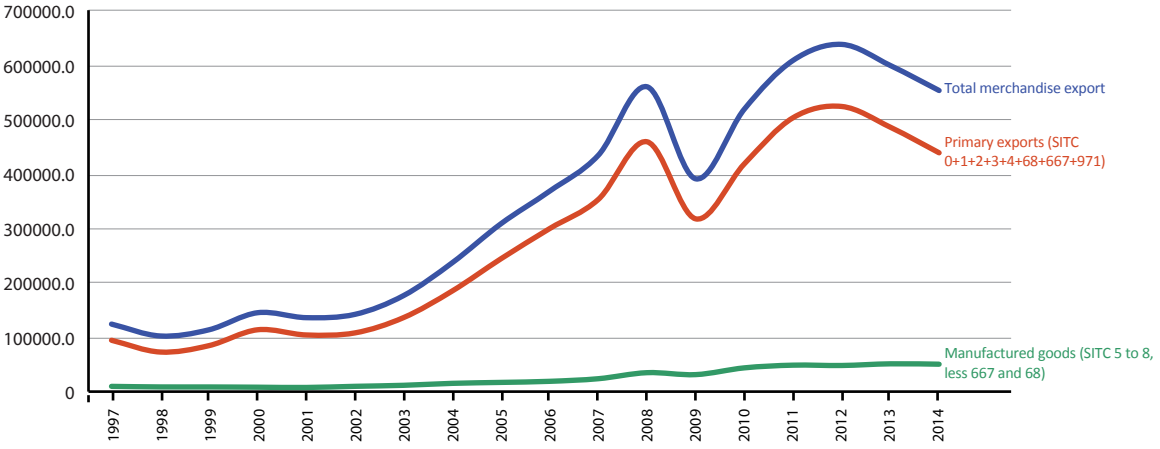
Comparative growth rates of selected country groupings (at constant 2005 prices and exchange rates)



Source: Based on UNCTADStat (2015).

Figure 3.5.

Growth of Africa's exports, 1997–2014



Source: Based on UNCTADStat (2015).

African countries need innovation-driven growth models

The main conclusion from this chapter's review of conceptual issues and linkages is that African countries need to pursue mutually reinforcing policies on growth, innovation and competitiveness, including:

- Expanding and deepening the stock of human capital through the tertiary education system and prioritizing science, engineering, technology and mathematics, particularly their quality, to allow countries to absorb and adapt technology.
- Exploiting the opportunities for innovation provided by intra-African integration schemes (subregional, regional, continental).
- Leveraging broader international cooperation to back Africa's innovation endeavours, especially through collaborative and open innovation.
- Leveraging the market potential of the demographic dividend as Africa's middle classes grow steadily.
- Targeting the continent's "bottom of the pyramid" through frugal innovations (chapter 6).

- Harnessing natural resource wealth, and the intellectual property assets embedded in them, such as biodiversity (chapter 4).

- Taking full advantage of cultural assets and traditional knowledge systems. The intellectual property assets embodied in culture and traditional knowledge is ready made for enhancing innovation capacities (chapter 4).

African countries need to build innovation-conscious and innovation-capable societies—some of the necessary conditions for innovation-driven economies. They must therefore systematically develop and nurture all elements of an innovation ecosystem: domestic knowledge and skills capacities (including absorption capacities), basic research (to produce innovation-supporting technologies, R&D, effective knowledge dissemination and skills development systems, and innovation-enabling infrastructure. Certain technologies like ICT should receive special attention because they are inherently innovation enabling (chapter 5). Mauritius is an African nation that "can do it." Others should follow.

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Chapter 4
Innovation and the Global Regulatory Regime for Intellectual Property

This chapter and the next review the policy frameworks needed for innovation and competitiveness. This chapter surveys the global intellectual property regime centred on the World Intellectual Property Organization (WIPO) and the World Trade Organization (WTO) from an African and developing-country perspective, focusing on two main concerns:

- IP (IP) regimes and the policy space left to African policy makers to enhance innovation and competitiveness so as to bring about structural change.

- The scope for reforming and coordinating intellectual property policy regionally, including the Continental Free Trade Area; where intellectual property is an issue for negotiation).

IP: Concepts and dilemmas

Article 2 (viii) of the Convention that established the WIPO in 1967 defines intellectual property thus:

> Intellectual property shall include rights relating to: literary, artistic and scientific works, performances of performing artists, phonograms and broadcasts, inventions in all fields of human endeavour, scientific discoveries, industrial designs, trademarks, service marks and commercial names and designations, protection against unfair competition, and all other rights resulting from intellectual activity in the industrial, scientific, literary or artistic fields.

IP is generated not only through research and development (R&D) but also routine learning and practice in economic and business operations as well as creative activities (WIPO, 2015).

Traditionally, intellectual property has been categorized into two groups: industrial property[26] and copyright and neighbouring rights.[27] However, as the phrase "all other rights resulting from intellectual activity in the industrial, scientific, literary or artistic fields" suggests, intellectual property is a much broader concept. This formulation is appropriate because intellectual property is an evolving field. Thus plant varieties, for instance, are protectable—if also controversial—in many countries under plant breeders' rights, an intellectual property category different from industrial property and copyright and neighbouring rights. New subjects come up regularly for protection, such as software programs, databases and traditional knowledge.

IP ownership is conferred through rights (intellectual property rights), outlined in Article 27 of the Universal Declaration of Human Rights. The Declaration includes as a human right "the right to benefit from the protection of the moral and material interests resulting from authorship of any scientific, literary, or artistic production." Intellectual property rights therefore allow the owner, or creator, of a patent, trademark, or copyright to benefit from his or her innovation and creativity.

While intellectual property rights provide an incentive to innovate, history has revealed an inherent dilemma in their application: they can only work in certain contexts. Intellectual property rights cannot boost innovation if the required conditions—skills, information, capital, market prospects—do not exist. In that case intellectual property protection may pre-empt the kind of duplicative imitation of foreign technologies that was crucial for the technological catch-up of countries such as the Republic of Korea and Japan.[28] And so there is a need to calibrate the strength of intellectual property rules to a country's level of development.

Indeed, the history of developed-country intellectual property rules suggests that their design should be adaptable to society's changing needs: the levels of intellectual property protection in developed countries increased as their industrial and technological capacities improved. The United States, for instance, introduced copyright protection for foreigners only at the end of the 19th century. Copyright protection was denied to foreigners to ensure availability of cheap

books for expanding literacy and to encourage growth of the domestic publishing industry.[29] Sometimes, intellectual property laws were revoked to protect or facilitate development of an industry. For example, in 1869 the Netherlands abolished patent protection to enable Philips to start producing light bulbs without infringing Edison's patents. The chemical and textile industry flourished in Switzerland in the 19th century, abetted by the absence of patent protection.[30]

To be effective, intellectual property rules should encourage innovation and creation relevant to the country. If they mainly benefit foreign firms undertaking research and production abroad, they will not do this, and could stifle domestic innovation.

Overview of the global intellectual property regime

International intellectual property agreements from industrial property to copyright and neighbouring rights were the main vehicles for intellectual property protection in the 19th century. Late 20th century additions include protection of computer software (part of copyright), patentability of micro-organisms (part of patent protection) and systems for protecting existing or new subject matter (plant varieties, as a new category of IP, and circuit layouts, as part of extended copyright protection) (Drahos and Smith, 1998).When colonies, most African territories early encountered the international intellectual property regime, and at independence inherited most of the colonial authorities' intellectual property rules. Many countries incorporated them into national legal frameworks—without, however, considering the implications for development.

WTO Trade Related Aspects of Intellectual Property Rights (TRIPS) Agreement

The TRIPS Agreement, which entered into force with the creation of WTO in 1995, is the most comprehensive multilateral agreement on intellectual property rights. It deals with all types of intellectual property except plant breeders' rights and utility models or innovations and inventions, which are protected on less stringent requirements than for patents.

TRIPS also incorporates the following intellectual property treaties concluded in WIPO before WTO was established: The Paris Convention for the Protection of Industrial Property, the Berne Convention for the Protection of Literary and Artistic Works, the Rome Convention for the Protection of Performers, Producers of Phonograms and Broadcasting Organizations, and the Washington Convention on the Protection of Layout Designs of Integrated Circuits.

All WTO member States are bound by the provisions of these conventions (except the Rome Convention), even if they have not ratified them. In a major departure from earlier intellectual property agreements, TRIPS contained detailed provisions on enforcing intellectual property rights.[31] It also had fundamental implications for the policy space available to developing countries in designing their national intellectual property rules and policies. TRIPS universalized standards of intellectual property protection that would benefit certain industrial sectors where firms from developed countries are dominant. Monopoly rights granted by intellectual property rights were regarded as an instrument to avoid catch-up based on imitative paths of industrialization by developing countries.[32]

Thus for copyright and related rights, TRIPS enhanced the market position of software, database and phonogram industries—sectors where US firms were globally dominant.[33] The main obligations under TRIPS for copyrights include protection of works covered by the Berne Convention; protection of computer programs as literary works and of compilations of data; recognition of rental rights at least for phonograms, computer programs and cinematographic works; and recognition of rights of performers, producers of phonograms and broadcasting organizations.[34] The recognition of computer programs as copyrightable material went beyond the requirements of the Berne Convention where it was not mandatory to regard computer programs as eligible for copyright protection.

TRIPS also broadened the understanding of databases such as collections of short stories, anthologies or scholarly works for copyright protection under the Berne Convention to include collections or compilations of factual material such as news stories, even if they do not constitute literary or artistic works. Another wide expansion from the Berne Convention was on the application of copyright exceptions and limitations. These became subject to a three-step test—it should be a special case, should not conflict with normal exploita-

tion of the work, and should not unreasonably prejudice the normal interests of the author.

On trademarks, TRIPS required all member States to comply with the provisions on trademark protection under the Paris Convention even if they had not ratified that convention,[35] which did not define the subject matter of trademark protection. In this context, Article 15 (1) of TRIPS provided an explicit definition of subject matter that would be eligible for trademark protection. It made any sign that is perceptible to a human being visually or through other sensory modes of perception such as sound and smell to qualify for trademark protection.[36] It also made "well-known" trademarks eligible for protection even if they were of no effective use in a country.[37]

TRIPS introduced the minimum period of trademark protection of seven years and made trademarks indefinitely renewable.[38] It also precluded countries' freedom to impose special requirements regulating the use of a trademark such as the use with another trademark or to use the trademark in a special form,[39] preventing a practice common among developing countries of requiring a foreign brand to link its mark with the trademark of a local enterprise so as to ensure continuity in business relationships and enable the local enterprise to develop its brand identity.[40] This provision could also preclude the ability of countries to require the depiction of trademarks for certain unhealthy products such as tobacco in a special form in order to diminish the brand identity, unless the government taking the measure can establish that such restrictions are justified (Frankel and Gervais, 2013).

On geographical indications, TRIPS requires member States to provide the legal means to prevent the use of a geographical indication in a manner that misleads the public or constitutes unfair competition, and requires countries to invalidate a trademark if the public is misled as to the true place of origin of the product. It provides additional protection for geographical indications on wines and spirits and requires negotiations to establish a multilateral system of notification and registration for increasing protection of geographical indications in this area.[41]

For industrial designs, the only requirement under TRIPS is for member States to provide a minimum standard of protection of industrial designs for at least 10 years,[42] although members have the freedom to decide how industrial designs should be protected, and can do so through copyright protection, the grant of design patents, or a *sui generis* system of registration of industrial designs.

With patents, TRIPS introduced substantial expansions over the standards in the Paris Convention. First, it required member States to grant patents without any discrimination over the field of technology involved, the place of invention or whether the product is locally produced or imported, if they are new, involve an inventive step and are capable of industrial application.[43] Patents now have to be granted for a minimum of 20 years. In this way, TRIPS took away much policy space hitherto available to developing countries to deny or restrict the term of patent protection in certain areas of technology such as chemicals and pharmaceuticals, or to require that a patent be granted only if the product is produced locally. Though member States can exclude plants, animals and essentially biological processes for the production of plants and animals from the scope of patent protection, microorganisms and non-biological as well as microbiological processes are eligible for patent protection Members are also required to grant protection of plant varieties either by patents or by a *sui generis* system, and while some developing countries have adopted their own system, many are being encouraged in bilateral trade agreements to adopt the International Union for the Protection of New Varieties of Plants system as the *sui generis* model.

TRIPS also requires layouts of designs and integrated circuits to be protected in accordance with the provisions of the Washington Treaty of 1989. For undisclosed information, member States are required to protect trade secrets against unfair competition, but this does not require members to provide exclusive protection to such undisclosed information. And with test results and other data submitted to governments to obtain approval for pharmaceutical or agro-chemical products, governments are required to protect such data against unfair commercial use or disclosure, but this does not extend to making the right over such data exclusive.[44]

An underlying principle of TRIPS is that protection and enforcement of intellectual property rights should contribute to the promotion of technological innovation and the transfer and dissemination of technology to the mutual advantage of producers and users of techno-

logical knowledge in a manner conducive to social and economic welfare and to a balance of rights and obligations.[45] Article 66.2 of the TRIPS Agreement creates an obligation on developed-country members to provide incentives to enterprises and institutions in their territories for promoting and encouraging technology transfer to least-developed countries to enable them to create a sound and viable technological base.

Least developed countries have, in fact, raised concerns over how this article has been implemented since 1998. A study on the reports submitted by developed countries on implementation for 1999 to 2002 found that the article's language and reporting mechanism did not provide enough data to identify how much developed-country incentives were working to promote technology transfer (Moon, 2008). In 2011, least developed countries submitted a proposal for standardizing the format of these reports to improve data analysis and evaluation.[46]

The Sustainable Development Goals adopted by the UN in September 2015 include two targets—17.6 and 17.7—on technology transfer through a balanced approach to intellectual property rights. The means of reaching them have yet to be agreed on. African countries should stay active on this issue.

Despite heavy expansion of the scope of patent protection, the TRIPS Agreement contains "flexibilities" that afford some policy space to developing countries. These include the ability to determine the criteria of patentability in a strict manner, the freedom to allow pre-grant opposition of patent applications by interested parties, post grant patent opposition, international exhaustion of patent rights, issuance of compulsory licences or government-use authorizations, and application-limited research exceptions.

An important flexibility for least developed countries under Article 66.1 is an extendable transition period. During this period least developed countries need not implement provisions (except for Articles 3, 4 and 5, which contain provisions on national treatment and most-favoured-nation treatment). This flexibility was given to least developed countries in recognition of their special needs and requirements, the economic, financial and administrative constraints faced by least developed countries, and their need for flexibility to create a viable technological base.[47]

This transition period can be extended if the least developed countries submit a "duly motivated request" for such extension to the TRIPS Council. According to Article 66.1, "The Council of TRIPS shall, upon duly motivated request … accord extensions of this period." The TRIPS Council has extended this transition period three times, including a specific extension for pharmaceutical products, and it is possible to seek further extensions. The least developed countries can use a general transition period until 1 January 2033. The least developed countries seek to make this extension permanent until such a time as a country graduates from least developed country status. This general transition period is without prejudice to the specific extension of the transition period for pharmaceutical products that is in force until 1 January 2033. Least developed countries[48]

Forty-two African countries are parties to the TRIPS Agreement by virtue of being members of WTO.[49] Twenty-nine of them belong to the WTO least developed country group (with 35 members).

WIPO agreements

WIPO administers 15 intellectual property treaties in 24 regimes, including the Paris and Berne Conventions. Table 4.1 summarizes the regimes in a three-tiered categorization where:

- Fifteen treaties define internationally agreed basic standards of intellectual property protection in each country.

- The five "global protection treaties" ensure that one international registration or filing will have effect in any of the signatory states. Through WIPO the applications and filings are simplified, and associated costs are reduced by removing the burden of having to deal with countries individually.

- The four "classification treaties" organize information on inventions, trademarks and industrial designs into indexed, manageable structures, to simplify retrieval.

Though not all countries are party to all WIPO-administered treaties, by virtue of the TRIPS Agreement all WTO member States are bound by them. Of these treaties, the WIPO Copyright Treaty, the WIPO Performances and Phonograms Treaty, the Beijing Treaty on Audio-visual

Table 4.1.

The WIPO regime

Tier 1. intellectual property protection		
IP regime	**IP protection subject matter**	
	Main	**Specific**
Paris convention for the protection of industrial property (1883)	Industrial property	All categories of industrial property
Berne convention for the protection of literary and artistic works (1886)	Copyright and neighbouring rights	All categories of copyright and neighbouring rights
Madrid agreement for the repression of false or deceptive indications of sources of goods (1891)	Industrial property	Unfair competition
Buenos Aires convention (1910)		
Universal copyrights convention (1952)	Copyright and neighbouring rights	All categories of copyright and neighbouring rights
Rome convention for the protection of performers, producers of phonographs, and broadcasting organisations (1961)	Copyright and neighbouring rights	Neighbouring rights
United Nations convention establishing the WIPO (1967)	All categories of IP	All categories of IP
Convention for the protection of producers of phonograms against unauthorized duplication of their phonograms (1971)	Copyright and neighbouring rights	Neighbouring rights
Brussels convention (1974)		
Nairobi treaty on the protection of the Olympic symbol (1981)	Industrial property	
Film register treaty (1989)	Copyright and neighbouring rights	
Treaty on intellectual property in respect of integrated circuit (1989)	Industrial property	
Trademark Law treaty (1994)	Industrial property	Trademark
WIPO copyright treaty	Copyright and neighbouring rights	Copyright
WIPO performances and phonograms treaty (1996)	Copyright and neighbouring rights	Neighbouring rights
Tier 2. Global protection treaties		
IP regime	**IP protection subject matter**	
	Main	**Specific**
Hague agreements (1934, 1964)		
Lisbon agreement for the protection of appellations of origin and their international registration (1958)	Industrial property	Appellations of origin
Patent cooperation treaty (1970)	Industrial property	Patents
Budapest treaty on the international recognition of deposit of microorganisms for the purposes of patent procedures (1977)	Industrial property	Patents
Madrid agreement concerning the international registration of marks (1891) and the protocol relating to that agreement (1989)	Copyright and neighbouring rights	Trademarks, service marks
Tier 3. Classification treaties		
IP regime	IP protection subject matter	
	Main	Specific
Nice agreement concerning the international classification of goods and services for the purpose of the registration of marks (1957)	Industrial property	Trademarks, service marks
Locarno agreements and establishing and international classification for industrial designs (1968)	Industrial property	Industrial designs
Vienna agreements establishing an international classification of the figurative elements marks (1973)	Industrial property	Trademarks, service marks
Strasbourg agreement concerning the international patent classification (1979)	Industrial property	Patents

Source: Authors' compilation from various WIPO sources.

Performances and the Marrakesh Treaty to Facilitate Access to Published Works for Persons who are Blind, Visually Impaired or Otherwise Print Disabled were concluded after the entry into force of the TRIPS Agreement.

The WIPO Copyright and Performances and Phonograms treaties expanded traditional copyright to the digital environment and restricted access to copyright works through the use of technological protection measures by intellectual property right holders. Parties are required to take legal measures to prevent the circumvention of such measures.[50] These treaties therefore create serious obstacles for developing countries to access copyrighted works using digital media. The Marrakesh Treaty requires parties to introduce a standard set of copyright exceptions and limitations to permit reproduction, distribution and making available published works in accessible formats for visually impaired persons, and to permit exchange of those works by organizations that serve such persons.[51]

In addition to the substantive intellectual property treaties, WIPO also administers treaties that lay down maximum requirements on formalities for intellectual property application. These are the Patent Law Treaty, the Trademark Law Treaty and the Singapore Treaty on the Law of Trademarks. WIPO also administers agreements on filing intellectual property applications. A very important agreement is the Patent Cooperation Treaty, which enables applicants to file in Patent Cooperation Treaty member states through a single international application that also receives a preliminary search and examination report by a recognized international search authority. While these reports do not preclude freedom of national offices to conduct their own substantive examination, developed countries have attempted to make the Patent Cooperation Treaty system more binding on national patent offices, which could curtail countries' ability to apply the standards of patentability under their own laws.

Negotiations on other treaties or legal instruments in WIPO have achieved little progress, such as the protection of broadcasting organizations; copyright exceptions and limitations for libraries and archives, and for educational and research institutions; a design law treaty and regulations; and an international legal instrument or instruments on traditional knowledge, traditional cultural expressions and genetic resources.

Some well-known analysts have made critical observations about the global intellectual property regime. Chang (2001) laments that the global regime is designed to favour technologically advanced countries. Bhagwati (2002) wonders how intellectual property protection became a trade issue driven by WTO—an organization that should be concerned with lowering trade barriers and tackling market access problems. The conspicuous development towards a stricter global intellectual property regime and the way developed countries achieved it have made intellectual property protection look more like a tool of neo-mercantilism than a public good instrument for promoting innovation.

Fifty-three African countries are members of WIPO.[52] Egypt has signed the most intellectual property treaties (15), South Sudan none (info 4.1 and annex 4.1). Ten African WIPO member States are not members of WTO,[53] and so are not bound by the TRIPS Agreement. Forty-seven of Africa's WIPO member States are also party to the Patent Cooperation Treaty.[54]

Annex 4.1 provides the status of subscription by African countries to multilateral intellectual property treaties.

Preserving intellectual property policy space in key economic and social sectors

African and other developing countries seek to know: If the intellectual property development ladder has been kicked away, how can they bring it back?

The most important issue in formulating domestic intellectual property policy is integrating intellectual property issues into national development policies. The main purpose of intellectual property policy is to improve the prospects of socio-economic development—not to protect and promote intellectual property rights (Correa, 2010).

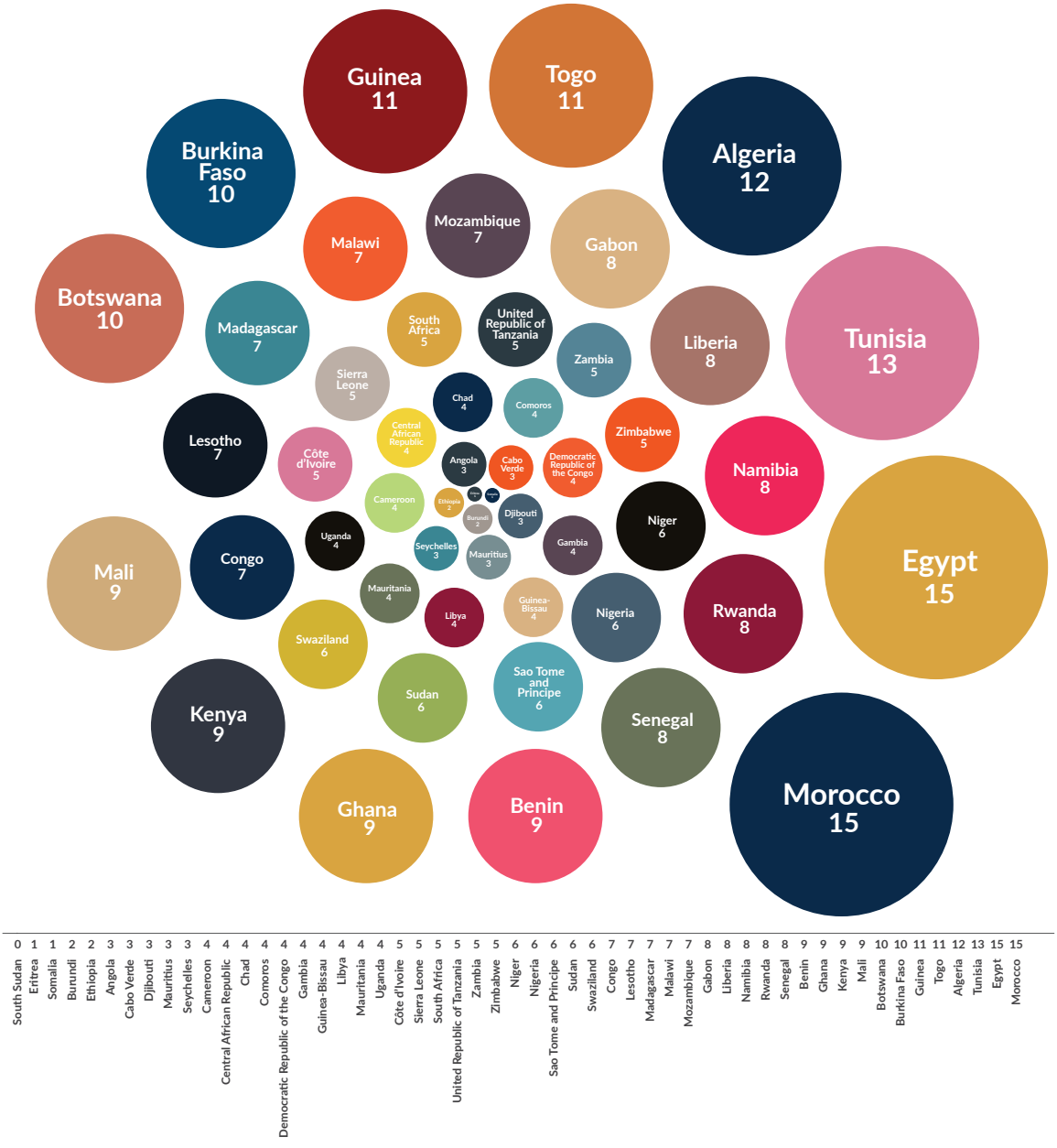
Agriculture

The agricultural sector is of huge importance to most African countries as a source of livelihood, income and employment, and so when designing an intellectual property system, policy makers must consider the sector's characteristics, possible changes from growing

Info 4.1—Who has signed the most intellectual property treaties, and who the fewest

Fifty-three African countries are members of the World Intellectual Property Association (WIPO). Egypt has signed the most IP treaties (15), South Sudan none. Ten African WIPO members are not members of World Trade Organization and so are not bound by the TRIPS Agreement. Forty-seven of Africa's WIPO members are also party to the Patent Cooperation Treaty.

Number of multilateral intellectual property treaties signed by African countries



Source: ECA calculations based on UNCTADStat, 2015.

liberalization of agricultural trade, the inputs in sustainable productions, and food security—including the structure of the seed supply system.

Traditionally, most seeds in developing countries have been produced by farmers through the customary practice of saving seeds for their own use or exchange. Although developing countries are required by the TRIPS Agreement to provide for protection of plant varieties either through patents or a *sui generis* system, the plant variety protection system was established to support commercial breeding activities by conferring temporary exclusive rights over plant varieties to the breeders. It is important for African countries, as some have already done, to adopt a *sui generis* system that strikes an appropriate balance between the rights of plant breeders and the ability of farmers to save and exchange seeds.

African countries should also assess whether patent protection is to be available for cells and subcellular components, including genes. Patenting of genes and cells may have sizeable implications in countries where genetically modified plant varieties have been accepted. In such countries, if one or more patented transgenes are incorporated into a variety, farmers may be prevented from saving seeds and breeders, too, would have limited freedom to conduct further research using that variety.

Countries in Africa will also want to ensure (after analysis) that intellectual property policy is based on the optimal mode and level of protection for the geographical indications that best suit local conditions. Geographical indication protection may be extended under collective trademarks, through a special geographical indication regime, or through disciplines on unfair competition. For some local agricultural products that have niche markets and high-value customers, geographical indication protection may add value and generate economic benefits in certain regions. However, increased geographical indication protection does not itself guarantee better market access unless quality is assured by, for example, producers' complying with importing countries' sanitary, phytosanitary and other quality regulations. Moreover, extended geographical indication protection could restrict local production of products that infringe foreign geographical indications. Therefore, a full cost-benefit analysis must inform the design of the national geographical indication regime.[55]

Manufacturing

How intellectual property may affect innovation in manufacturing's several branches must be considered. To be effective incentive mechanisms, intellectual property rights need a large market with sufficient capital, enough qualified personnel at firm level, innovation-oriented entrepreneurs and a solid scientific base open to collaboration with industry. Few African countries have these markets (chapter 5).

And even if these conditions are met, intellectual property rights may not promote innovation. For instance, pharmaceutical patent protection has not increased production, R&D or foreign direct investment and domestic investment in pharmaceuticals in developing countries. It is often assumed (on little evidence) that high intellectual property protection in a sector will encourage foreign direct investment, yet it may simply encourage intellectual property rights holders to exploit their rights through exporting the final product rather than investing in or transferring technology for local production.[56]

National intellectual property policy should reflect the country's stage of industrial development, typically categorized into three stages—initiation, internalization and generation.[57]

Initiation. Firms adopt primarily "mature" or fully developed technologies through acquisition of machinery and equipment, reverse engineering and subcontracting, turnkey agreements and foreign direct investment. Intellectual property laws are unlikely to promote local innovation, and should allow as much space as possible for absorbing and diffusing acquired technologies.[58]

Internalization. Local producers develop minor or incremental innovations derived from routine exploitation of existing technologies rather than deliberate R&D. High intellectual property protection may have little or no effect on innovation, but could reduce technology diffusion and increase the cost of foreign inputs and technologies. The intellectual property system should be very flexible, but given the TRIPS Agreement (and other free trade agreements that impose yet higher standards), developing countries have limited policy space.[59] Those in this phase should make full use of the flexibilities open to them to allow reverse engineering and technological diffusion, such as strict criteria to as-

sess patentability, exceptions to exclusive intellectual property rights, compulsory licences and exceptions for education in copyright laws.

Generation. Some industries may benefit from increased intellectual property protection, but there may be a need to balance that with the need to ensure access to and diffusion of technology.

Public health

The intellectual property system must not constrain access to affordable generic medicines and health technologies. African countries must be able to use, to the maximum possible extent, the flexibilities granted under the TRIPS Agreement and avoid accepting obligations in bilateral or regional agreements that may erode them. One key flexibility is the freedom of countries to define the criteria of patentability and apply a differential standard for pharmaceutical patent applications. Patent offices should be encouraged to consider the following typical applications as *not* constituting inventions: new dosage forms of known medicines; new salts, ethers, esters and other forms of existing pharmaceutical products; discovery of polymorphs of existing compounds, enantiomers, therapeutic, diagnostic or surgical methods of treatment; and claims for new uses of known products.[60]

African countries should also be free to use patented products for research and to conduct experiments and other procedures to obtain marketing approval for a generic drug during the patent's life. They should adopt an international regime of exhaustion of patents allowing parallel importation of a generic medicine if the patented product is put on the market in any country. Under the TRIPS Agreement, countries also have the freedom to determine the grounds for issuing a compulsory licence. In addition, they should refrain from introducing data exclusivity in relation to test data as this will require generic companies to incur significant expenses in generating test data rather than relying on test data already submitted by the originator drug company. There is no obligation under TRIPS to grant data exclusivity: Article 39.3 only requires protection of test data from unfair competition.

Many African WTO member states have yet to ratify the Doha Declaration on the TRIPS Agreement and Public Health. They should do that soon.

Access to knowledge

On the cross-sectoral issue of access to knowledge, intellectual property policy should aim to make the maximum use of flexibilities available under copyright law to facilitate access to creative works, including protected computer programs.[61] Official texts and their translations, political speeches and speeches delivered in course of legal proceedings should be excluded from copyright protection, and access to copyright content in the digital media for legitimate use should not be constrained by "technological protection measures" or "anti-circumvention measures."[62]

African countries should also ensure the broadest possible accessibility to scientific and factual data. Though such content is traditionally excluded from the scope of copyright protection, some regulations, such as the European Database Directive of 1996, make it possible to apply and extend proprietary claims to all factual content.[63]

African countries should consider making it easier to grant compulsory licences on patents over environmentally sound technologies to promote affordable and sustainable access to these technologies. Agenda 21, adopted by the 1992 UN Conference on Environment and Development, suggested use of such licences to prevent abuse of intellectual property rights (Correa, 2010 p. 40).[64]

African initiatives for intellectual property rule-making

Engaging the global regime

African countries have as a regional group coordinated their negotiating stance for the global intellectual property regime at WTO and WIPO; they have also cooperated with other regional developing-country groups (table 4.2). At WIPO, some African countries are members of the Development Agenda Group, a cross-regional group of developing countries. African countries also collaborate with the Group of Friends of Development at WIPO.

At WTO, five major initiatives stand out in which African countries have been involved. First, African countries were major sponsors of the 2001 amendment to the TRIPS Agreement through a special Ministerial Declara-

Table 4.2.

Overview of intellectual property proposals involving African countries

Platform	Subject of proposal	Countries and groups behind the proposal
WTO TRIPS Council	Public health and access to medicines	African Group, least developed countries and so on (2001)
WTO TRIPS Council	Extension of the TRIPS implementation transition period for least developed countries	Least developed country group (2005, 2011 and 2012), Senegal (2011), Mali (2012), Madagascar (2013) and Togo (2013)
WTO TRIPS Council	Review of Article 27.3 (b) of TRIPS on introducing a mandatory disclosure requirement about country and source of origin of genetic resources used in a patent application	Zambia and Zimbabwe with non-African countries (2002); African, Caribbean and Pacific (ACP) group (2003); African, Caribbean and Pacific group, African Group, least developed country Group, South Africa, with non-African countries (2006); ACP Group, African Group, LDC Group, with non-African countries (2008); Africa Group (2010); African, Caribbean and Pacific Group and Africa Group, with non-African countries (2011)
WTO TRIPS Council	Geographical indications	Guinea, Kenya, Madagascar, with non-African countries (2005)
WTO Trade and Negotiations Committee	Geographical indications	Kenya, Madagascar, United Republic of Tanzania, with non-African countries (2007); African Group (2008); ACP Group, African Group, with non-African countries (2008)
WTO TRIPS Council	Issues in the TRIPS Agreement on transfer of technology	LDC Group (2002, 2011, 2012); Egypt, Kenya, Zimbabwe, and several non-African countries (2002)
Working Group on Trade Transfer of Technology	Issues on transfer of technology	Egypt, Kenya, Mauritius, Tanzania, Uganda, Zimbabwe, with non-African countries (2002); Kenya, Tanzania, Zimbabwe, with non-African countries (2003)
WIPO/Standing Committee on the Law of Patents	Patents	African Group and the Development Agenda Group (2011, 2014)
WIPO/Standing Committee on Copyright and Related Rights	Issues on copyrights, limitations and exceptions	African Group (2009, 2010, 2011, 2012)
WIPO/Intergovernmental Committee on Genetic Resources, Traditional Knowledge and Folklore	Issues on genetic resources, traditional knowledge and folklore	African Group (2011, 2014)

Source: Authors' compilation from various WTO and WIPO documents.

tion at the WTO Ministerial Conference in Doha to clarify ambiguities on the need for governments to override parts of the Agreement on public-health grounds (box 4.1).

The second initiative was technology transfer, where several proposals were made in the WTOTRIPS Council as well as the Working Group on Trade and Transfer of Technology. Third was extension of the transition period for least developed countries to implement TRIPS. Fourth was review of Article 27.3 (b) of TRIPS on introducing a mandatory disclosure requirement about country and source of origin of genetic resources in a patent application. Fifth was extension of the register of geographical indications to include African products.

African countries have taken common positions on the following proposals at WIPO: in the Standing Committee on the Law of Patents for a work programme on patents and public health; on the WIPO Marrakesh treaty; on limitations and exceptions in the Standing Committee on Copyright and Related Rights work programme; on the work plan for the Intergovernmental Committee on Genetic Resources, Traditional Knowledge and Folklore (box 4.2); on geographical indications; and on an external review of WIPO's development agenda and of its technical assistance programme.

Africa's engagement with the global intellectual property regime throws into relief the need to ensure that intellectual property rules are development friendly and that mercantilist forces are brought under control. It also shows that this policy area requires capacities to deal with technically complex issues. A comprehensive and functional intellectual property system is expensive to put in place, and would include an intellectual property governance framework (institutions, policies, strategies, laws, regulations), intellectual property administration, intellectual property adjudication (to interpret and enforce entitlements), and intellectual

Box 4.1.

The Doha Declaration on the TRIPS Agreement and Public Health

The Declaration addresses concerns that patent rules restrict access to affordable medicines for populations in developing countries in their efforts to control diseases of public health importance, including HIV, tuberculosis and malaria.

The Doha Declaration affirms that "the TRIPS Agreement does not and should not prevent Members from taking measures to protect public health," enshrining the principles that the World Health Organization (WHO) has advocated over the years, namely the reaffirmation of the rights of WTO Members to fully use the safeguard provisions of the TRIPS Agreement to protect public health and enhance access to medicines for poor countries.

The Doha Declaration refers to several aspects of TRIPS, including the right to grant compulsory licences and the freedom to determine the grounds upon which licences are granted, the right to determine what constitutes a national emergency and circumstances of extreme urgency, and the freedom to establish the regime of exhaustion of intellectual property rights.

Source: World Health Organization: http://www.who.int/medicines/areas/policy/doha_declaration/en.

property enforcement agencies. African countries have much further scope for cooperation at national and regional levels to pool resources (discussed below under "Reforming Africa's regional intellectual property cooperation"). At global level, African countries have developed a well-honed system of engagement through the various initiatives of the African Group in Geneva.

International agreements on benefit sharing,[65] such as the Nagoya Protocol,[66] have not helped Africa much, and only a meagre fraction of the patent-holding company's profits find their way back to the nation whence the resource is derived. In the case of *Swartzia madagascariensis*, for example, the revenues accruing to Zimbabwe amount just 0.75 per cent of profits from the exploitation of its natural resource (Mutandwa and Moyse, 2003).

Innovation policy in developing countries should support traditional knowledge-based innovations in two ways. On the one hand, it should consider how to support innovation within traditional knowledge systems for the benefit of the local communities and indigenous peoples that hold—and depend on—such knowledge. On the other, it should consider how to promote and build capabilities to use traditional knowledge as a source of modern innovation for growth in a way that empowers traditional knowledge holders. In both contexts, connections need to be made among related and at times conflicting policies (development, public health, industrial, trade, IP, and so on) and institutions.[67] It is critical to build appropriate institutions to manage the interactions among both traditional knowledge holders and the diversity of users of traditional knowledge so as to reduce the uncertainties that surround knowledge sharing.

Cooperation issues on regional intellectual property reforms

Turning from cooperation among African countries with like-minded allies in engaging the global intellectual property regime, at regional level we see that cooperation has been less close.

Developing countries have followed at least three approaches for generating local intellectual property expertise. In the first—most commonly among regional economic communities in Latin America and the Caribbean, best exemplified by the Andean Community—IP issues are a component of broad regional economic integration and related shifts.

The second is looser, typified by Association of Southeast Asian Nations. intellectual property action plans covering science, technology and innovation (STI)policies (and flexibilities in the global regime) are adopted consensually, with implementation the responsibility of each member State. This allows for different levels of development.[68] The Association of Southeast Asian Nations nevertheless has a strong record on coordinating intellectual property negotiations for bilateral trade and investment agreements and on promoting intellectual property policy dialogue with the EU, United States, Japan, and China, and so on (chapter 6).

In the third approach, regional intellectual property organizations are established as independent entities

Box 4.2.

Traditional knowledge

Traditional knowledge is invaluable. It includes how to use natural resources for health and food in local livelihoods and rural development, and may also have modern applications in pharmaceuticals and biotechnology, but is rarely integrated with innovation policies. Nor do global intellectual property regimes protect these valuable African assets, creating a loophole for bio-prospecting and bio-piracy among other forms of abuse (as seen in the two cases below).

Bio-prospecting refers to the search for naturally occurring chemical compounds and biological material, and, for Africa's biological resources by big pharmaceutical companies and research institutions, has witnessed an upsurge, largely because therapeutic moieties based on medical plants used in traditional medicine offer a relatively high success rate for developing new medicinal agents (Mposhi et al., 2013).

Bio-piracy is theft that involves the illegal collection of indigenous plants by corporations who patent them for their own use without fair compensation to the indigenous people in whose territory the plants were discovered (American Heritage Dictionary, 2009).

Case 1: Zimbabwe

Swartzia madagascariensis is a leguminous tree found throughout tropical Africa and producing phytochemical compounds used in medicine. Its leaves can cure scabies and cutaneous infections, its bark, toothaches. Its roots contain a very strong anti-fungal ingredient, and extract from the flowers is used as an insecticide against transmission of dengue fever.

In Zimbabwe, knowledge of this tree and its medicinal value have been kept by indigenous communities and passed from generation to generation. But in 1999 a patent on a powerful fungicidal ingredient based on the tree was granted to a research professor at the University of Lausanne, Switzerland, in violation of the Convention on Biological Diversity, which states that: "Access to genetic resources shall be subject to *prior informed consent* of the contracting party providing such resources" (Mutandwa and Moyse, 2003). Some years ago *Swartzia madagascariensis* had an estimated market value of over $1 billion (Mutandwa and Moyse, 2003).

Source: Mposhi, Manyeruke and Hamauswa (2013).

Case 2: Madagascar

The rosy periwinkle, having the botanical name *Cathrarantusroseus* (or *Vincarosea*), is an herb native to Madagascar. Traditionally it has been used as an anti-diabetic but, after testing, the American pharmaceutical company Eli Lilly discovered that it had anti-cancer properties too. In 1954, the firm extracted two alkaloids, vinblastine and vincristine, from the herb and subsequently patented drugs made from the rosy periwinkle, making millions of dollars from them. The people of Madagascar never received any compensation for their traditional knowledge of the herb's healing abilities.

Source: Mposhi, Manyeruke and Hamauswa (2013); Case Western Reserve University (2012).

with little or no linkages to regional economic communities and the broader regional integration agenda. This scenario obtains mostly in Africa, although in recent years efforts have been made to overcome this problem.

Issues stemming from Africa's fragmented regional approach. Most African countries are members of one of two, separate regional intellectual property bodies: The African Regional Intellectual Property Organization made up mainly of Anglophone countries, and the Organisation Africaine de la Propriété Intellectuelle incorporating mainly Francophone countries (boxes 4.3 and 4.4).

Africa's inconsistent approach presents four main difficulties.

First, unlike the practice in Latin America and the Caribbean and in the Association of Southeast Asian Nations, the two intellectual property bodies generally operate outside the broad policy framework on research, technology development and innovation that should inform intellectual property policy formulation (Musungu et al., 2004). Linkages with policy frameworks at national, regional and continental levels are tenuous. In particular, cooperation between African Regional Intellectual Property Organization and Organization Africaine de la Propriété Intellectuelle with the regional economic communities is weak (Musungu et al., 2004). In recent

Box 4.3.

African Regional Intellectual Property Organization and Organization Africaine De La Propriété Intellectuelle

African Regional Intellectual Property Organization

Catering to 19 countries,[69] African Regional Intellectual Property Organization was established by the Lusaka Agreement in 1976 and is based in Harare, Zimbabwe.[70] Of the 19 countries, Liberia, Sao Tome and Principe, Somalia and Sudan are least developed countries but not WTO members and thus are under no obligation to implement any aspect of the TRIPS Agreement. Nine countries (Gambia, Lesotho, Malawi, Mozambique, Sierra Leone, Rwanda, Tanzania, Uganda and Zambia) are WTO Members but fall within the LDC category and thus are exempted from TRIPS implementation, except for Articles 3, 4 and 5 of the Agreement for as long as the LDC transition period remains in force (Shashikant, 2014).[71]

In 1982 the African Regional Intellectual Property Organization Member States adopted the Protocol on Patents and Industrial Designs[72] (the "Harare Protocol"), which empowers African Regional Intellectual Property Organization to grant patents and register utility models and industrial designs in the contracting states. This protocol allows African Regional Intellectual Property Organization to grant patents on behalf of the contracting states. Applications to African Regional Intellectual Property Organization have to designate the contracting states in which a patent is sought. The African Regional Intellectual Property Organization system operates on an opt-out basis, that is, it is not mandatory for contracting states (Drahos, 2010).

Examination capacity at the African Regional Intellectual Property Organization office is minimal. (The Kenyan Industrial Property Institute alone has 16 examiners, against African Regional Intellectual Property Organization's handful.) The office arranges for the patent applications to be examined by foreign patent offices, such as the European Patent Office and those in the Republic of Korea or Mexico. In 2007 it signed a cooperation agreement with China's State Intellectual Property Office (Drahos, 2010). Essentially, it has to rely on reports generated by the Patent Cooperation Treaty system. According to African Regional Intellectual Property Organization officials, the office is finalizing its own guidelines on examining applications (Shashikant, 2014).

The operation of the Harare Protocol is fully integrated with the Patent Cooperation Treaty. Direct national filing is another approach for most African Regional Intellectual Property Organization members, which can also file at African Regional Intellectual Property Organization itself. Claiming formats for first and second medical indications are standardized under the implementing regulations to the Harare Protocol, the regulations specifying the phrases to be used. It is a good example of regulatory information, but whether a regional patent organization in Africa should open the door to pharmaceutical patenting is another matter.

Where the African Regional Intellectual Property Organization Office determines that the application is deserving of a patent, it notifies the applicant and each designated state. Discussions with officials at African Regional Intellectual Property Organization and some national intellectual property offices revealed that apart from Kenya, which occasionally objects, contracting parties rarely object to the granting of a patent (Shashikant, 2014).

According to African Regional Intellectual Property Organization officials, it is not uncommon for the African Regional Intellectual Property Organization office to grant pharmaceutical patents that contravene national law (national intellectual property offices often fail to communicate their written objection, as they are required to do, in a timely manner).[73]

In 2010 African Regional Intellectual Property Organization Member States adopted the Swakopmund Protocol on the Protection of Traditional Knowledge and Expressions of Folklore.[74] This landmark African Regional Intellectual Property Organization achievement is yet to gain recognition in the global intellectual property regime. African Regional Intellectual Property Organization Member States are also consid-

Continued

Box 4.3.

African Regional Intellectual Property Organization and Organization Africaine De La Propriété Intellectuelle (continued)

ering a draft African Regional Intellectual Property Organization Legal Framework for the Protection of New Varieties of Plants, which would empower African Regional Intellectual Property Organization to grant and administer breeders' rights.[75]

Organization Africaine de la Propriété Intellectuelle

Organization Africaine de la Propriété Intellectuelle is a regional intellectual property office for 17 countries.[76] Organization Africaine de la Propriété Intellectuelle replaces the African and Malagasy Industrial Property Organization (better known under its French acronym, OAMPI), set up in 1962. Organization Africaine de la Propriété Intellectuelle was established in 1977 under the Bangui Agreement Relating to the Creation of an African Intellectual Property Organization,[77] Constituting a Revision of the Agreement Relating to the Creation of an African and Malagasy Office of Industrial Property.[78]

Organization Africaine de la Propriété Intellectuelle grants one patent valid in all members of the Bangui Agreement. As with the Harare Protocol, the Agreement is integrated with Patent Cooperation Treaty procedures (Drahos, 2010).

years, efforts have been made to bridge the gaps but policy and institutional coherence remain challenges.

Second, the focus is overwhelmingly on patent management, also often a source of lucrative fees for patent grants. Indeed, the mandates of African Regional Intellectual Property Organization and Organization Africaine de la Propriété Intellectuelle are mostly limited to matters of patent grants, examination and registration. They generally do not work on issues relating to the exercise of patent rights. This has the effect of limiting the help that these organizations can offer member States in the use of TRIPS flexibilities for development and public health purposes (Musungu et al., 2004). A key implication is that the majority of the patent applications granted in these countries are examined and decided on by regional intellectual property offices, but if a patent is wrongly granted, it is very difficult for these countries to invalidate it.

Third, regional intellectual property organizations tend to take a "one size fits all" approach in attempting to harmonize rather than coordinate. Organization Africaine de la Propriété Intellectuelle, for example, harmonized the rules on compulsory licensing by requiring that no compulsory licence be issued before the end of three years from the date the patent was issued or four years from the date of application, under the Bangui Agreement, which also provides that compulsory licences do not extend to acts of importation— defeating the purpose of the provision on compulsory licences. This goes beyond the requirements of TRIPS and limits the policy space of the member States to use compulsory licensing.

Fourth, organization Africaine De La Propriété Intellectuelle and African Regional Intellectual Property Organization do not provide an intellectual property cooperation framework for negotiating bilateral trade and investment agreements. The free trade agreements and bilateral investment treaties signed by African countries often contain provisions that curtail their policy space to make maximum use of the TRIPS flexibilities.

For example, the economic partnership agreements refer to protection and enforcement of IP—specifically to intellectual property as a subject of further discussions in the "rendezvous clause." African countries that are parties to these negotiations must be cautious about the possibility of the European Union demanding the adoption of standards of intellectual property protection and enforcement that are above the requirements of the TRIPS Agreement and that can significantly diminish the scope of TRIPS flexibilities for these countries (South Centre, 2007).[82] For instance, the Egypt-EU Partnership Agreement, which entered into force in 2004, requires Egypt to join international intellectual property conventions including the Patent Cooperation Treaty and the 1991 Act of the UPOV Convention. The Algeria-EU Association Agreement requires Algeria to implement the WIPO Internet Treaties, negatively affecting access to knowledge. Similarly, African country parties to the economic partnership agreement could be required to accede to international intellectual prop-

Box 4.4.

REC policies: COMESA and SADC

Some African regional economic communities have undertaken their own strong intellectual property initiatives. COMESA, for example, has developed an intellectual property policy that seeks to put intellectual property rights at the centre of a competitive growth strategy.[79] The draft intellectual property policy requires member States to facilitate intellectual property rights through protection of intellectual property and the mainstreaming of IP. However, this suggests an emphasis on protection and enforcement rather than exploring how intellectual property policy can be tailored to complement, and not constrain, development policies. The draft policy makes only general reference to flexibilities under TRIPS and does not lay down how they can be fully used in specific situations in different sectors.

Similarly, SADC, independent of Organization Africaine de la Propriété Intellectuelle or African Regional Intellectual Property Organization, has taken policy steps to facilitate full use of TRIPS flexibilities for regional production of medicines and to ensure access to affordable medicines. SADC has developed a Pharmaceutical Business Plan that requires SADC member States to coordinate the implementation of TRIPS flexibilities.[80] EAC has adopted a regional policy on the use of TRIPS flexibilities for public health and has developed a regional pharmaceutical manufacturing plan of action that stresses the need to make full use of the TRIPS flexibilities by EAC member States.[81] The African Union Commission also has an initiative developing pharmaceutical manufacturing capacity, but neither Organization Africaine de la Propriété Intellectuelle nor African Regional Intellectual Property Organization are members of the technical committee.

erty agreements that may not benefit their development interests and may curtail their intellectual property policy space.

In some bilateral investment treaties and trade cooperation agreements concluded by African countries with the United States and the European Free Trade Association, intellectual property rights are included within the definition of investments protected by such agreements. This could greatly curtail the ability of these governments to use TRIPS flexibilities to address public policy needs, including those in health.

Reforming Africa's regional intellectual property cooperation. The African Union has undertaken two initiatives that could help to bring coherence to regional intellectual property cooperation: Continental Free Trade Area negotiations (launched in June 2015), which cover IP; and efforts to establish a Pan-African Intellectual Property Organization, with headquarters in Tunisia.

A Continental Free Trade Area agreement on intellectual property would provide an opportunity to set common rules on intellectual property protection and use of flexibilities in the global intellectual property regimes, based on a common approach. It would also provide a framework for subregional cooperation, given that COMESA, EAC and SADC are committed to cooperating on intellectual property policy under the Tripartite Free Trade Area. As in The Association of Southeast Asian Nations, intellectual property cooperation among the Continental Free Trade Area parties could provide the basis for policy dialogue with development partners to advance development and economic integration objectives. Given a similar range of diversity in levels of development within Africa as in the Association of Southeast Asian Nations, enough flexibility should be maintained for African countries—within the framework of global intellectual property commitments—to adopt intellectual property policies that advance development priorities.

A statute for Pan-African Intellectual Property Organization has been drafted.[83] In 2014, the African Union Assembly adopted a decision requesting the African Union Commission to present it for further consideration and recommendations to the Specialized Technical Committee on Justice and Legal Affairs. It also requested the African Union Commission to prepare a roadmap for implementing Pan-African Intellectual Property Organization. The decision recognized African Regional Intellectual Property Organization and Organization Africaine de la Propriété Intellectuelle as Pan-African Intellectual Property Organization's building blocks,[84] opening an opportunity to ensure better collaboration—between the two bodies, with the regional economic communities and with Tripartite Free Trade Area and Continental Free Trade Area, among others.

Box 4.5.

Mercantilist patent filing

The *Economist* in its 8 August 2015 issue showed how patents can be abused: "patents are supposed to spread knowledge by obliging holders to lay out their innovation for all to see; they often fail because patent lawyers are masters of obfuscation." Mercantilist patent-filing practices illustrate this.

Trivial patents. Patent applications that do not reflect genuine innovation have increased alarmingly. Rather, IPR owners seek to obtain registrations for patents on trivial developments with little or no inventive step, to gain a competitive advantage in markets—the "ever-greening" of patents (Correa, 2014).

Patents of questionable validity. This effort pays off for some IPR owners because the legal proceedings delay the entry of potential competitors to the market. Around 28 per cent of current patents have been found to be invalid by US courts (Correa, 2014).

Divisional patent applications. These are patent applications that include some part of a subject matter claimed in a prior ("parent") application. Because they claim the priority from the parent application's filing date, they fulfil the novelty or inventive step requirement. They can be misused to keep pending the decision on grant of a patent for long periods, making it difficult for competitors to know whether they might infringe any patent (Correa, 2014).

Critics have pointed out that the draft Pan-African Intellectual Property Organization statute promotes a narrow vision of intellectual property that focuses on promoting intellectual property rights as an end in itself and harmonizing intellectual property laws across Africa without considering differences in development and socio-economic conditions. The draft statute also fails to address or facilitate the full use of TRIPS flexibilities, reinforcing the obstacles in African Regional Intellectual Property Organization and Organization Africaine de la Propriété Intellectuelle. In light of these concerns, the draft statute should be reviewed (Kawooya, 2012; Baker, 2012). Furthermore, the Pan-African Intellectual Property Organization mandate and statutes should be fully consistent with Agenda 2063.[85]

It follows that a Continental Free Trade Area agreement on intellectual property and the proposed pan-African Intellectual Property Organization should consider the implications of an IP-oriented approach divorced from development concerns. These two initiatives should use mechanisms to prevent TRIPS flexibilities from being further eroded through "TRIPS-plus" provisions (conditions more restrictive than are required by the TRIPS Agreement) in trade agreements. They should also seek to further regional cooperation on maximizing the use of the TRIPS flexibilities to address development concerns for industrial development, public health, education and environmental protection. African countries need to establish intellectual property policies and laws at national level and should therefore consider adopting differential standards of intellectual property protection within the flexibilities available under the TRIPS Agreement. In particular, national legislation should adopt strict standards of patentability criteria in chemicals and pharmaceuticals, to pre-empt mercantilist patent-filing practices (box 4.5). The proposed Pan-African Intellectual Property Organization provides an institutional basis to manage these complex issues.

National laws should also require mandatory disclosure of country or source of origin of genetic resources used in patent applications. African countries should develop robust systems for examination of patent applications. The approach of regional patent offices like African Regional Intellectual Property Organization and Organization Africaine de la Propriété Intellectuelle and of the proposed Pan-African Intellectual Property Organization should be revised to accommodate the flexibilities available under TRIPS, such as the transition period for least developed countries and application of strict criteria of patentability.

These reforms will help to ensure that an intellectual property system emerges in Africa that is fit to support the continent's regional integration growth model. A strategic approach to intellectual property policy can also provide the basis for cooperation and pooling of resources among African countries and regional economic communities in building capacities required for intellectual property governance, given the onerous capacity needs.

Conclusions and policy messages

The TRIPS Agreement removed much of the policy space open to developing countries under WIPO treaties, but still contains flexibilities that developing countries should use when designing their intellectual property regimes. Least developed countries in particular have an extendable transition period they must exploit to construct national intellectual property policies that may fall below the bar set by TRIPS. Intellectual property rules and policies should, after all, be adaptable to the changing needs of African—not just developed-country—societies.

All African countries—least developed countries and non-least developed countries alike—should adopt strategies to maximize policy space in agriculture, manufacturing and public health, and more broadly on access to knowledge, following differential standards of intellectual property protection within the flexibilities allowed under TRIPS. African countries should remain active on operationalizing the two targets (17.6 and 17.7) on intellectual property rights under the Sustainable Development Goals.

African countries have been active at WTO and WIPO in pursuing intellectual property rule-making—the Doha Declaration on the TRIPS Agreement and Public Health is a rare example of success. Conversely, initiatives on global intellectual property rules for protecting traditional knowledge and countering bio-piracy are yet to bear fruit.

If African countries have been proactive in engaging with the global intellectual property regime, they have not been as strategic in harnessing intellectual property to enhance innovation and competitiveness for driving structural change. Regional arrangements for cooperation on intellectual property policy require reform. Africa's intellectual property bodies—African Regional Intellectual Property Organization and Organization Africaine de la Propriété Intellectuelle—have in recent years attempted to work together but links to the regional economic communities (and broader regional integration objectives) are still weak. Operationally, ties between these two bodies with science, technology and innovation policy frameworks at national, regional and continental levels are tenuous, while their mandates touch mainly on granting, examining and registering patents rather than exercising patent rights, thus undercutting their help to states in identifying and using TRIPS flexibilities. Moreover, African Regional Intellectual Property Organization and Organization Africaine de la Propriété Intellectuelle are largely disconnected from free trade and bilateral investment agreements with external partners.

Two current African Union initiatives—Continental Free Trade Area negotiations and efforts to establish Pan-African Intellectual Property Organization—present the chance to cohere Africa's approach to regional intellectual property policy cooperation. Both initiatives should use mechanisms open to them to safeguard TRIPS flexibilities to address development needs. A Continental Free Trade Area agreement on intellectual property could be the basis for a common approach to negotiating intellectual property trade and investment agreements with external partners. A strategic approach to intellectual property policy at continental level can also provide a basis for pooling resources among African countries and regional economic communities to build the heavy capacities required for ensuring intellectual property protection.

Annex 4.1. Status of subscription by African countries to multilateral intellectual property treaties

African states	W	P	B	PCT	PLT	MI	MM	MP	H	GH	N	LI	RO	LO	IPC	PH	VC	BP	S	NOS	TLT	WCT	WPPT	BEIJING	WAS	SG	MARRA	UN	U	WTO
Algeria	●	●	●	●		●	●				●	●	●							●		●	●					●		
Angola	●	●		●																								●		●
Benin	●	●	●	●					●		●											●	●			●		●		●
Botswana	●	●	●	●				●	●	●												●	●	●				●		●
Burkina Faso	●	●	●	●								●	●			●					●	●	●					●		●
Burundi	●	●	●																									●		●
Cape Verde	●	●	●										●															●		●
Cameroon	●	●	●	●																								●		●
Central African Republic	●	●	●	●																								●		●
Chad	●	●	●	●																								●		●
Comoros	●	●	●	●																								●		
Congo	●	●	●	●								●	●							●								●		●
Côte d'Ivoire	●	●	●	●					●																			●		●
Democratic Republic of the Congo	●	●	●													●												●		●
Djibouti	●	●	●																									●		●
Egypt	●	●	●	●		●	●	●	●	●	●				●	●				●	●				*			●		●
Eritrea	●																											●		
Ethiopia	●																			●								●		
Gabon	●	●	●	●					●			●										●	●					●		●
Gambia	●	●	●	●																								●		●
Ghana	●	●	●	●				●	●	●												●	●					●		●
Guinea	●	●	●	●							●			●	●		●				●	●	●					●		●
Guinea-Bissau	●	●	●	●																								●		●
Kenya	●	●	●	●			●	●								●			●	●								●	●	●
Lesotho	●	●	●	●			●	●					●															●		●
Liberia	●	●	●	●			●	●					●			●												●		
Libya	●	●	●	●																								●		
Madagascar	●	●	●	●				●														●	●					●		●

African states	W	P	B	PCT	PLT	MI	MM	MP	H	GH	N	LI	RO	LO	IPC	PH	VC	BP	S	NOS	TLT	WCT	WPPT	BEIJING	WAS	SG	MARRA	UN	U	WTO
Malawi	●	●	●	●							●			●	●													●		●
Mali	●	●	●	●					●													●	●			●	●	●		●
Mauritania	●	●	●	●																								●		●
Mauritius		●	●	●																								●		●
Morocco		●	●	●	●		●	●	●	●		●							●	●	●	●	●	●				●	●	●
Mozambique		●	●	●	●			●	●			●																●		●
Namibia		●	●	●	●			●	●	●	●																	●		●
Niger		●	●	●	●					●				●														●		●
Nigeria		●	●	●	●	●								●														●		●
Rwanda		●	●	●	●				●	●	●									●								●		●
Sao Tome and Principe		●	●		●				●	●	●																	●		
Senegal		●	●	●	●					●											●		●	●				●		●
Seychelles		●	●		●																							●		●
Sierra Leone		●	●		●			●	●																			●		●
Somalia		●																										●		
South Africa		●	●	●	●														●									●	●	●
South Sudan																												●		
Sudan		●	●	●	●			●	●																			●		
Swaziland		●	●	●	●			●	●																			●		●
Togo		●	●	●	●								●	●			●			●	●		●	●				●		●
Tunisia		●	●	●	●		●		●	●	●	●	●					●	●		●							●	●	●
Uganda		●	●	●	●																●							●		●
Tanzania		●	●	●	●							●																●		●
Zambia		●	●	●	●				●																			●		●
Zimbabwe		●	●	●	●				●																			●		●

Note: B, Berne convention; BEIJING, Beijing treaty on audio-visual performances; BP, Budapest treaty; GH, Geneva Act of Hague; H, Hague agreement; IPC, Strasbourg agreement; LI, Lisbon Agreement; LO, Locarno agreement; MARRA, Marrakesh treaty to facilitate access to published works for persons who are blind, visually impaired or otherwise print disabled; MI. Madrid agreement (indications of source;, MM, Madrid agreement Marks; MP, Madrid protocol; N, Nice agreement; NOS, Nairobi treaty; P, Paris convention; PCT-Patent Cooperation Treaty; PH, Phonograms convention; PLT, Patent law treaty; RO, Rome convention; S, Brussels convention; SG, Singapore treaty; TLT, Trademark law treaty; U, UPOV convention; UN, United Nations; VC, Vienna agreement; WAS, Washington Treaty; WCT, WIPO copyright treaty; WPPT, WIPO performances and phonograms treaty; WTO, Agreements establishing the World Trade Organization.

Source: Authors' compilation based on various WIPO and WTO sources.

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Chapter 5

Africa's Science, Technology and Innovation Policies—National, Regional and Continental

> *Today, no country can secure higher levels of scientific advances and technological progress without interacting with its peers and neighbours. The ability of countries and firms to innovate, both in technical and managerial ways, is largely determined by strategic alliances they forge both within their industrial landscape and across sectors. (New Economic Partnership for Africa's Development, Africa's Science, Technology Consolidated Plan of Action)*
>
> *We aspire that by 2063, Africa shall be a prosperous continent, with the means and resources to drive its own development, and where... well educated and skilled citizens, underpinned by science, technology and innovation for a knowledge society [, are] the norm....* (African Union Commission, 2015)

The two excerpts above express the theme of this chapter and provide evidence that Africa's leaders recognize the critical role that science, technology and innovation (STI) could play in the foundation of a modern economy. The dynamic and organic relationship between scientific development and technological innovation and their application in producing, distributing and consuming goods and services forms one of the key drivers of the rapid, profound and pervasive changes humanity has experienced since the beginning of the industrial revolution.

This chapter provides an overview of the concept and rationale of science, technology and innovation policies, highlighting the following:

- Africa's science, technology and innovation policies in over a dozen countries and at regional and continental levels.
- The performance of science, technology and innovation policies at these levels.
- Key messages to enable African governments to use science, technology and innovation policies better.

Concept and rationale

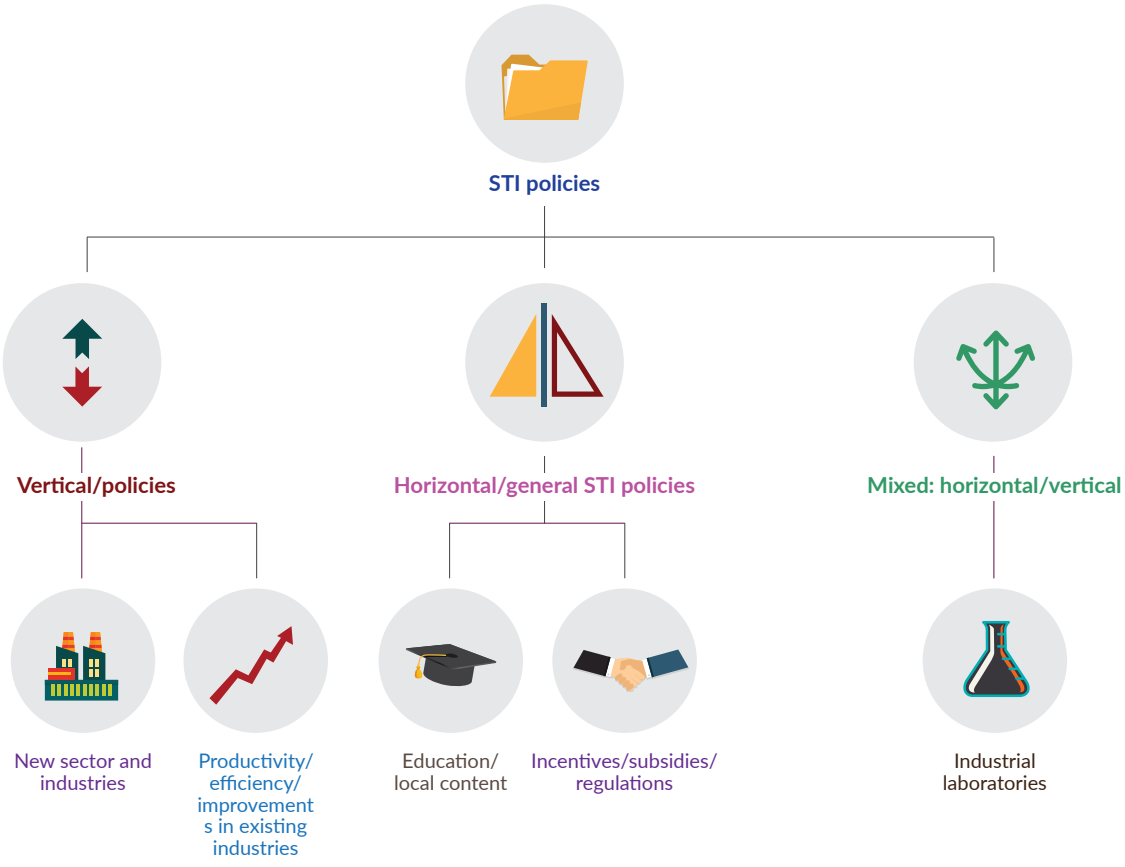
No unifying definitions exist for all three terms—S, T or I. For this chapter, science, technology and innovation policy is defined as" the set of actions that governments can take to deal with a range of problems in the intersecting and complementary domains of science, technology and innovation to achieve a clearly defined (national) objective when private incentives provided by free markets systematically perform poorly" (Weimer and Vining, 1989).

STI policies can be classified into vertical (sectoral), horizontal and mixed policies (figure 5.1). Sectoral policies reflect government-identified national development priorities. Sectoral policies may represent governments' attempts to choose (that is, pick) "winners" and "losers" and are frequently criticized because of their potentially distortionary effects. But they can also drive the concentration of national efforts to achieve global leadership positions in some sectors or areas of science and technology.[86] Sectoral policies can result in the creation of new sectors either through technology transfer or through endogenous science and technology efforts such as chemicals and pharmaceuticals (as in Ethiopia), a space sector (Nigeria) or green technology (South Africa). Sectoral policies may also focus on improving the efficiency and competitiveness of existing sectors like agriculture and manufacturing.

Horizontal science, technology and innovation policies are general, supporting across sectors, and therefore bridge sectoral divides and can attenuate the shortcomings of vertical policies. They follow a market approach in providing general principles and guidelines and are thus less vulnerable to the charge that they represent government efforts to pick winners and losers science, technology and innovation. However, while they are infrequently distortionary, they seldom provide impetus

Figure 5.1.

Science, technology, and innovation policies classified by coverage



Source: Based on Nwuke (2015).

for creating new sectors. Examples include education and human resource development policies, local content policies and market incentives (taxes and subsidies) that do not target specific sectors.

Mixed policies combine the attributes of horizontal and sectoral policies and are set out in national theme-specific policy documents on, for example, biotechnology, energy or information and communications technology (ICT). Countries may choose not to have an explicit science, technology and innovation policy but instead to nest or embed science, technology and innovation aspirations in national policy on education, training and human resource development. Countries may also outline their science, technology and innovation policies sectorally in national development plans, annual budgets, industrial policy, intellectual property legislation or trade policy.

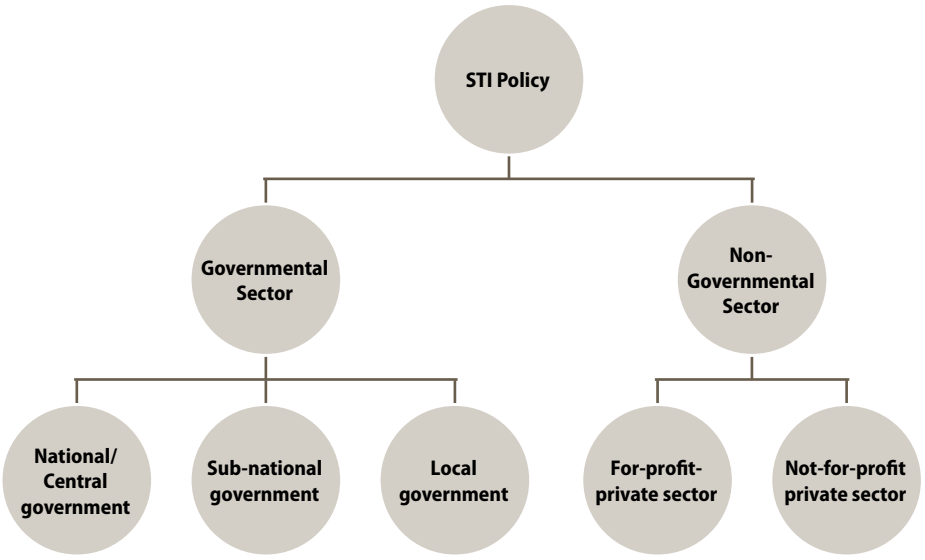
Another way of classifying national science, technology and innovation policy is by jurisdiction or inclusivity (figure 5.2), an approach common in advanced countries with large research-focused companies.

Many governments adopt vertical or horizontal policies for economic or political reasons.[87] The vertical policies are intended largely to prevent or rectify market failures that signify problems with market mechanisms. The horizontal policies may require action to guide socio-economic development while safeguarding national interests (including economic and political sovereignty). Political interventions may also be needed to induce a certain type of educational behaviour—for instance, seeking to influence the choice of university courses and specializations as part of efforts to encourage enrolment in science, technology, engineering and mathematics (STEM).

STI policy can help promote competitiveness, which relies on innovation and diffusion of technological innovations. As national economies become more integrated, policies are set at various levels from national to global, and science, technology and innovation

Figure 5.2.

STI policies classified by jurisdiction



Source: Based on Nwuke (2015).

policies form a key component of the policy mix. Evidence abounds of the transformative impact of policies promoting science, technology and innovation on all spheres of human endeavour, most recently in East Asia, where they led to rises in competitiveness and thus economic growth.

African experience of science, technology and innovation policies

National approaches

Early on, newly independent African countries formulated national education and science and technology policies. The government of Ghana, for example, created the Ghana Research Council in 1959, barely two years after independence;[88] Nigeria established the National Council for Scientific and Industrial Research in 1966 and Kenya established the National Council for Science and Technology in the late 1970s These institutions focused on supporting specific, strategic industries.[89] Practically all science and technology policies were sectoral, carried out by government sectoral ministries and departments.

During the 1960s and 1970s, African governments also established and expanded their higher education sectors by setting up universities and dedicated science and technology research institutes to tackle development challenges and, later, governance institutions to oversee national efforts. However, these efforts were generally poorly coordinated; institutions had inadequate funding and outcomes were often disappointing. Over time, as the shortcomings of this vertical governance structure became obvious, some governments turned to horizontal governance. Some created a super-ministry for science and technology,[90] while others attached science and technology to an existing ministry.[91]

Governments recognized these weaknesses in the sectoral framework as well as the failure of science and technology to contribute to development. In response African leaders met under the auspices of the Organization of African Unity in Monrovia, Liberia, in 1979. There they adopted the Monrovia Declaration, in which they committed "individually and collectively on behalf of our governments to put science and technology in the service of development by reinforcing autonomous capacity in the field." This commitment was reaffirmed in the Lagos Plan of Action adopted at the end of the Organization of African Unity Extraordinary Summit in Lagos, Nigeria, in 1980. The Lagos Programme of Action called on member States to "formulate national policies on science and technology plans to be incorporated in the overall national development, as science and technology are a fundamental input to the development of all other sectors …."[92]

The adoption of the Lagos Programme of Action marked a structural break in science and technology policy making in Africa, because African countries committed to musings policy as an instrument to advance economic growth and structural change. This section reviews the African experience since 1980, drawing heavily on the experience of 15 countries[93] selected mainly for quantity and quality of available data. The sample is nonetheless roughly representative.

Response to the LPA

African governments did not respond speedily to their Lagos Programme of Action commitments, with several signatory countries in the sample not adopting their first policies until two or more decades later (figure 5.3). Organization of African Unity The slow pace may be attributable to several factors: economic stress caused by structural adjustment programmes; cutbacks in higher education financing (also influenced by creditors and donors); migration of qualified scientists and technologists from universities to the domestic private sector or to foreign (mostly Western) countries; and the contraction of manufacturing. The turnaround started in only the early 1990s.[94]

Policy objectives and priorities

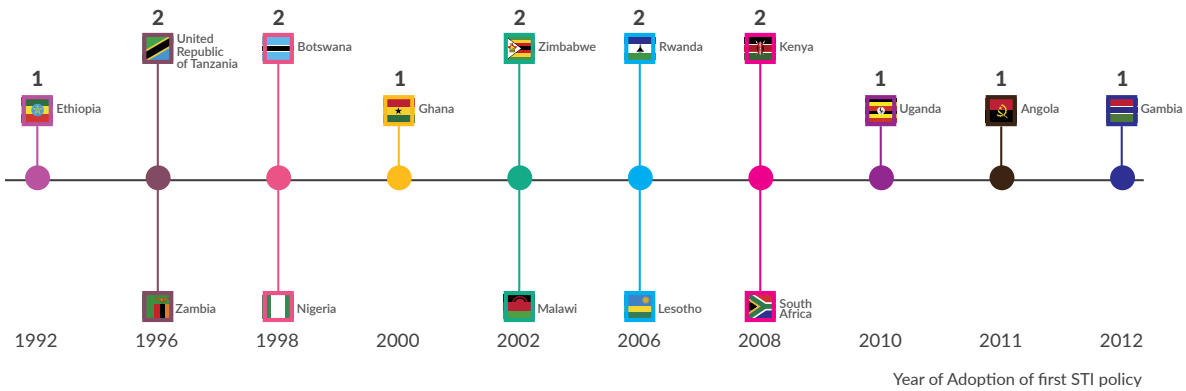
By 2002—the year the African Union ratified the successor development framework to the Lagos Programme of Action, the New Partnership for Africa's Development (new Economic Partnership for Africa's Development)—eight of the 15 countries had an explicit science, technology and innovation policy. Annex 5.1 summarizes elements of science, technology and innovation policy in the sample countries. Most countries seek to harness the transfer and adaptation of knowledge and technology. However, the sheer number of objectives complicates monitoring and evaluation (M&E) and makes it costlier.

The following features emerge from an analysis of these policies:

- Excluding South Africa, the countries show striking similarities in structure.
- Common priorities include education and human resources development, agriculture, energy, health, environment, industry, intellectual property protection, and transport and communications.
- Each national science, technology and innovation policy defines a set of key national priorities ranging from six for South Africa to 18 for Nigeria. South Africa has horizontal, the rest sectoral, policies.
- Some priorities mirror the national context (though many do not, and seem to reflect a standardized approach that does not vary across countries) and build on areas where countries either have a capacity to be at the frontier of knowledge or believe that science, technology and innovation can help them address pressing development challenges and accelerate catch-up.[95] The policies show a cross-cutting weakness, that is, the inability to estimate cost of implementing them. This weakness may explain the poor outcomes. Institutional reform, includ-

Figure 5.3.

STI policy adoption in 15 African countries since the Lagos Programme of Action



Note: Zimbabwe and South Africa joined the Organization of African Unity in 1980 and 1994, respectively.

Source: Based on Nwuke (2015).

ing legislation and creation of new governance or administration institutions, is an implementation mechanism common to science, technology and innovation policies.

Institutional arrangements

The institutional arrangements for science, technology and innovation policy implementation show wide divergence (table 5.1 and figure 5.4). [While most science, technology and innovation policy is implemented through a ministry responsible for science, technology, education and research, some countries have created other special bodies. Table 5.1 and figure 5.4 illustrate the wide variety of institutional arrangements that different African countries have adopted for their science, technology and innovation policies.

Understanding the importance to industry and society of industrial research institutes as specialized knowledge developers and as a bridge between basic research and industrial production, African countries have founded several industrial research institutes (box 5.1).

STI finance

Most African science, technology and innovation policies provide for financing. Financing arrangements often include commitments to increase investment in R&D to at least 1 per cent of GDP, reflecting Lagos Programme of Action aspirations and those of other Organization of African Unity/African Union frameworks, sometimes combined with provisions for creating a science and technology development fund. Some have provisions for public–private partnerships (PPPs) and for the private sector (table 5.2).

Table 5.1.

Institutional arrangements and legal and regulatory frameworks of national science, technology and innovation policies in 15 African countries

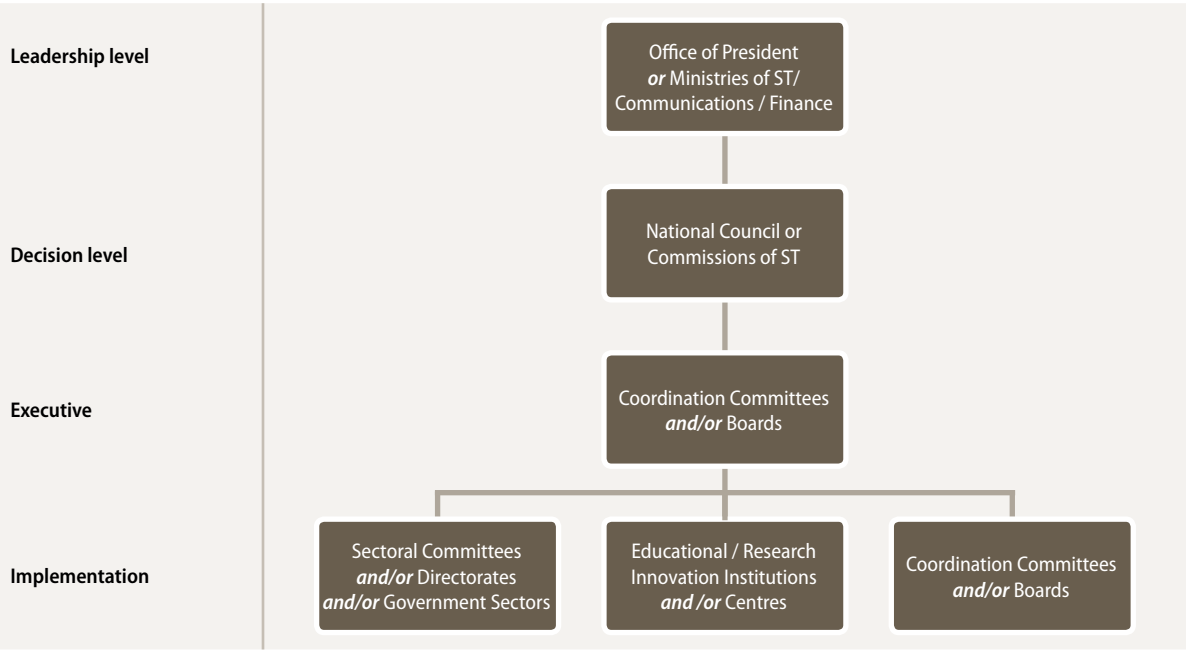
Country	Institutional arrangements	Legal and regulatory frameworks
Angola	• Ministry of Higher Education and Science and Technology, established in 2010.	• Presidential Decree of the National Strategy for Science, Technology and Innovation
Botswana	• Ministry of Communications Science and Technology	• Administrative issuance • The Department of Research, Science and Technology under the Ministry of Infrastructure, Science and Technology to propose policy and legislation
Ethiopia	• National Science, Technology and Innovation Council • The Ministry of Science, Technology and Innovation	• Policy is enforced through parliamentary proclamations, regulations and directives
The Gambia	• Ministry of Higher Education, Research, Science and Technology	• N/A
Ghana	• The Ministry of Environment, Science and Technology	• N/A
Kenya	• Ministry of Science and Technology • National Council for Science and Technology	• Government acts and provisions
Lesotho	• Ministry of Communication, Science and Technology	• Science and Technology Act • • Science and Technologies Institution Bill, 2007
Nigeria	• National Innovation Research Council • The Federal Ministry of Science and Technology • State Innovation and Research Council	• Science and Technology Act (No. 16 of 2003)
Rwanda	• Ministry in the President's Office in Charge of Science, Technology and Scientific Research;	• National Science and Technology Act
South Africa	• The Department of Science and Technology; • Technology Innovation Agency	• N/A
Tanzania	• Ministry of Science, Technology and Higher Education	• Legislation
Uganda	• Ministry of Finance, Planning and Economic Development	• Uganda National Council for Science and Technology Act (1990)
Zambia	• Ministry of Science, Technology and Vocational Training	• Parliamentary acts
Zimbabwe	• Ministry of Science and Technology Development	• Statutory instruments under the Science and Technology Act

Note: N/A = not available

Source: Compilation based on Nwuke (2015).

Figure 5.4.

Science, technology and innovation administration system in most countries



Source: Nwuke (2015).

Box 5.1.

Industrial research institutes

Three cases provide some insight into the workings, accomplishments and challenges of African industrial research institutes.

National Institute for Scientific and Industrial Research, Zambia

Established in 1967, the National Institute for Scientific and Industrial Research provides technological services to industries, rural communities and government agencies, encourages promotion and transfer of technology to small and medium-sized enterprises, trains researchers and technologists and provides advisory and consulting services to government and industry.

The National Institute for Scientific and Industrial Research developed and transferred the non-alcoholic Maheu drink technology to the (at the time) small firm Trade Kings Limited, which since has grown and now exports the drink to seven countries. Research conducted by the National Institute for Scientific and Industrial Research with Zambia Sugar has helped Zambia become the only country in Africa (outside of North Africa) to fortify sugar. The National Institute for Scientific and Industrial Research collaborated with New Economic Partnership for Africa's Development and the Council for Scientific and Industrial Research to develop the first effective herbal medicine for managing HIV/AIDS. Lack of funding and declining numbers of researchers are the main obstacles.

Source: ECA, 2013.

Institute of Industrial Research, Ghana

Founded in 1998, the Institute of Industrial Research is the country's main R&D institution. Its goals include reducing poverty through cost-effective environmentally and commercially viable industrial technologies. Its strengths include product and process design and development, adaptive technology promotion and scientific instrumentation and calibration.

Some of its accomplishments include provision of processing technologies to the local salt industry, transfer of ceramic and glaze technologies to the local pottery industry and design and production of small machinery for the local agro-processing industry. Challenges

Continued

Box 5.1.

Industrial research institutes (continued)

include lack of funds for research activities, underequipped laboratories and decreases in number of researchers and, consequently, research output.

Source: ECA, 2013.

Council for Scientific and Industrial Research, South Africa

Established in 1945, the Council for Scientific and Industrial Research's goal is to improve the quality of life of the people of South Africa through scientific or industrial development, either on its own or with principals from the private or public sectors. It uses photonics, robotics and ICT at its modelling and research facilities for its work in energy, health, industry, defence and security, and the built or natural environment.

The Council for Scientific and Industrial Research has partnerships with big multinational companies such as Eskom (on laser leak-sealing technology), Boeing (for titanium powder manufacturing) and ArcelorMittal South Africa (laser processing for continuous caster foot rolls of steel). Its accomplishments include the Tellurometer (the world's first microwave distance-measuring instrument, used by telecommunication companies and surveyors) and the heavy-vehicle pavement simulator (to predict the condition of a paved road after 20 years' use). It has patented and licensed its lithium-ion rechargeable battery material to multinational companies.

Via the Council for Scientific and Industrial Research-Meraka Institute, it has helped launch start-ups such as the Dr. Math mobile tutoring service, through which users can access tutors on their mobile phones. It has transferred technology underlying CoroCAM, which inspects eye corona discharge, to UViRCO technologies.

Source: Council for Scientific and Industrial Research (South Africa), 2015; 2013a; 2013b; 2010; defenceWeb, 2013; Ittmann, 2010; Ministry of Science and Technology of India, 2015; National Geo-Spatial Information (South Africa), 2013.

Regional collaboration among countries

Many of the 15 countries have regional science, technology and innovation policies. Ethiopia, for instance, seeks to "encourage cooperation with developed and developing countries as well as with various international and regional organizations."[97] Others do not mention New Economic Partnership for Africa's Development or regional economic community (REC) policies.[98]

Some countries, like Ghana, explicitly link efforts to subregional commitments as defined by the ECOWAS Revised Treaty, which urges member States to ensure proper application of science and technology for the development of priority sectors, and some link to the African Union/New Economic Partnership for Africa's Development Consolidated Plan of Action for Science, Technology and Innovation. Box 5.2 provides an example of regional cooperation.

The country experience summarized

The science, technology and innovation policies can be classified generally as either "leap-frog" or "catch-up/late-comer." Some are a mix.[99] Countries with a leap-frog policy will undertake more R&D, publish more, collaborate more, allocate more resources to science and technology research and obtain more patents than countries seeking to catch up through transfer of foreign technologies (as seen in the discussion below on patents). science, technology and innovation progress in countries with catch-up/late-comer policies should be assessed with a different set of metrics. Categorizing national policies in this way thus has implications for R&D funding and for the relevance of commonly used metrics, such as patent count. For example, the LPA's target funding level of 1 per cent of GDP along with subsequent decisions by the Organization of African Unity and the African Union Commission, is too close to one-size-fits-all, as catch-up may not require a 1 per cent funding level. Each country must cost its science, technology and innovation policy individually.

The policies also contain a mix of types of measures. Some are "nudges"[100] to change the behaviour of actors, others are explicit regulations and still others are based on market incentives. The diversity mirrors differences in ideological orientation, particularly views on the roles of the state and markets. Countries that subscribe

Table 5.2.

STI financing arrangements and goals for 13 African countries[96]

Country	Financing arrangement or goal
Botswana	Attain Gross Expenditure on Research and Development (dedicated to science and technology research and innovation by 2016) of at least 2 per cent by 2016 from the government budget and private contributions.
Ethiopia	STI activities in all sectors are to receive 1.5 per cent of GDP from a 1 per cent profit contribution from all service and productive sectors for an innovation fund for R&D activities and from the government budget.
Ghana	Achieve Gross Expenditure on Research and Development of 1 per cent of GDP from the government budget and via public-private partnerships.
Kenya	Reach Gross Expenditure on Research and Development of 2 per cent of GDP from the government budget channelled through the National Research Fund.
Lesotho	Attain Gross Expenditure on Research and Development of 1 per cent of GNP from the government budget channelled through the Lesotho Innovation Trust Fund and through private and donor contributions.
Malawi	Achieve funding from the Science and Technology Fund, appropriated by Parliament.
Nigeria	Attain Gross Expenditure on Research and Development of 1 per cent of Gross National Product from the national budget, channelled through the National Research and Innovation Fund and public-private partnerships.
Rwanda	Secure funding from the Rwanda Innovation Endowment Fund; 5 per cent of the government budget to go to the National Research Fund; and funding via public-private partnerships.
South Africa	Receives funds from the National Research Foundation and the Technology Innovation Agency.
Uganda	Reach Gross Expenditure on Research and Development of 1 per cent of GDP funded by private actors, public-private partnerships, and the government budget.
Tanzania	Achieve Gross Expenditure on Research and Development of at least 1 per cent of GDP through the government budget.
Zambia	Government to allocate 3 per cent of GDP to science and technology activities.
Zimbabwe	Attain Gross Expenditure on Research and Development of at least 1 per cent of GDP through the government budget channelled through the Innovation and Commercial Fund.

Note: Angola and Gambia were omitted due to lack of information.

Source: Authors.

Box 5.2.

Pan African Rinderpest Campaign

In 1986 the African Union Inter-African Bureau for Animal Resources launched the Pan African Rinderpest Campaign. This regional body coordinated national projects in 35 African countries, helping build national capacities of veterinary services for disease diagnosis and developing regional coordination, vaccine control and vaccine-production centres in several countries. It also mobilized stakeholders at all levels and improved cross-border flows of information, personnel and materials. It boosted the quality and supply of vaccines by upgrading science and technology and institutional capacities and provided training to community workers.

The Campaign had $200 million in support from the European Union. It ultimately eradicated rinderpest in Africa through a sustained vaccination campaign, and in 2011 the disease was declared eradicated worldwide.

Source: Tambi (1999), Roeder (2011), Food and Agricultural Organization of the United Nations and World Organization for Animal Health (2011).

to the developmental state concept, such as Ethiopia, Rwanda and South Africa, have policies favouring a leading role for the state.

Regional policies

African regional economic communities recognize the central role of science, technology and innovation in integrating their regions. They also recognize that a wider economic space—free of entry barriers—can spur innovation and creativity.

In regional markets, innovative firms can exploit economies of scale and of scope and so increase their competitiveness. And as knowledge is a public good at all levels, it can be harnessed to tackle many regional challenges (infectious and contagious diseases, poverty, environmental degradation and so on). Against this background, the science, technology and innovation policies of five of the eight African Union–recognized regional economic communities are surveyed.

COMESA

Article 3 of the Treaty Establishing COMESA commits member States "to co-operate in the creation of an enabling environment for foreign, cross border and domestic investment including the joint promotion of research and adaptation of science and technology for development" (p. 9). Member States also commit to sharing knowledge on research developments and science and technology in various areas of cooperation such as meteorological services (Article 94, p. 49): "The Member States shall exchange information and expertise concerning new developments in meteorological science and technology including the calibration and comparison of instruments." Chapter 17 (p. 65) of the Treaty spells out the role of science in socio-economic and cultural development and technological progress. The chapter provides member States scope for cooperation (Article 127, p. 65) and guidelines for the promotion of science and technology (Article 128, pp. 65–66).

EAC

The Treaty Establishing EAC exhorts member States in Article 80 to "promote industrial research and the transfer of technology, acquisition, adaptation and development of modern technology" and "disseminate and exchange industrial and technological information."

Article 102 concerns the development of human resources and of science and technology. In Article 103 EAC member States undertake to promote cooperation in science and technology. EAC member States signed in 2013 the Protocol establishing the East African Science and Research Council[101] as an anchor institution to serve as the region's "leader in the promotion and coordination of the development and application of science and technology for sustainable socio-economic development in Partner States." The Council has 19 objectives, including formulating a regional science and technology policy; carrying out regular reviews of that policy; guiding, monitoring and evaluating implementation; establishing and supporting joint science and technology research institutions; creating a conducive environment for promoting science and technology and promoting the use and development of indigenous knowledge and technologies. Financed by contributions from member States, it is also tasked with determining priorities for regional research.

ECOWAS

Under Article 3 of the ECOWAS Treaty, "harmonization and coordination of national policies and the promotion of integration programmes, projects and activities… particularly in science and technology" is one of the aims of the Community. Article 22 established technical commissions including one for industry, science and technology and energy "to prepare community projects and programmes and ensure the harmonization of Community projects and programmes."

Article 27 lists member States' science and technology commitments. For example, they pledge to strengthen national science and technology capabilities to bring about socio-economic transformation; ensure the proper application of science and technology to the development of priority sectors; and to reduce their dependence on foreign technology and promote their individual and collective technological self-reliance. They also commit to cooperate in the development, acquisition and dissemination of appropriate technologies, to strengthen existing scientific research institutions, and to take all necessary measures to prepare and implement joint scientific research and technological development programmes.

The Treaty further states that member States shall harmonize, at regional economic community level, their national policies on science and technology research with a view to facilitating their integration into national economic and social development plans. They are to coordinate their applied research and development research programmes and science and technology services and harmonize their national technological development plans by emphasizing indigenous and adapted technologies and regulations on industrial property and transfer of technology. However, unlike SADC and EAC, ECOWAS does not have a separate body charged with harmonizing science, technology and innovation policies or determining its priorities.

In 2012, the Second Conference of ECOWAS Ministers for Science and Technology adopted an ECOWAS regional policy on science and technology and its action plan.[102] The policy gave directives to create a directorate for science, technology and innovation; to implement, monitor and evaluate the policy; to create a one-stop science and technology window from its Solidarity Fund; to finance R&D and facilitate funding support from partners; to

strengthen financial capacities of science and technology research institutions and to promote regional and international cooperation in science, technology and innovation, mainstreaming it in national and Community sectoral policies.

IGAD

Article 7 of the Agreement Establishing IGAD[103] identifies steps to "[f]acilitate, promote and strengthen cooperation in research, development and application in the fields of science and technology" as one of the key aims of the Authority. Article 13A implores member States to "cooperate in the gradual harmonization of their national policies in science and technology research and development, transfer of technology, and their policies on capacity building in science and technology in the subregion."

SADC

The SADC Treaty[104] is thin on science and technology. Article 5.2(f) states that member States "shall promote the development, transfer and mastery of technology" and "improve economic management and performance through regional integration." Article 21 identifies science and technology as an area of cooperation. Subsequently, member States adopted the SADC Declaration on science, technology and innovation in 2006, given legal effect in 2008 by ratification of the SADC Protocol on Science, Technology and Innovation. The Protocol's objective is "to foster cooperation and promote the transfer and mastery of science, technology and innovation in Member States" to "promote the development and harmonization of science, technology and innovation policies in the region; resources for scientific, technological development and innovation within the region; and optimize public and private investment in research and development... and leverage external contributions." Member States committed themselves "to act in common pursuit of the objectives" of the Protocol, which also created institutional mechanisms for managing and administering science, technology and innovation at regional level.

Pan-African policy initiatives

The African Union and its predecessor, the Organization of African Unity, have been influential in developing science, technology and innovation policies, beginning with the Lagos Programme of Action in 1980. The importance of a comprehensive science, technology and innovation policy was reiterated in the Cairo Declaration and Cairo Plan of Action, adopted at the 2000 Africa-Europe Summit, which "encouraged the formulation of comprehensive programmes in the development and transfer of technology with special emphasis on science and technology, indigenous technologies, the development of educational and training systems, and information technology."

The African Union placed yet greater emphasis on science and technology. Article 13 of its Constitutive Act empowers its executive council to "coordinate and take decisions on policies of common interest to the member States including in science and technology" and to "establish a system of African awards, medals and prizes."[105] In article 14, the Act set up specialized committees, including one on industry, science and technology, energy and natural resources. These committees are charged with preparing, coordinating and harmonizing African Union initiatives.

In 2002, the African Union ratified the New Economic Partnership for Africa's Development, adopted by the African Heads of State and Government of the Organization of African Unity the previous year. The New Economic Partnership for Africa's Development identified science, technology and innovation as the key means of implementation of its agenda. In 2005, the African Union Commission adopted the Consolidated Plan of Action for Science, Technology and Innovation to concretize the continent's approach to science, technology and innovation. The Consolidated Plan of Action for Science, Technology and Innovation had a vision of "Africa that is free of poverty and well integrated into the global knowledge economy." Its principal goals were "to enable Africa to harness and apply science, technology and related innovations to eradicate poverty and achieve sustainable development; and to ensure that Africa contributes to the global pool of scientific knowledge and technological innovations." The Consolidated Plan of Action for Science, Technology and Innovation also identified four science, technology and innovation priority areas: biodiversity, biotechnology and indigenous knowledge; energy, water and desertification; material sciences, manufacturing, laser and post-harvest technologies; and ICT, space science and technologies. In the African Union Declaration on science and technology[106] in 2007, African leaders committed to "[i]

ncrease funding for national, regional and continental programmes for science and technology and support the establishment of national and regional centres of excellence in science and technology."

In 2014 the Consolidated Plan of Action for Science, Technology and Innovation was replaced by the Science, Technology and Innovation Strategy for Africa 2024. This strategy identifies six science, technology and innovation priorities: eradicating hunger and achieving food security; preventing and controlling disease; building communication and transport infrastructure (for physical and intellectual mobility); protecting the integrity of African resources and "space"; "live together—build the society"; and wealth creation. Carrying out these priorities rests on four pillars: building or upgrading research infrastructure, enhancing professional and technical competencies, promoting entrepreneurship and innovation and providing an enabling environment for science, technology and innovation development.

Under the Science, Technology and Innovation Strategy for Africa-2024, "continental, regional and national programmes will be designed, implemented and synchronized to ensure that their strategic orientations and pillars are mutually reinforcing, and achieve the envisaged developmental impact."[107] The strategy proposes a monitoring and evaluation framework,[108] funding mechanisms and a pan-African African Science and Technology Innovation Fund. It aims to fulfil the continental initiatives set out in two policy framework documents, the Common African Position on the Post-2015 Development Agenda and Agenda 2063, both of which identify science, technology and innovation as undergirding the achievement of African aspirations.

To report on progress on the science, technology and innovation priorities of the African Union and its member States, New Economic Partnership for Africa's Development's Office for Science and Technology conducts regular indicator surveys and reports the results every few years in the publication African Innovation Outlook.

At the June 2015 African Union Summit, African leaders reiterated their commitment to harnessing science, technology and innovation for Africa's development. Leaders decided to establish a committee of 10 Heads of State and Government (two from each region) whose members will serve as the continent's champions of education and science and technology. The committee will report to the African Union Summit once a year.[109]

The above makes clear that, at pan-African level, leaders take science, technology and innovation policies extremely seriously. But there is scope for more practical collaboration at regional and continental levels to address the under-provisioning of regional public goods such as public health, to perform collaborative research on regional challenges and to improve the competitiveness of firms and other economic operators.

STI policy performance—not so impressive

The science, technology and innovation policies reviewed above[110] have not improved Africa's science, technology and innovation performance. African countries still perform poorly on three main indicators: tertiary education institutions, intellectual property and innovativeness and productivity and competitiveness.

Tertiary education institutions

African universities have very low rankings globally. The latest findings (2015–2016) of the Quacquarelli Symonds ranking, introduced in 2004, ranks universities from only five African countries (table 5.3). Quacquarelli Symonds assesses thousands of universities, but among African universities only the universities of Cape Town, Stellenbosch and Witwatersrand rank in the top 400 universities worldwide.

IP and innovativeness

African countries perform poorly on intellectual property generation, too, suggesting that policies have not yet stimulated intellectual property and innovations based either on research and development or routine learning and practice. No African country ranks in the top 20 countries for patent applications, according to the World Intellectual Property Organization (WIPO). The 12 countries that lead Africa in patents show a wide range in numbers of patents granted by the United States Patent and Trademark Office—as few as two between

Table 5.3.

Quacquarelli Symonds ranking of African universities in 2015–2016

Institution	Global QS rank	Score (out of 100 per cent)
University of Cape Town (South Africa)	171	57.8
University of Stellenbosch (South Africa)	302	42.3
University of Witwatersrand (South Africa)	331	39.7
University of Pretoria (South Africa)	501–550	Not indicated
University of Johannesburg (South Africa)	601–650	Not indicated
Makerere University (Uganda)	701+	Not indicated
University of Dar es Salaam (Tanzania)		
University of Ghana Legon (Ghana)		
University of Nairobi (Kenya)		
University of the Western Cape (South Africa)		

Note: The criteria are: academic reputation (40 per cent), employer reputation (10 per cent), student-to-faculty-ratio (20 per cent), citations per faculty ratio (20 per cent), international faculty ratio (5 per cent), and international student ratio (5 per cent). The top 400 universities are ranked individually, while the rest are ranked in groups from 401–410 to 701+.

Source: QS World Ranking of Universities 2015–2016. Available at: http://www.topuniversities.com/university-rankings-articles/world-university-rankings/qs-world-university-rankings-methodology.

2001 and 2014—and their performance is dominated by South Africa (figure 5.5). And on intellectual property generation and ownership, Africa is the worst performer of all the global regions (figure 5.6).

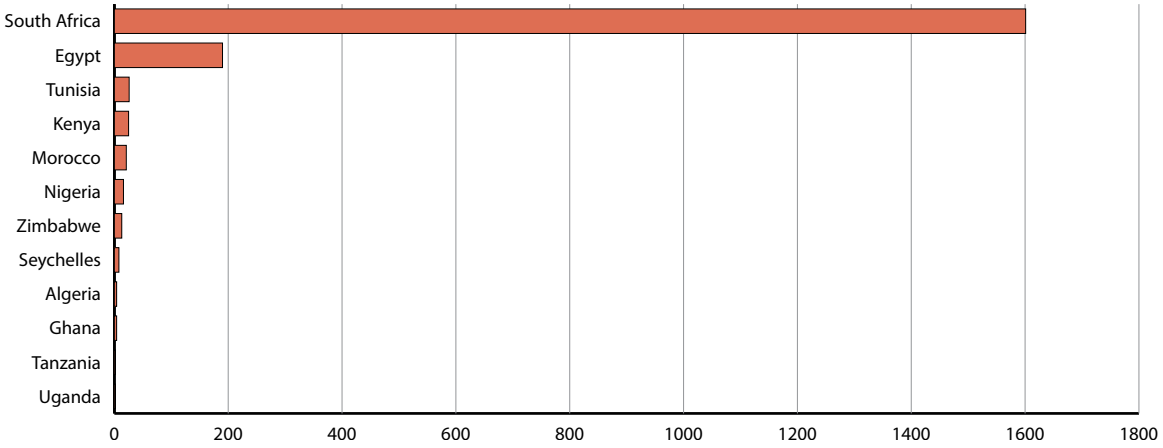
Productivity and competitiveness

Growth in most of African countries from 1995 to 2010 derived from factor accumulation and not gains in input combinations that can be measured by total factor productivity (table 5.4). Nigeria reported positive total factor productivity growth for the 15 years except for 2001 to 2004. In 2010 total factor productivity growth in Nigeria stood at an enviable 8.79 per cent, the highest among the countries in the table. But with excess labour and high youth unemployment, Nigeria should focus on growth driven by factor accumulation rather than efficiency. In contrast, South Africa, the continent's most scientifically and technologically advanced country has been mired in low total factor productivity growth, reporting just 0.04 per cent growth in 2010.[111] This could suggest that the country is caught in the middle-income trap.[112] Ethiopia had a negative total factor productivity growth rate from 2005, evidence that much of its recent economic growth has been driven by factor accumulation rather than productivity growth.

Most African countries are still on the lowest ranks of competitiveness, regardless of the indicator used (see chapter 3 and the CIP index). The ratio of Africa's high

Figure 5.5.

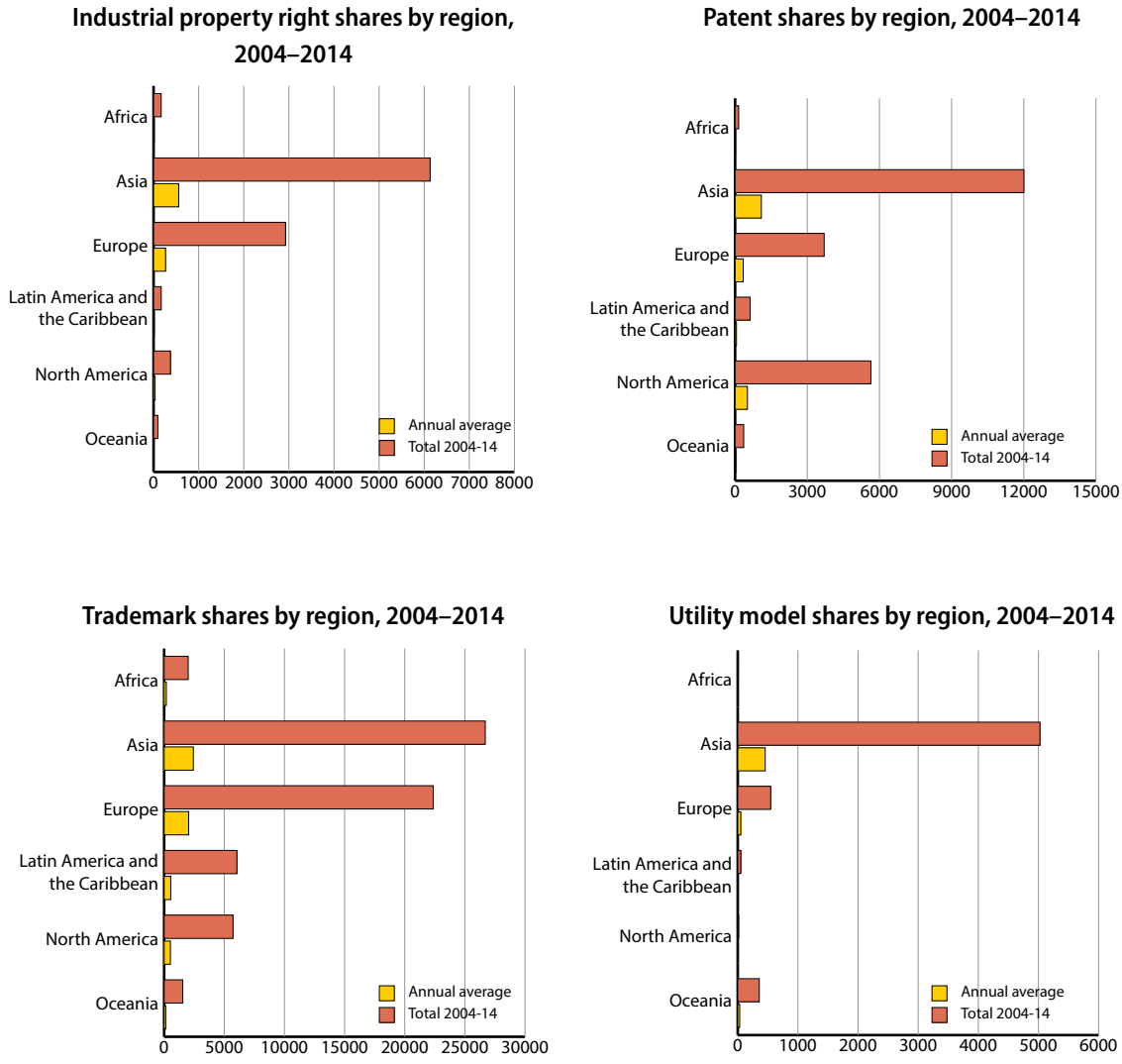
Top 12 African countries by number of United States Patent and Trademark Office patents, 2001–2014



Source: United States Patent and Trademark Office/ www.uspto.gov/.

Figure 5.6.

Africa in global intellectual property performance



Source: Computed by author, based on statistics, available at: http://ipstats.wipo.int/ipstatv2/keysearch.htm?keyId=203, accessed on 8 February 2016.

technology exports relative to GDP, though rising, is also low. Overall, Africa's suboptimal performance can to a very large extent be attributed to its lack of effective capacity, which hinders countries from setting out on a sustainable economic growth and development trajectory driven by structural change.

Table 5.4.

Change in total factor productivity, 1995–2010 (per cent)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Angola	1.1	1.09	0.99	1.08	1.07	0.94	-14	-19.2	-19	-13	-4.1	3.4	7.96	9.3	8.44	6.66
Botswana	1.01	1.04	1.05	1.08	1.07	1.04	1.86	-0.03	-1.5	-2.5	-2.9	-2.8	-2.45	-1.83	-1.12	-0.4
Ethiopia	1.01	1.02	1	0.95	1.05	1.08	8.57	7.18	4.16	0.53	-2.7	-4.7	-5.16	-4.25	-2.38	-0.2
Gambia	0.95	0.97	1.05	0.96	1.1	1.06	2.89	-0.49	-3.5	-5.2	-5.2	-3.6	-1.1	1.58	3.58	4.35
Ghana	1.04	1.01	0.94	1.02	1	1.09	11.8	12.19	10.2	6.51	2.25	-1.7	-4.58	-6.06	-6.09	-4.9
Kenya	1.02	1.01	1.01	1	0.98	1	0.31	0.9	2	0.89	0.4	-0.2	-0.57	-0.74	-0.63	-0.3
Lesotho	0.9	0.92	1.03	0.98	0.98	1.01	2.44	3.18	3.5	3.48	3.21	2.78	2.26	1.71	1.18	0.7
Malawi	1.27	1.08	1.04	0.99	1.05	1	-2.9	-3.7	-3.6	-3	-2	-1	0.01	0.68	1.05	1.13
Nigeria	1.05	1	1.12	0.97	0.85	0.78	-26	-23.6	-16	-6.1	4.57	13.3	18.3	18.94	15.38	8.79
Rwanda	1.31	1.13	0.97	1.06	1.06	1.02	-0.1	-1.97	-3.2	-3.5	-3	-1.9	-0.51	0.76	1.67	2.08
South Africa	1	1	1.01	0.99	1.01	1.01	1.04	0.74	0.3	-0.1	-0.5	-0.7	-0.66	-0.5	-0.24	0.04
Uganda	1.02	1.02	1.01	0.99	1	0.97	-4	-4.24	-3.9	-3	-2	-0.9	0.05	0.8	1.26	1.46
Tanzania	1.02	1.03	0.92	1.11	1.04	2.2	0.99	-0.37	-1.6	-2.4	-2.7	-2.5	-1.76	-0.76	0.32	1.03
Zambia	0.96	1.04	1.05	1	1.01	1.02	1.09	0.412	-0.2	-2.4	-0.9	-0.8	-0.55	-0.23	0.09	0.31
Zimbabwe	0.99	1.09	0.98	1.02	0.98	0.96	-4.7	-4.52	-3.8	-2.4	-2	-1.2	-0.52	-0.07	0.2	0.34

Note: Values for 2001–2010 are forecasts of total factor productivity growth.

Source: Based on United Nations Industrial Development Organization, 2015; https://www.unido.org/data1/wpd/Index.cfm.

Science, technology and innovation key policy messages

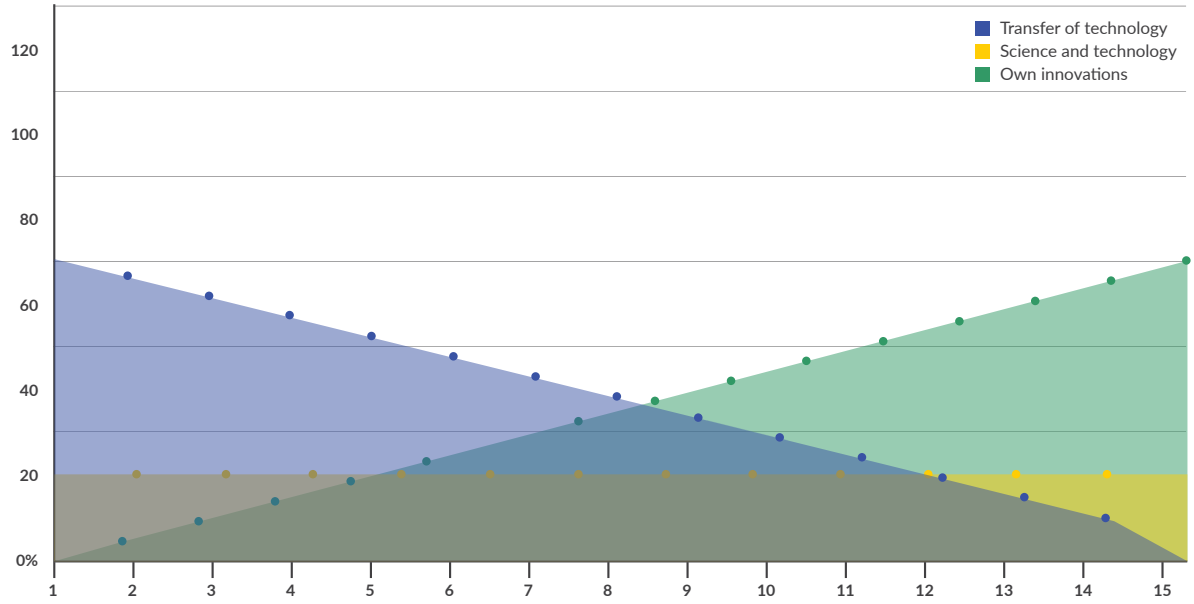
African governments can use science, technology and innovation policies more effectively by heeding these recommendations:

- Governments should raise spending on high-quality tertiary education.
- African science, technology and innovation policies should be pragmatic and pursue a phased approach to innovation, as decades of science, technology and innovation policy rhetoric has not translated into increased STI capacity.
- STI policies should take into account the intervention environment, which usually varies by country. Countries' policies look quite similar, suggesting little linkage to country particularities.
- Governments should strengthen funding for research and development. African countries are far from achieving a critical mass of research and development finance and human capital, largely owing to fiscal constraints. Resource paucity also often affects African businesses, exacerbating matters.
- Countries should boost domestic funding for developing capacity rather than rely on support from development partners as is common across Africa. Such support may help, but there is no evidence that any country has develop edits capacity through development assistance.
- A mixed approach to policy, blending horizontal policies and vertical policies, as well as governmental (regulatory) and non-governmental (incentive) policies, would be prudent. Most urgently, governments should design and adopt an M&E framework for development processes.

The departure point is to recognize the need for reform of higher education to generate a pool of graduates in STEM disciplines. These skills and capabilities are critical because they develop capacity and readiness for technological diffusion (crucial in the earlier phases of development) and technological innovations (more prevalent in the long run). Figure 5.7 illustrates the complementarities between such diffusion and innovation. But a country's own technological innovations, which depend on capabilities in STEM disciplines for sustainable competitiveness, are also important.

Figure 5.7.

Indicative distribution of science, technology and innovation efforts to develop competitive domestic innovative capacities



Annex 5.1. Objectives, priorities and M&E frameworks of African national science, technology and innovation policies

Country	Objectives	Priorities	M&E mechanisms
Angola	The advancement of technological innovation in parallel with the transfer of technologies in the productive sector for the sustainable development of the economy of Angola	1. Education, culture and professional training 2. Higher education 3. Agriculture and fishery 4. Telecommunications and information technologies 5. Industry, oil, gas and mineral resources 6. Health 7. Water resources 8. Energy 9. Environment	Annual assessment to determine the progress and difficulties encountered in implementing this policy.
Botswana	The adopting, development, generation and transfer of suitable technologies for poverty reduction	1. Agriculture 2. Education and HR development 3. Health 4. Meteorology 5. Mining 6. Wildlife 7. Population planning and human settlement 8. Transport and communications 9. Tourism 10. Water	M&E strategies outlined in the policy document.
Ethiopia	The transfer of suitable technologies for sustainable economic development and betterment of the livelihood of Ethiopian people	1. Technology transfer 2. Human resources development 3. Manufacturing and service-providing enterprises 4. Research 5. Financing and incentive schemes 6. National quality infrastructure 7. Universities, research institutes, TVET institutions and industry linkages 8. IP system 9. Science and technology information system 10. Environmental protection and development 11. International cooperation	No explicit M&E mechanisms are specified
Gambia	STI knowledge transfer, adopting and diffusion to find solutions to the social, economic and cultural challenges facing the country	1. Education and training 2. Medical and public health 3. Economy 4. Trade and industry, innovation and entrepreneurship 5. Energy 6. Agriculture, environment & natural resources 7. Transport 8. National security 9. Sports and recreation 10. Tourism and hospitality 11. Youth and innovation	No explicit M&E mechanisms specified

Country	Objectives	Priorities	M&E mechanisms
Ghana	Promotion of science and technology culture, that fosters the transfer of technologies for the development of the economy	1. Agriculture 2. Health 3. Education 4. Environment 5. Energy 6. Trade 7. Industry 8. Natural resources 9. Human settlements and communications 10. Tourism 11. Youth innovation 12. Basic research 13. Sports and recreation 14. Nuclear science and technology 15. Building and construction 16. Information and communications technology 17. Science acceleration 18. Natural resources	Explicit M&E mechanisms not yet specified, but planned
Kenya	Identify and develop new knowledge-intensive industries	1. Agriculture 2. Human resource development 3. Industry and entrepreneurship 4. Physical infrastructure 5. Energy 6. Environment and natural resources 7. Education and training 8. Information and communications technology 9. Health and life sciences	Explicit M&E mechanisms not yet specified, but planned
Lesotho	The transfer of technologies for the betterment of the lives of the people of Lesotho	1. Education 2. Biotechnology 3. Agriculture 4. Tourism and culture 5. Health and social welfare 6. Energy 7. Environment 8, Wildlife and tourism 9. Meteorology 10. Industry and trade 11. Natural resources 12. Mining 13. Gender equity in science and technology 14. Standardization and quality assurance 15. Private sector and parastatals	Explicit M&E mechanisms not yet specified, but planned

Country	Objectives	Priorities	M&E mechanisms
Nigeria		1. Agriculture 2. Water resources 3. Biotechnology research 4. Health research and innovation 5. Energy 6. Environmental science and technology 7. Mines and material development 8. Ferrous and non-ferrous materials chemical technologies 9. Information and communications technology 10. Space research and investment 11. Industrial research, development and production 12. New and emerging technologies 13. Transport 14. Youth, sport and tourism development 15. Works, land, housing and urban development 16. Raw materials and manufacturing 17. Defence and national security 18. Works, land, housing and urban development	Explicit M&E mechanisms not yet specified, but planned
Rwanda		1. Agriculture and animal husbandry 2. Biotechnology 3. Health 4. Environment 5. Education 6. Transport 7. Energy 8. Information and communications technology 9. Geo-information 10. Industry 11. Private sector 12. Water and sanitation 13. Tourism	Explicit M&E mechanisms not yet specified, but planned Chief Scientific Advisor will be appointed who will oversee a system of independent evaluation of science policy and programmes across a range of issues.
South Africa		1. Human capital development 2. Knowledge generation and exploitation R&D 3. Knowledge infrastructure 4. Expanding the limits of space science and technology 5. Search for energy security; embracing renewable energy technologies 6. Responding to global climate change	Explicit M&E mechanisms not yet specified Annual review to be conducted by Department of Science and Technology plans to conduct an annual.
United Republic of Tanzania	The establishment of conducive legal environment for the development and transfer of technology	1. Food and agriculture 2. Industry 3. Energy 4. Natural resources 5. Environment 6. Health, sanitation and population planning 7. Transport and communication 8. Science and innovation education and manpower	Explicit M&E mechanisms not yet specified or planned.

Country	Objectives	Priorities	M&E mechanisms
Uganda	To build a strong national conducive system for the generation, transfer and application of technologies in line with Uganda's development objectives	1. Technology forecasting, assessment and transfer 2. Industrial development 3. intellectual property management 4. Traditional, conventional and emerging technologies 5. Gender and equity 6. Sector financing and investment 7. Human capital development and retention 8. science, technology and innovation infrastructure 9. Research 10. Technology incubation 11. science, technology and innovation safety regulations 12. Standards and quality assurance in science, technology and innovation 13. Public awareness and appreciation of science, technology and innovation 14. Information management system 15. Sector coordination and partnerships	Explicit M&E mechanisms not yet specified Management information management system planned
Zambia	To promote science and technology in key sectors to encourage competitiveness in the production of quality goods and services	1. Gender concerns in science and technology 2. Technology diffusion, transfer, innovation and commercialization 3. Standardization, quality assurance and environmental protection 4. Development of appropriate skills 5. Gathering and dissemination of information 6. Cultural and public awareness 7. Regional and international cooperation in science and technology 8. Mechanism for funding for science and technology R&D	Explicit M&E mechanisms not yet specified, but planned

Country	Objectives	Priorities	M&E mechanisms
Zimbabwe	The adaptation, use and implementation of new emergent technologies for the development of the economy	1. Education 2. Institutions and infrastructure development 3. Biotechnology 4. Information and communications technology 5. Space sciences 6. Nanotechnology 7. Indigenous knowledge systems 8. Technologies yet to emerge 9. Commercialization of research results 10. Search for scientific solutions to emergent environmental challenges 11. Mobilize resources and popularize science, technology and innovation 12. Foster international collaboration in science, technology and innovation	M&E mechanisms not yet outlined in the policy document

Source: Compilation based on Nwuke (2015).

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Chapter 6
Lessons from India and Association of Southeast Asian Nations

This chapter examines a case study on India and another on the Association of Southeast Asian Nations to illuminate the Asian experience on regional integration, innovation and competitiveness and to draw lessons for Africa.

India's experience of building capabilities to enhance innovation capacities includes an active human capital policy to construct a strong educational infrastructure and increase skills and learning competencies through an enlarged and specialized workforce. India also offers an example of how to tap the diaspora for skills and funding in a 21st-century knowledge economy.

India's massive investments in tertiary education, especially in science, technology, engineering and mathematics, has made the country one of the global leaders in informatics and other science and technology sectors. The country's enlarged science, technology, engineering and mathematics capacity thus helped develop its innovative capabilities and capacities.

Africa may be able to draw lessons from India's expansion of tertiary education, which generated a human capital base with highly developed STEM expertise. India even "exported" many of its best scientists and technologists, although this was seen at the time as evidence of a "brain drain." But in the interconnected world of the late 20th and early 21st century, the brain drain is turning into a gain. Though the African diaspora is also connected to its homeland and it already contributes to science, technology and innovation trends on the continent, a key challenge is to better tap this resource.

The Association of Southeast Asian Nations case study reviews the region's experience in fostering innovation and competitiveness as part of its remarkable economic transformation. Regional integration has been both a driver and beneficiary of innovation, and innovation has been both a driver and beneficiary of structural change in production capacities and competitiveness (see Chapter 3).

Although concrete actions towards harmonizing science, technology and innovation and (IP) policies have been limited in The Association of Southeast Asian Nations, the region's commitment to an integrated economic community marks its "soft" approach to regionalism, emphasizing dialogue, country-driven implementation, and private-sector response over centralized institutions.

ASEAN's implementation of agreed-on policy commitments at national level may offer insights for African policy makers. The Association of Southeast Asian Nations regional integration experience of science, technology and innovation and intellectual property has been driven more by country needs and market forces than "grand design." There is also scope for Africa to emulate ASEAN's approach to international cooperation on technology acquisition while being generally cautious about entering into restrictive commitments of the TRIPS-plus type.

Indian case study

India's history of tertiary education goes back to ancient times. Early systems included the Nalanda (5th to 12th century AD) and the Vikramshila universities (750–1174 AD). Sweeping changes came during British rule, when the first modern universities were founded in 1857 in Calcutta, Bombay and Madras (now Kolkata, Mumbai and Chennai). Independence again brought about broad changes in policy, the number of institutions and enrolments, and finance (Kanth, 2015).

National education policy and structure

In 1968, India adopted a National Policy on Education, which regarded education as "a unique investment in the present and the future." It recommended a review of education policy every five years to consider changes required for further development (Kanth, 2015). The National Policy on Education was heavily revised in 1986, 1992 and 1998 to adapt to changing economic needs by emphasizing expansion of science and technology

and scientific research as well as improving access, equity (in higher education in general and technical education in particular), quality of education and inter-regional mobility.

To ensure access and inter-regional mobility, a common structure of education was introduced throughout the country: a "10+2+3" system with five years of primary education, three years of upper primary, two years of high school (making 10), two years of senior high school (or pre-university in some states) and three years of undergraduate university studies. Science and mathematics were made compulsory in the school curricula.

The Ministry of Human Resource Development is responsible for formulating the National Policy on Education and ensuring its implementation, planning its further development, paying special attention to disadvantaged groups, providing financial help to deserving students from deprived sections of society and encouraging international cooperation.

Higher education

The federal government is also responsible for formulating major policies on standards in higher education. Alongside the Ministry of Human Resource Development, several institutions are involved in higher education governance. These include the Department of Science and Technology, a central advisory board and statutory councils. The many governance institutions underscore contemporary India's complex system of higher education but also the importance ascribed to developing human capital by India's government.

A weighty consideration in the National Policy on Education was that the informal sector engages over 90 per cent of India's workforce, for whom vocational education is vital. The Ministry of Micro, Small and Medium Enterprises established vocational and entrepreneurship development programmes. The government also included the subject in the XIth and XIIth Five-Year Plans covering 2007 to 2017. The Ministry of Human Resource Development is developing a National Vocational Qualification Framework to link vocational programmes, provide a common reference construct and set common principles and guidelines. The Framework is being implemented in schools, polytechnics, engineering and other colleges across the country, aiming to bridge the skill gap and prepare young people for the vocations of their choice (Planning Commission, 2013).

At independence in 1947, India had 20 universities and fewer than 500 colleges. Since then, their numbers have increased more than 50-fold (table 6.1). And the trend continues: by 2014, India boasted one of the largest higher education systems in the world, with over 42,000 institutions of higher learning (Stolarick, 2014). These institutions, both private and public, are found across the nation.

Table 6.1.

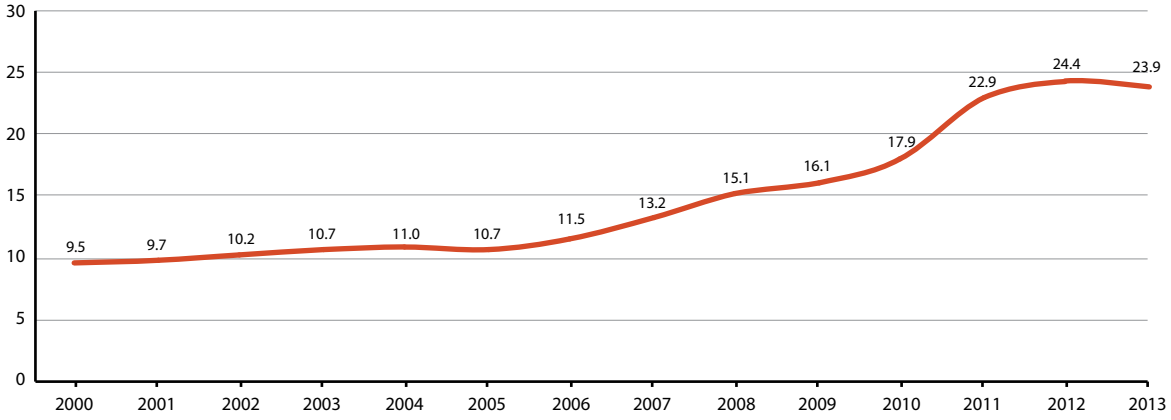
All-India growth of universities and colleges, 1947–2010

Year	Universities	Colleges	Total
1947/48	20	496	516
1950/51	28	578	606
1960/61	45	1,819	1,864
1970/71	93	3,227	3,320
1980/81	123	4,738	4,861
1990/91	184	5,748	5,932
2000/01	266	11,146	11,412
2004/05	348	17,625	17,973
2005/06	355	18,064	18,419
2006/07	367	19,000	19,367
2007/08	416	20,677	21,093
2008/09	480	22,000	22,480
2009/10	504	25,951	26,455

Source: Gupta and Gupta (2012).

Figure 6.1.

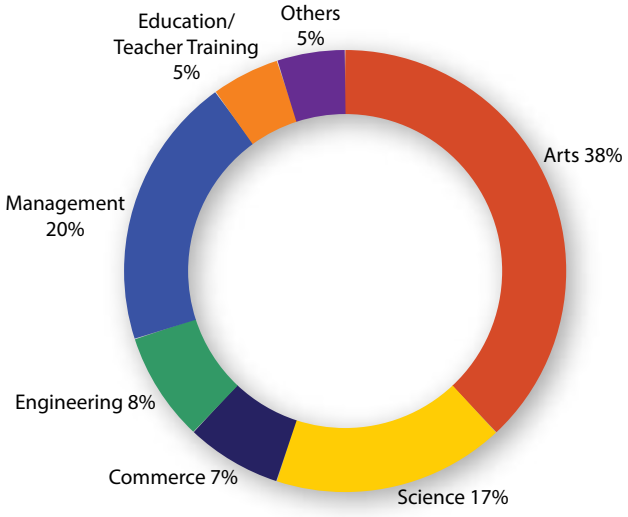
Growth in tertiary education enrolment ratio, 2000–2013



Source: Based on UNESCO statistics accessed on 2016-01-20 (available at: http://data.uis.unesco.org/?queryid=142).

Figure 6.2

Distribution of postgraduate enrolment by field, 2012



Source: Based on University Grants Commission (2013).

The private sector has contributed substantially to expanding tertiary education since the 1990s and now accounts for 58.5 per cent of enrolments (Kanth, 2015). Tertiary education enrolment in India increased sharply after independence, doubling from 1991 to 2001 and more than doubling from 2001 to 2011 (University Grants Commission of India, 2012; figure 6.1).

The country has also been building its pool of scientists, with increasing numbers enrolling in science and engineering disciplines. In 2013 their combined postgraduate enrolment represented 25 per cent of total postgraduate enrolment (figure 6.2). Programmes in tertiary education and R&D have also enabled India to systematically increase the number of its graduates in the engineering, natural and management sciences, all central to innovation. Basic science capabilities across a broad spectrum of disciplines also lay a foundation for innovation.

The science, technology and innovation system

India has embraced science, technology and innovation as an instrument for driving economic growth, structural change and competitiveness, blending the three pillars of science, technology and innovation to create value. Since the adoption of the Scientific Policy Resolution in 1958, the country's science, technology and innovation system has evolved in line with its national de-

Table 6.2.

Evolution of India's science, technology and innovation policy frameworks

Framework	Key objectives
Scientific Policy Resolution ,1958	• Cultivate scientific research. • Achieve technology through established scientific infrastructure.
Technology Policy Statement, 1983	• Attain technological competence and technological self-reliance.
Science and Technology Policy 2003	• Integrate science and technology development efforts. • Create a national innovation system. • Integrate programmes in socio-economic sectors (such as nonprofit organizations, social enterprises and charities) with the national R&D system. • Enhance investments in R&D.
Science, Technology and Innovation Policy 2013	• Popularize science among all sections of society. • Make careers in science, research and innovation attractive. • Position India among the top five global scientific powers by 2020. • Link science, research and innovation system with the inclusive economic growth agenda and priorities of excellence and relevance. • Create an environment for enhanced private-sector participation in R&D. • Foster resource-optimized, cost-effective innovations across size and technology domains. • Create a robust national innovation system.

Source: Based on Ministry of Science and Technology(2013b).

Box 6.1.

Some frugal Indian innovations

India is one of the key players in frugal innovations[114], both as a market and a production location. It possesses such advantages as low-cost R&D and manufacturing, a broad manufacturing base, access to multinational firms' innovation networks, first-hand knowledge of people's needs, and so on (Tiwari and Herstatt, 2014). Among India's frugal innovations are the Jaipur prosthetic foot, low-power automated teller machines, and a mobile banking service.

The Jaipur Foot and Knee

The Jaipur prosthetic foot is one of the best known examples of innovation in India. The original foot was developed in the 1960s by a temple sculptor. Using rubber, wood and tyre cord, he designed and manufactured a foot that, for under $45, had far greater functionality than a $12,000 model few Indians found affordable. The lightweight Jaipur foot not only enhanced movement but also became socially acceptable: it appears lifelike and can be worn barefoot, it is easier to squat or sit cross-legged on, it can be used to walk on uneven terrain and it can be immersed in water for long periods, as when tending rice paddies.

In 2009, Bhagwan Mahaveer Viklang Sahayta Samiti, a nongovernmental organisation, worked with Stanford University to jointly develop the $20 Jaipur knee, an above-knee prosthesis made of oil-filled nylon that requires no tools to make—yet takes just under an hour to assemble.

Gramteller and Ecoteller ATMs

Vortex Engineering, founded by Lakshminarayan Kannan, a mechanical engineer from Indian Institute of Technology Madras, developed two automated teller machines in 2010. The Gramteller Duo requires less than 100 watts of power and tolerates temperatures up to 50 degrees Celsius; the Ecoteller requires only 60 watts and can be powered by solar energy.

Mobile Wallet

Airtel, India's mobile service provider, launched its Mobile Wallet in 2012 as a fast, simple and secure service that allows its users to load cash on their mobile devices and spend it to pay utility bills, shop at 7,000 or so merchant outlets, transact online and transfer money across the country. Mobile banking has the potential to convert millions of non-consumers of financial services in the developing world into consumers.

Source: Based on Kanth (2015).

velopment aspirations and was grounded in key policy frameworks (table 6.2). But these evolved incrementally and were not integrated.

By 2013, however, the government had put in place a fully integrated science, technology and innovation policy with an institutional structure in the form of the National Innovation Council, which aspired to create an Indian innovation model by establishing five key parameters: platform, inclusion, ecosystem, drivers and discourse. It redefined innovation in an inclusive and contextual manner to embrace both *classical* and *frugal* innovations (box 6.1).[113] The Council set up state innovation councils, sectoral innovation councils and the India Inclusive Innovation Fund.

R&D expenditure

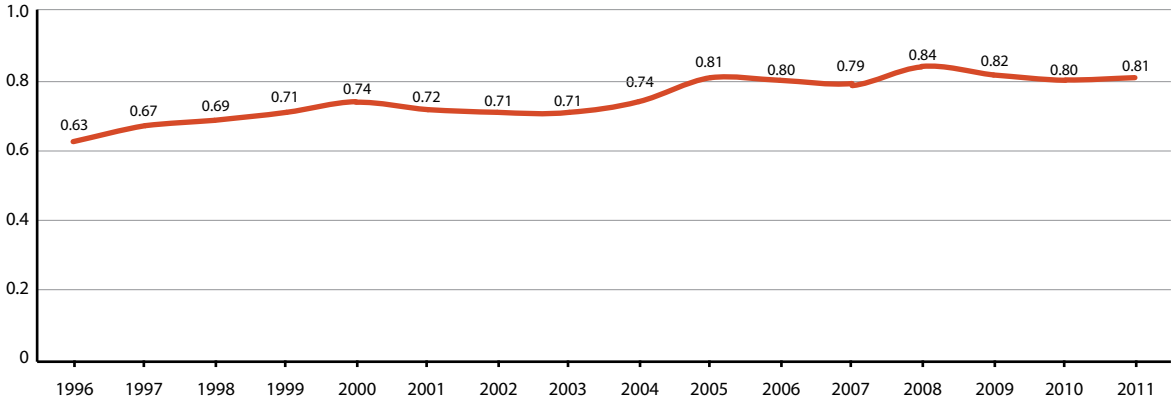
STI policy also seeks to address India's R&D shortcomings, such as the concentration in public research institutes (focusing on atomic energy, defence, medicine, biotechnology, pharmaceuticals, and so on), the lack of a strong research orientation among universities and the absence of public–private partnerships engaged in research. Despite these drawbacks, India's R&D expenditure has been substantial (figures 6.4 and 6.5; table 6.3).

Landmark achievements

Despite the chequered evolution of its science, technology and innovation policy, India's consistent investment

Figure 6.3.

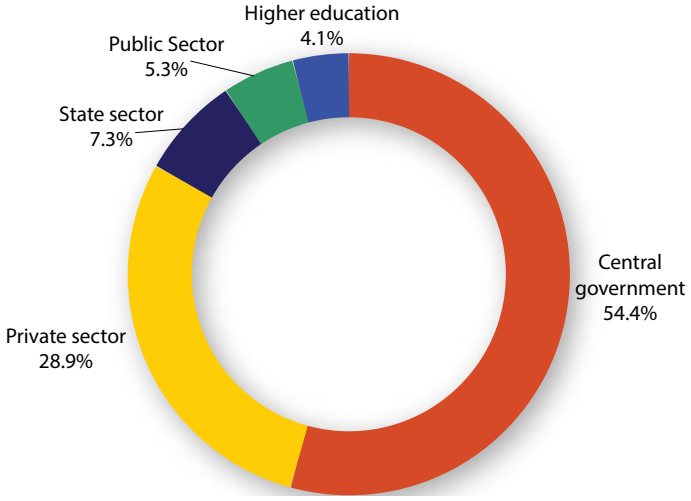
R&D expenditure as a share of GDP (per cent)



Source: Based on United Nations Educational, Scientific and Cultural Organization statistics accessed on 2015-09-04 (available at: http://data.uis.unesco.org/?queryid=74).

Figure 6.4.

Key measures of R&D in India



Source: Based on Ministry of Science and Technology of India(2013a).

Table 6.3.

Key measures of R&D in India

Measure	Description
Investment in R&D as a share of GDP	• Under 1 per cent, but growing.
Share of sales turnover spent on R&D	• In 2009–2010: • 0.61 per cent for industrial R&D units. • 0.27 per cent for private-sector units. • 8.7 per cent for public-sector units.
Per capita R&D expenditure	• Increased from Rs. 217 ($4.80) in 2004–2005 to Rs. 451 ($9.50) in 2009–2010.
Global share of gross expenditure on research and development	• Increased from 1.9% (in 2004–2005) to 2.4% in 2009–2010.
Full-time R&D professionals	• 154,000 in 2008.
Share of R&D expenditure to academic sector	• 64 per cent of total extramural R&D support during 2009–2010.

Source: Based on Ministry of Science and Technology of India(2013a).

in the tertiary sector and research has paid off in its nuclear and space programmes, information and communications technology (ICT)services, and automotive and pharmaceuticals industries. A growing number of tertiary education institutions, rising enrolment in tertiary education, an increasing national pool of skilled labour, accumulation of strategic science and technology capabilities, and a wide range of innovative activities testify to India's remarkable achievements.

By the 1980s India had developed an advanced science and technology infrastructure and establishment:

- A nuclear energy sector with capability independent of other countries. A space sector with strong communications infrastructure and remote-sensing capabilities.
- A chain of industrial research laboratories in fields ranging from leather to modern biotechnology.
- A network of defence research laboratories.
- A national agricultural research system and extension system that sharply lifted agricultural productivity and diversity.
- A system of institutions for medical teaching and research with expertise in several areas of medicine.

Since the 1990s, India has experienced rapid growth in information technology (IT) and IT-enabled services. Its English-speaking technical workforce was well placed to benefit from the ICT revolution through the Internet and satellite communications. India has expanded its knowledge-based industries by providing skilled workers to the world while its manufacturing lagged far behind South-East Asia's (Dukkipati, 2010).

The country has also performed well in such sectors as biotechnology, drugs and pharmaceuticals, emerging as a key player in the global knowledge economy. Its comparative advantage is its scientific human resources and a wide range of research institutions that can undertake R&D far more cheaply than in developed nations.

India is also active in intellectual property generation (table 6.4).

Technology transfer and absorption depends on recipients' learning capacity, and one of India's enduring research successes has been its adaptation of

Table 6.4.

India's intellectual property applications, 2012–2013

	Patents	Designs	Trademarks	Geographical indications
Filed	43,674	8,337	194,216	24
Examined	12,268	6,776	202,385	30
Granted/registered	4,126	7,252	44,361	21
Disposal of applications	9,027	7,300	69,736	[?]

Source: Authors' compilation based on information obtained from Office of Controller General of Patents, Designs and Trademarks of India, 2012–13.

Box 6.2.

Harnessing traditional knowledge in pharmaceutical innovation

India is a global leader in using traditional knowledge for innovation, which can produce practical business solutions. Traditional knowledge applied to pharmaceutical innovation can shorten the time needed for developing a drug.

The Mumbai-based pharmaceutical company Lupin and the Indian Council for Scientific and Industrial Research have partnered to transform a plant long used in traditional medicine into a scientifically validated anti-psoriasis drug. The drug, a purified extract from the leaves of a plant, is now awaiting approval for Phase II clinical trials in patients with psoriasis, after successful completion of Phase I trials (toxicity) in healthy volunteers in September 2004. It is estimated that the global market for drugs against psoriasis is worth about $3 billion, based on the latest available estimates.

The success of this initiative highlights how well India is positioned to use its own knowledge to develop pharmaceutical products of global importance in a cost-effective way.

Source: Kanth, 2015.

imported agricultural knowledge during the 1970s, which helped change its status from chronically food deficient to agriculturally competitive. Three critical factors were the continuing expansion of farming areas, double-cropping of farmland and using high-yield seeds. The Indian Agricultural Research Institute and the Indian Council for Agricultural Research developed high-yield varieties of wheat and rice. Excessive use of pesticides and chemical fertilizers, however, has had negative impacts. The country relied primarily on imported technology that it mastered and adapted to local conditions (Jayaraman, 2015).

Tapping the diaspora

The Indian diaspora community is estimated to include about 25 million people in every region in the world. But with increased foreign direct investment in India's IT and electronic industries, many Indian professionals have returned home. The country was one of the first to launch concrete measures to leverage its diaspora for development, setting up over time the following institutions:

- Overseas Indian Facilitation Centre. Partners with the Confederation of Indian Industries to serve as a one-stop shop for economic and business engagement.
- India Development Foundation of Overseas Indians. Facilitates diaspora philanthropy and attracts overseas capital to Indian social development.
- India Centre for Migration. Conducts and disseminates research on overseas employment markets for Indian workers.
- Indian Network of Knowledge. Eases knowledge transfers via a robust, global platform.
- The Prime Minister's Global Advisory Council. Serves as a high-level body to draw on the best overseas Indian minds.
- Overseas India Centres. Provide institutional support and services on matters concerning overseas Indians at Indian embassies in Washington, D.C., and Abu Dhabi, United Arab Emirates, among others.

India has turned the brain drain of the past diaspora into a contemporary brain gain. The diaspora is credited with some of the country's high-tech successes (box 6.3).

Lessons for Africa from India

- Publicly funded colleges and universities are essential to developing higher and technical education. It is therefore vital for the state to provide a high-quality public education, with easy access for poorer students. In India, the Indian Institutes of Technology, Indian Institute of Science and other such institutes are excellent examples of public education funded by the central government. The inconsistency and general insufficiency of private higher education

Box 6.3.

India diaspora contributions to science, technology and innovation

The diaspora helped set up Indian research institutions:

- Advanced Network Laboratory & IBM Research Centre at Indian Institute of Technology Delhi.
- Jyoti Mehta Biosciences and Bio-engineering School at Indian Institute of Technology Mumbai.
- Vinod Gupta School of Business Management and Advanced VLSI Design Laboratory at Indian Institute of Technology Kharagpur.
- Centre for Theoretical Physics at the Indian Institute of Science, Bangalore.
- And it achieved advancements in pharmaceuticals:
- Setting up research facilities (like cancer cell lines) at the National Cancer Institute, Rockville, Maryland.
- Establishing facilities in Bethesda, Maryland, for testing anti-cancer and anti-Acquired Immuno-Deficiency Syndrome (AIDS) compounds.
- Building a facility at Johns Hopkins University, Baltimore, Maryland, to test neem extracts for their activity against malarial parasites.
- Helping Indian scientists take part in the Indian Ocean Experiment, a major international programme.
- Financing by United States of America-based alumni to IIT Kanpur and Indian Institute of Technology Kharagpur for infrastructure upgrading.
- Instituting bilateral programmes of cooperation in science and technology: The Indo-US Science and Technology Forum, Indo-French Centre for Promotion of Advanced Research, a Department of Science and Technology –National Science Foundation cooperative programme for scientists and engineers and a Department of Science and Technology –Deutsch Akademischen Austauschdienst project-based programme with the Indian Ministry of Overseas Indian Affairs.

Source: Compiled by authors.

must be considered in formulating policies for higher education.

- Not all private institutes offer a high quality of education. Most Indian private institutions have no libraries, laboratories or research programmes, or good teaching faculty. The emphasis is on short-term courses that are profitable and without serious academic content. Also, as Jandhyala (2014) notes, "Private education [in India] essentially views education as a private good, yielding benefit to the individual student, and is not concerned with social values or national concerns. The social responsibility of higher education needs to be valued, protected and nurtured, and this is not possible in a system dominated by a profit-motivated private higher education system."

- Tertiary education should produce skills that can conduct country-specific research, especially in agriculture. Depending solely on research conducted in industrialized countries may not be suitable to poor countries because of low access to technology as well as climate and geography or other regional characteristics. Institutes like the National Innovation Foundation can help local people with locally produced and engineered technology, which would be cost effective.

- More joint training programmes with industry partners, including topics such as business administration for small and medium-sized enterprises, would help university curricula to reflect market needs. It also is important to establish a vocational education and training system that interacts with industry. Both systems need further market alignment through private participation, curriculum development, upgraded infrastructure, performance incentives to institutes and regulatory authorities, and greater autonomy to respond to market needs. Governments should ensure that the benefits of in-service training are widely recognized by enterprises.

- To build a robust R&D structure, it is important that synergies are created between different institutions engaged in R&D. In developing countries, it is criti-

cal for the state to play a dominant role by investing in research activities in the key areas of agriculture and health.

- Along the lines of India's National Innovation Foundation (which gives financial support to innovators), African countries should consider regional innovation funds that can pool financial and human resources.

- It is equally important to establish affordable regional institutes of excellence for higher education in science and technology to attract the best talent from across Africa. Institutes of vocational education and training should also be established at sub-regional and regional level.

- India has done much to leverage the benefits of its diaspora for policy and research. An Africa-wide initiative should tap the continent's diaspora in industrialized countries.

Association of Southeast Asian Nations case study

The Association of Southeast Asian Nations was established in 1967 with Indonesia, Malaysia, Philippines, Singapore and Thailand as founding member s. They were joined by Brunei Darussalam (1984), Vietnam (1995), Lao People's Democratic Republic (Lao PDR) and Myanmar (both in 1997) and Cambodia (1999). Papua New Guinea has special observer status. Cambodia, Lao PDR and Myanmar are least-developed countries (least developed countries), Brunei Darussalam and Singapore are high-income countries and the others are middle-income countries.

The Association of Southeast Asian Nations' overall objective is to create a regional economic community and single market as well as to promote regional peace and stability through respect for justice and the rule of law.

As a regional integration scheme, the Association of Southeast Asian Nations has evolved in response to specific needs and market forces rather than by any grand design. Association of Southeast Asian Nations can be described as "institution lite," with little delegation of power by the member States to the supranational organization, and its regional integration approach as The Association of Southeast Asian Nations "soft regionalism," emphasizing dialogue, implementation of policy commitments made at national level and private-sector partnerships with peer-to-peer accountability. A hallmark of the model is its recognition of the region's diversity and socio-cultural plurality.

Nevertheless, integration is moving forward steadily. The Association of Southeast Asian Nations Free Trade Area was formally established in 1992. Through the bloc's Common Effective Preferential Tariff, tariffs have been cut heavily. Tariffs for more than 99 per cent of the products in the agreement's inclusion list for the (non-least developed country) Association of Southeast Asian Nations-6 (Brunei Darussalam, Indonesia, Malaysia, Philippines, Singapore and Thailand) range from 0 per cent to 5 per cent (Puutio, 2015).The Association of Southeast Asian Nations Free Trade Area is complemented by related agreements such as the Association of Southeast Asian Nations Framework Agreement on Services (1995), the Association of Southeast Asian Nations Agreement on the Promotion and Protection of Investment (1981, 1996), the Association of Southeast Asian Nations Investment Area Agreement (1998, 2001), and the Association of Southeast Asian Nations Economic Community (2007),which aimed to create a single internal market by the end of 2015.

On innovation and intellectual property policies, concrete actions towards harmonizing regional frameworks are few. The bloc's approach is a blend of regional and national innovation initiatives.

Regional science, technology and innovation and intellectual property cooperation

STI policies

An evident consensus on priorities underlies science, technology and innovation cooperation among Association of Southeast Asian Nations countries. The bloc's economic integration objectives are linked with implementation strategies at national level. Private-sector engagement and foreign partnerships, including those with regional hegemons such as Japan and China, are an essential part of the strategy.

STI policies go back to 1978, when the bloc adopted an overall vision to make Association of Southeast Asian Nations countries innovative, competitive, vibrant,

sustainable and economically integrated. An inter-governmental Committee on Science and Technology was established to provide the institutional framework for developing common policies, programmes and blueprints and is focused most recently on nine programme areas (Association of Southeast Asian Nations science, technology and innovation, 2015b): food science and technology, biotechnology, meteorology and geophysics, marine science and technology, non-conventional energy research, microelectronics and IT, material science and technology, space technology and applications, and science and technology infrastructure and resources development.

In microelectronics and IT, for example, a strong private-sector response including foreign partnerships has emerged. Association of Southeast Asian Nations demonstrates high global value chain intensity in this area, although participation rates among Association of Southeast Asian Nations countries vary widely, and high rates of process and product innovation are observed in this and other subsectors.

These priorities form the basis of collaboration, regional-level reporting and sharing of national experiences. The overarching science, technology and innovation frameworks are implemented in accord with Association of Southeast Asian Nations Plans of Action on Science and Technology, first formulated by the Committee on Science and Technology in 1981. New plans have since been created for 1996–2000, 2001–2004 with an extension up to 2006, and most recently for 2007–2011 with an extension up to 2015.

The Plans of Action detail strategic areas and actions and assign to each area a "country champion" expected to lead and finance implementation efforts. The (now-extended) 2007–2011 Plan identifies six major areas with more than 200 accompanying actions: Early Warning System for Disaster Risk Reduction (Indonesia); Biofuels (Malaysia); Application and Development of Open Source System (Indonesia); Functional Food (Thailand); Health (Singapore); and Climate Change (the Philippines and Vietnam). Reflecting rapid developments in science, technology and innovation, the Plans have been transformed from one iteration to the next. Many previously identified strategic areas are not included in subsequent action plans.

IP cooperation initiatives

Within the parameters of the minimalist or "soft" approach to regionalization, Association of Southeast Asian Nations members also have begun intellectual property cooperation initiatives. Issues have been included in intellectual property provisions of the Asian Economic Community, Association of Southeast Asian Nations Socio-Cultural Community and the action plans of the Association of Southeast Asian Nations Working Group on intellectual property Cooperation. The provisions seek to foster a consensus-based approach—within the bloc and with external partners and investors—to promote learning, innovation and creativity.

International support is important to Association of Southeast Asian Nations' innovation dynamics. The region is the recipient of (or stakeholder in) numerous initiatives by multi- and bilateral actors (table 6.6). Association of Southeast Asian Nations' partnerships generally do not, however, include TRIPS-plus provisions, which are more restrictive than required by the TRIPS Agreement.

Association of Southeast Asian Nations countries differ in emphasizing intellectual property Rs. Cambodia, the Lao PDR and Myanmar, taking their first steps towards economic transformation, see intellectual property rights from a vastly different perspective than countries such as Singapore that are transitioning into a knowledge-based economy. Cambodia and the Lao PDR are WTO members and enjoy a lower level of obligation under the TRIPS Agreement; Myanmar is not a WTO member.

But diversity in capacity ultimately leads to more profound ideological differences between Association of Southeast Asian Nations member states. At their very core, protection of intellectual property rights comes down to a trade-off between short-term benefits of freer use of protected goods and the long-term gains of incentivizing innovation, foreign direct investment (foreign direct investment) and technology transfer. The blatant operation of well-known hives of pirate markets in Indonesia and Thailand, contrasted with strict enforcement of intellectual property rights in Singapore, is tangible proof of how wide the ideological gulf remains.

Table 6.6.

Overview of Association of Southeast Asian Nations' main intellectual property cooperation initiatives

Framework	Issues stipulated
Networking of science and technology centres of excellence and programmes to optimize resources and achieve maximum results (2004–2010)	• Improving the regional intellectual property policy framework and ultimately foster learning, innovation and creativity. • Concrete actions include: - Fostering intellectual property creation. - Developing an intellectual property framework of simplification, harmonization, registration and protection, promoting greater awareness and building intellectual property capacity. - Enhancing collaborative business development services in national intellectual property offices.
Association of Southeast Asian Nations Intellectual Property Rights Action Plan (2011–2015)	• Intensifying R&D collaboration in strategic and enabling technologies and promoting technology commercialization. • Concrete actions include: - Accelerating the pace and scope of intellectual property asset creation. - Improving the regional framework of intellectual property right policies and intellectual property institutions. - Promoting intellectual property cooperation and collaboration with partners. - Strengthening IP-related human and institutional capabilities in the region.

Source: Authors' compilation based on relevant Association of Southeast Asian Nations legal frameworks.

The broad approach to intellectual property policy in the Association of Southeast Asian Nations can be summarized as follows:

- The Association of Southeast Asian Nations' members understand IP's potential to transform the region into an innovative and competitive bloc. They see that intellectual property enforcing intellectual property rights will not only stimulate cultural, intellectual and artistic creativity and its commercialization, but also promote efficient adoption and adaptation of more advanced technologies and continuous learning to meet ever-rising performance thresholds. They believe that intellectual property enforcing intellectual property rights will foster regional dynamism, synergy and growth.

- The members focus on catch-up, encouraging adapting and applying innovations. They have explicitly noted that foreign partnerships and purchase of technology is the best means to enhancing competitiveness, and the region sees itself becoming the biggest purchaser of technology in the next decade (Association of Southeast Asian Nations Secretariat, 2015).

- However, dissimilarities among Association of Southeast Asian Nations markets mean that the catch-up distance varies. A country far behind the technological curve can secure substantial benefits by purely national actions, including improving institutions, education and infrastructure. International cooperation becomes cost efficient only after a nation's "low-hanging fruit" has been picked. Thus the value of Association of Southeast Asian Nations' concrete interventions on intellectual property rights is not equally obvious to all member States.

- Association of Southeast Asian Nations members leverage intellectual property protection to attract foreign direct investment inflows, regarding it mainly as a means to foster adaptation and application of innovations developed abroad. This is a meaningful difference from the classical theoretical grounds for protecting intellectual property rights—that intellectual property rights exist to incentivize further innovations.

- They also leverage intellectual property protection to integrate themselves more closely with the global trading system, a goal they believe requires intellectual property protection, especially for partnerships with more advanced countries.

Country indicators of science, technology and innovation implementation and outcomes

STI and intellectual property policies among Association of Southeast Asian Nations countries are, as noted, part of the regional cooperation framework, but their

Table 6.7.

Association of Southeast Asian Nations countries' global knowledge economy rankings, 2000 and 2012

Country	2000	2012
Cambodia	116	132
Indonesia	105	108
Lao PDR	129	131
Malaysia	45	48
Myanmar	137	145
Philippines	77	92
Singapore	20	23
Thailand	60	66
Vietnam	113	104

Note: Rankings are out of a total of 146 countries.

Source: World Bank (2015a).

implementation is a blend of regional and national approaches.

Knowledge economy

Initial science, technology and innovation conditions among nine Association of Southeast Asian Nations economies ranked globally on their knowledge economy vary greatly (table 6.7).[115] Overall, their rankings have deteriorated over the past decade (Vietnam aside).

R&D expenditure and personnel

The Association of Southeast Asian Nations countries exhibit considerable diversity on R&D expenditure. For instance, while Singapore's 2012 R&D share in GDP was 2.2 per cent, Indonesia's was only 0.1 per cent. This underlines major differences in efforts to develop endogenous capacities for innovation. Globally, several forward-looking economies have set minimum thresholds for R&D intensity ratios, with some of the most ambitious targets, like the European Union's, close to 3 per cent by 2020.

The number of R&D personnel is another component of endogenous capacity for innovation where inter-country differences stand out. In 2009 Thailand had the most R&D personnel (60,344), nearly twice Malaysia's 35,461. Similarly, Thailand had 15,000 technicians per 1 million people, compared with Malaysia's 1,986 (United Nations Educational, Scientific and Cultural Organization, 2015a; United Nations Educational, Scientific and Cultural Organization, 2015b).

Tertiary education enrolment and scientific publications

The productivity of the tertiary education system (measured by enrolments, publications of scientific and technical journal articles, and so on) is also important. As was seen for India, tertiary education is crucial both to successfully transition from an efficiency-driven to a knowledge-driven economy and to efficiently absorb and diffuse technological innovations, especially in the earlier stages of development. Here too Association of Southeast Asian Nations presents a diversified picture: most Association of Southeast Asian Nations members have consistently increased absolute enrolment in tertiary education, but Myanmar, Thailand and Vietnam have not (table 6.8).

Publications of scientific and technical journal articles also show wide variation, but with little correspondence to enrolment: Singapore led with more than 4,543, followed by Thailand with 2,304—and ultimately Myanmar with only nine. The disconnect between increased enrolment in tertiary education and the number of such journal articles is sharp (World Bank, 2015c).

Science and technology parks

Conditions within Association of Southeast Asian Nations countries also differ greatly for science and technology parks, which have evolved differently in different countries. For example, Penang, Malaysia, is one of the top 10 dynamic industrial cluster locations in the world (United Nations Industrial Development Organization, 2009).

Foreign direct investment

Foreign direct investment is a major exogenous factor driving innovation and is more likely to flow to economies that can access technology and have the capacity to absorb it. Virtually all Association of Southeast Asian Nations countries have seen huge surges in foreign direct investment inflows over past decades, with cross-country discrepancies (info 6.1) that to a degree reflect that capacity. For example, Brunei Darussalam and Lao PDR have particularly small inflows, even

Table 6.8.

Association of Southeast Asian Nations' tertiary education enrolment, 2003–2013

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Brunei Darussalam	4546	4917	5023	5094	5284	5607	6107	5776	6626	8336	-
Cambodia	43210	45370	56810	94708	117420	137490	168003	195402	223222	-	-
Indonesia	3441429	3551092	3662234	3657429	3806629	4419577	4859409	5001048	5364301	6233984	-
Lao PDR	28117	33760	47424	56716	75003	89457	113341	118295	125323	126314	137092
Malaysia	725865	731077	696760	737267	805136	922239	1000694	1061421	1036354	1076675	-
Myanmar	-	-	-	-	507660	-	-	-	659510	634306	-
Philippines	2427211	2420997	2402649	2483988	-	2651466	2625385	-	-	-	-
Singapore	-	-	-	-	-	183627	198634	213446	236891	243546	255348
Thailand	2205581	2251453	2359127	2338572	2503572	2430047	2417262	2426577	2497323	2430471	2405109
Vietnam	829459	-	1354543	1427046	1587609	1654846	1774321	2020413	2229494	2261204	2250030

Source: United Nations Educational, Scientific and Cultural Organization(2015c).

compared with Cambodia and Myanmar, while Singapore, with its substantial capacity, receives vastly larger inflows.

Capital goods imports

Association of Southeast Asian Nations countries access technological innovations originating from abroad in the form of imports of capital goods (see info 6.1). The ratio of imported to domestically produced capital goods is an indicator of access to technology, with higher ratios signifying a substantial positive effect on per capita income growth, particularly among developing countries (Lee, 1994). Association of Southeast Asian Nations. Here, too, wide inter-country differences highlight the diversity of the initial conditions on accessing external technological innovations by importing capital goods.

Association of Southeast Asian Nations' intellectual property generation

Diversity in capacity to innovate is also apparent in intellectual property generation (table 6.9) across the spectrum of intellectual property categories, leading to vastly different needs and demands (as seen).

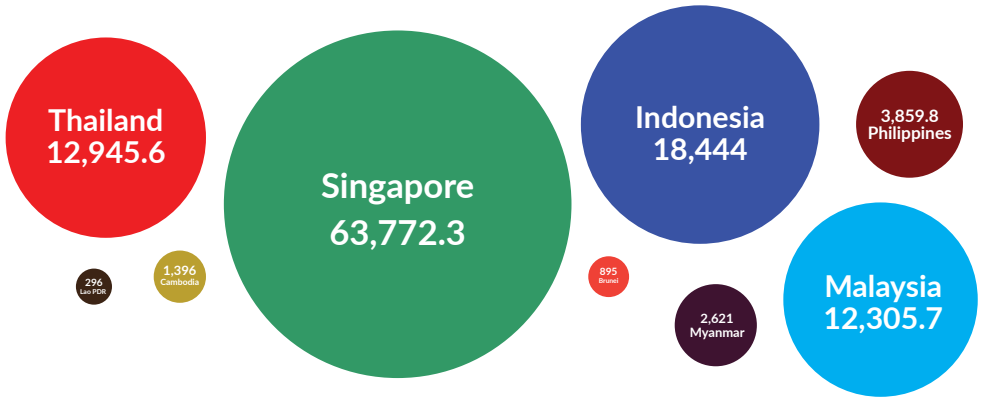
Association of Southeast Asian Nations high-technology exports

As expected, variation in innovation-related resources and capacities translates into variation in outcomes. In 2012, the shares of high-technology products out of all manufacturing exports from Malaysia, Philippines and Singapore surpassed 40 per cent, far outweighing those of other Association of Southeast Asian Nations members (figure 6.6). Cambodia's high-technology exports

Info 6.1—FDI, capital goods imports and licensing drive ASEAN innovation

FDI, a major exogenous factor driving innovation, is more likely to flow to economies that can access technology and have the capacity to absorb it. Virtually all ASEAN countries have seen huge surges in FDI inflows over the past decades, with cross-country discrepancies that largely reflect capacity. For example, Brunei Darussalam and Lao PDR have particularly small inflows, even compared with Cambodia and Myanmar.

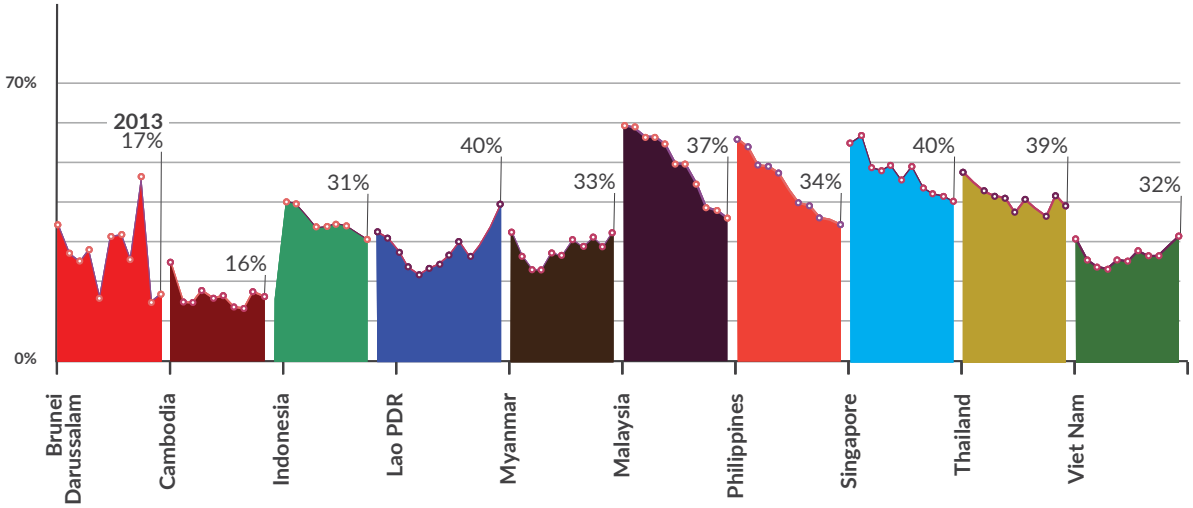
FDI inflows into ASEAN countries, 2013 ($ million)



Source: Puutio, 2015.

ASEAN countries acquire technological innovations from abroad in imports of capital goods. Higher ratios of imported to domestically produced capital goods signify a substantial positive effect on per capita income growth, particularly among developing countries.

Share of capital goods in total imports, ASEAN countries, 2003 to 2013



Source: Puutio, 2015.

Table 6.9.

Selected intellectual property generation indicators in The Association of Southeast Asian Nations, 2007 and 2013

	Patent applications		Trademark applications	
	2007	2013	2007	2013
Brunei Darussalam	91	30	883	999
Cambodia	13	75	553	1,008
Indonesia	3,326	7,542	44,738	63,599
Lao PDR	1	0	0	1
Malaysia	1,879	8,305	29,481	37,644
Myanmar	3	0	17	59
Philippines	3,578	3,415	16,019	23,847
Singapore	12,983	14,049	31,977	38,022
Thailand	7,003	7,743	37,994	53,102
Vietnam	2,873	4,049	32,039	38,103

Source: WIPO (2015).

failed even to register in the dataset while Indonesia's share was only 7 per cent. As an indicator, the share of high-technology exports is agnostic of the source of technologies and patents that enable production, but is telling about the country's capacity to apply—if not absorb—technologies and the importance of patents for manufacturing overall.

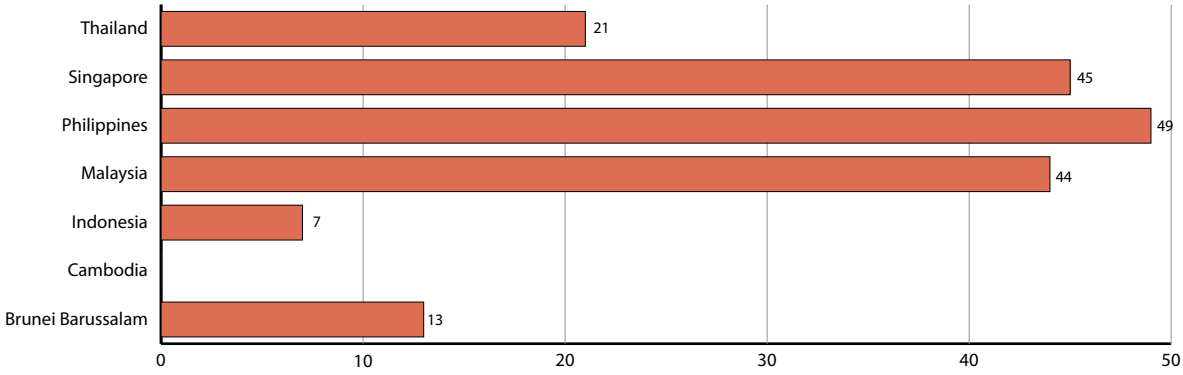
Association of Southeast Asian Nations' reliance on outsourced innovations

All Association of Southeast Asian Nations member countries rely heavily on outsourced innovations, paying licence fees and royalties for using them (figure 6.7). Globally, net exporters of innovations—and therefore earners of royalties and licence fees—are in developed economies. Within the Association of Southeast Asian Nations, only Singapore has a meaningful export share, with $2.04 billion in exports in 2013. In the same year, Cambodia exported only $2 million, again reinforcing the pattern of diversity within Association of Southeast Asian Nations (WTO, 2015).

Lessons for Africa from the Association of Southeast Asian Nations Reflecting its minimalist or "soft" approach to regional integration, the Association of Southeast Asian Nations provides a model of country-level implementation of regional policies and action plans rather than regional frameworks. This model reflects the level of development and requirements of member countries: ambition for their own innovations tends to pace economic development. Hence countries are consciously distinguishing between technological

Figure 6.6.

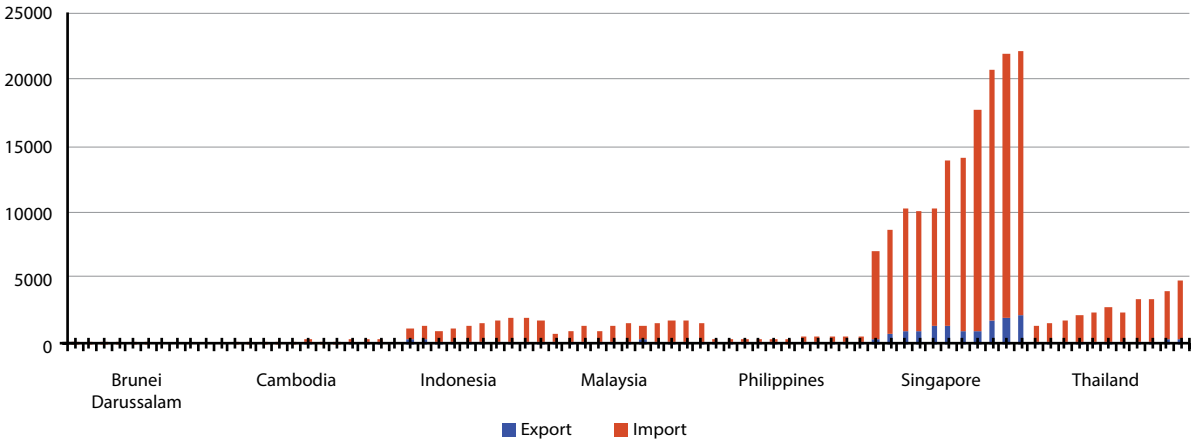
High-technology exports share of manufactured exports (per cent), 2012



Source: Based on World Bank (2015). Lao PDR, Myanmar and Vietnam are omitted due to a lack of data.

Figure 6.7.

Royalties and licence fees, 2003 to 2013 ($ million)



Note: Data for 2013 labelled, except Brunei Darussalam (2008).

Source: WTO (2015).

innovation and diffusion, because their relative importance differs by development level.

- As the majority of Association of Southeast Asian Nations members are in a catch-up stage and lack the capacity to innovate, their emphasis appears to be on the inflow and diffusion of technological innovations rather than promoting home-grown technological innovations.

- Institutions are necessary but not mandatory conditions for promoting regional economic integration. Association of Southeast Asian Nations countries have not established strong joint intellectual property frameworks or harmonized national frameworks across the region. Nevertheless, they have proved that an approach based on dialogue and consensus-building without necessarily engaging in deep integration can also provide a regional framework for innovation. Concrete collaboration through such projects as the Association of Southeast Asian Nations intellectual property Portal are proof of how regional integration can foster innovation even among countries at different levels of development.

- Association of Southeast Asian Nations' model of cooperation is driven by realistic and achievable goals, with implementation related to specific country contexts.

- Association of Southeast Asian Nations' agreements with external partners generally do not go beyond internationally established norms or obligations. For instance, intellectual property protection and cooperation agreements would restate commitments contained in such multilateral regimes such as the TRIPS Agreement.

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Notes

1 Though the most recent data are used in this chapter, many relate to 2013 or earlier, due to the usual time lag in collecting, processing and publishing data.

2 All are listed under *Acronyms* at the end of the publication.

3 Benin, Burkina Faso, Côte d'Ivoire, Mali, Niger, Nigeria, Senegal and Togo.

4 Data were not available for CEN-SAD.

5 Data were not available for CEN-SAD.

6 Cameroon, Madagascar, Mauritius, Seychelles and Zimbabwe.

7 Latest year is 2013, except for Gabon and Guinea (2011) and Zambia (2010).

8 The ratification rate indicates the proportion of member States of the regional economic community that has ratified the protocol on free movement of persons (for SADC, under Articles 14, 17 and 18 of the SADC Treaty).

9 IGAD is not shown in the figure because it does not have a protocol on free movement of persons. The SADC Protocol on Free Movement of persons has not yet come into force; this chart shows the implementation rate of articles 14, 17 and 18 of the SADC treaty.

10 That is, rates of increase fluctuated from year to year but averaged 1 per cent a year.

11 According to country data supplemented by data from the International Telecommunication Union and United Nations Population Division.

12 A Country Mining Vision guidebook: Domesticating the Africa Mining Vision. http://goxi.org/profiles/blogs/a-country-mining-vision-guidebook-domesticating-the-africa-mining.

13 Formal institutions driving regional integration include policies, laws and regulations.

14 Informal institutions driving regional integration in Africa include business networks, exporter networks and civil society networks.

15 Much innovation derives from routine learning and practice of economic activities, not necessarily linked to R&D-generated intellectual property (IP). Also, the impact of intellectual property (and of the routine learning and practice of economic activities) on technological innovation and technological diffusion depends on diverse factors, which together constitute the framework conditions for innovation.

16 For instance, empirical evidence based on a sample of 23 African countries and panel data for 2004-2009 found unequivocal evidence that being globally competitive was a driver of economic growth in Africa (Ben Amar and Hamdi, 2012).

17 These include investments in R&D, data, firm-specific knowledge and skills, IP, innovations and software.

18 For a detailed account, see Organization for Economic Cooperation and Development (2015a).

19 The Austrian–American economist, Joseph Schumpeter, is credited with the earliest thinking on innovation, which he defined as: "Innovation is what incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one" (Schumpeter, 1962). His conceptualization of such "creative destruction" illustrated how new factor combinations arise to displace what had previously been the established way of doing things.

20 Since Schumpeter, the debate has evolved and innovation is associated with *newness* (e.g. new product), or *modifications* (e.g. modified products). Some of the other definitions include: (i) Innovation is a market-oriented economical use of an invention, expressed as by a simple formula: 'invention + exploitation = innovation'. In this definition, commercial exploitation is the nexus that interlinks innovation and invention (Roberts, 1987). (ii) Innovation signifies the commercial value (utility, usefulness) of a novelty, a definition that distinguishes it clearly from invention (Dornberger et al. (2012)]. (iii) "Innovation means effective policies to attract foreign investment, to promote applied worked-oriented research, to create an innovation and entrepreneurial culture, to facilitate the integration of new technologies and to support small and medium-sized enterprises and other creators in their efforts to innovate" (WIPO, 2008).

21 Innovation in a developing country encompasses context: frontiers of knowledge, that is novelty; application and use of new and existing knowledge in the local context; and frugal applications with new and existing knowledge (e.g. M-Pesa and Tigo-Pesa). These last are not poor solutions, but provide value propositions addressed to the needs of the consumer. Frugal innovations involve imitation and efforts to tailor technologies and practices to local needs.

22 Entrepreneurship can be concerned with change that makes a difference. It pertains to all activities of human beings, including business, economic and social. See Wickham (1998) and Hatten (1997).

23 For useful country-based definitions of competitiveness, see Atkinson (2013), European Union (2000) and Porter (2008).

24 The full list of 24 "innovation learner" economies in 2014 contains Armenia, Burkina Faso, China, Costa Rica, Gambia, Georgia, Hungary, India, Jordan, Kenya, Latvia, Malaysia, Malawi, Mali, Moldova, Mongolia, Montenegro, Mozambique, Rwanda, Senegal, Tajikistan, Uganda and Viet Nam.

25 Angola, Burkina Faso, Cape Verde, Chad, Eritrea, Ethiopia, Guinea, Malawi, Mauritania, Sierra Leone, Sudan, Niger, Rwanda, the Central African Republic, and The Gambia.

26 Industrial property rights embrace patents, utility models, industrial designs, trademarks, service marks, trade names, geographical indications (indications of source or appellations of origin), and the repression of unfair competition.

27 Copyright covers literary and artistic works, computer software, databases, and architectural designs. Related (or neighbouring) rights include the rights of performing artists in their performances, producers of sound recordings in their sound recordings, and those of broadcasters in their radio and television broadcasts.

28 See Correa (2007), p. 7.

29 See Correa (2005), p.1.

30 See Correa (2005), p.2.

31 See Correa (2000), pp.1-2.

32 See Correa (2000), pp.4-5. In the 1980s, US supremacy in manufacturing and technology was heavily eroded by Japan and newly industrializing countries in Asia, particularly in consumer electronics, microelectronics, robotics, and computer hardware. Overseas counterfeiting and piracy was a major source of declining American competitiveness. The pharmaceutical, software and phonogram industries forcefully lobbied the United States government to link Intellectual property rights to trade so as to increase returns on R&D and to prevent imitation.

33 See Correa (2000), p.12.

34 See UNCTAD and International Centre for Trade and Sustainable Development (2005), p. 138.

35 Article 15 (2), TRIPS Agreement.

36 See UNCTAD and International Centre for Trade and Sustainable Development (2005), p. 138.

37 See Correa, 2000, p. 13.

38 Article 18, TRIPS Agreement.

39 Article 20, TRIPS Agreement.

40 See UNCTAD and International Centre for Trade and Sustainable Development (2005), p. 246.

41 Articles 22-24, TRIPS Agreement.

42 Articles 25-26, TRIPS Agreement.

43 Article 27.1, TRIPS Agreement.

44 See Correa (2000), p.18.

45 Article 7, TRIPS Agreement.

46 Proposed Format for Reports submitted by the Developed Country Members under Article 66.2, Submission by the Least Developed Country Group, WTO document IP/C/W/561, 6 October 2011.

47 The negotiators of TRIPS were aware of the special needs of least developed countries and the unique challenges they would face in technological catch-up as late-comers. They recognized that intellectual property rights cannot be effective as an incentive mechanism without a sound and viable technological base. To be effective, intellectual property rights need to apply in a context where there is a large market, enough capital, qualified personnel at firm level, innovation-oriented entrepreneurs, and a solid science and technology base. Access to new technology is inadequate for least developed countries' technological catch-up—they need access to *appropriate* technology and have to use such technology effectively in the local context. This requires adequate absorptive capacity—the ability to assimilate and adopt technological know-how, which least developed countries lack. These primary conditions for benefiting from stronger standards of intellectual property protection are absent in least developed countries. Strong intellectual property protection in such a context can actually stifle technological learning, severely impeding growth of a technological base. For this reason, Article 66 was crafted to give least developed countries maximum flexibility to develop a viable base.

48 *Extension of the Transition Period under Article 66.1 of the Trips Agreement for Least Developed Country Members for Certain Obligations with respect to Pharmaceutical Products: Decision of the Council for TRIPS of 6 November 2015*; *Draft Recommendation on Least Developed Country Members – Obligations under Article 70.8 and Article 70.9 of the TRIPS Agreement with respect to Pharmaceutical Products* (3 November 2015).

49 Listed at WTO (2014), Groups in the WTO, https://www.wto.org/english/tratop_e/dda_e/negotiating_groups_e.pdf.

50 See South Centre (2007), p. 6.

51 WIPO, Summary of the Marrakesh Treaty to Facilitate Access to Published Works for Persons who are Blind, Visually Impaired or Otherwise Print Disabled, http://www.wipo.int/treaties/en/ip/marrakesh/summary_marrakesh.html.

52 Listed at WIPO, member States, http://www.wipo.int/members/en.

53 Comoros, Equatorial Guinea, Eritrea, Ethiopia, Liberia, Libya, Seychelles, Somalia, Sudan and Tonga.

54 WIPO, States Parties to the PCT and the Paris Convention and Members of the World Trade Organization, http://www.wipo.int/export/sites/www/pct/en/texts/pdf/pct_paris_wto.pdf.

55 See Correa, 2010, pp. 25-32.

56 See Correa (2010), p. 10.

57 See Correa (2010), p. 14.

58 Article 66.1 of the TRIPS Agreement recognized that implementation of higher standards of IP protection contained in TRIPS would be detrimental to the development of least developed countries. This argument would also apply to other developing countries where high intellectual

property protection will not lead to technology transfer or local innovation.

59 See Correa (2010), p. 14.

60 See Correa (2010), pp. 19-20.

61 Keeping the term of copyright protection to the minimum required by the TRIPS Agreement and the Berne Convention, allow for parallel imports of protected works without the consent of the right holder, implement compulsory licences for translation, reproduction and publication of copyright protected works as stipulated in the Appendix to the Berne Convention, make fixation of the work in a material form a condition for the grant of copyright protection, limit the protection to the expression of the work rather than the idea expressed in the work, control anti-competitive practices, allow for the use of copyright work in broadcasts, make minor use of the copyright work for educational purposes in respect of performing, recitation, broadcasting, recording and cinematographic rights, and include exceptions with regard to news about current events, facts and miscellaneous data, personal use, quotations and citations, reproduction by libraries and archives for storage and replacement, reproduction, distribution and broadcasting of works and speeches by the press, reproduction and adaptation of a computer code for interoperability purposes, ephemeral recordings, use of a work for informational, scientific and educational purposes, and reproduction of articles on current events for information purposes by the press.

62 Correa(2010), pp. 33-37.

63 Correa (2010), p. 37.

64 Correa (2010), p. 40.

65 *Benefit sharing* holds that profits obtained from patents on indigenous resources must be shared between the patent holders and the indigenous communities from which the materials are derived. This entails the equitable sharing of profits between all relevant stakeholders so that in the end everyone benefits.

66 The *Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits arising from their Utilization* (Nagoya Protocol) is an international instrument that was adopted in October 2010 under the auspices of the Convention on Biodiversity. It seeks to promote fair and equitable sharing of the benefits arising from the use of genetic resources, and thereby contribute to the conservation and sustainable use of biodiversity. It, *inter alia*, addresses appropriate access to genetic resources and transfer of relevant technologies.

67 Institutions can be broadly understood as the "rules of the game." As defined by Douglas North, "they are the humanly devised constraints that structure human interaction." See North (1990). Institutions can also constitute "social technologies." See Nelson and Sampat (2000).

68 Including technologically advanced Singapore; a high-income economy like Brunei; middle-income developing economies like Malaysia, Philippines, Thailand and Vietnam; and least developed countries like Cambodia, Lao PDR and Myanmar.

69 Botswana, the Gambia, Ghana, Kenya, Lesotho, Malawi, Mozambique, Namibia, Sierra Leone, Liberia, Rwanda, Sao Tome and Principe, Somalia, Sudan, Swaziland, Tanzania, Uganda, Zambia and Zimbabwe.

70 Lusaka Agreement: http://www.aripo.org/index.php/resources/laws-and-protocols/finish/13-laws-protocols/50-the-lusaka-agreement-on-the-creation-of-the-organization.

71 ARIPO is also authorized to register and administer trade marks for nine contracting parties under the Banjul Protocol on Marks, 1995.African Regional Intellectual Property Organization, Banjul Protocol, http://www.aripo.org/index.php/resources/laws-and-protocols/finish/13-laws-protocols/52-the-banjul-protocol-on-marks.

72 African Regional Intellectual Property Organization, Harare Protocol, http://www.aripo.org/index.php/resources/laws-and-protocols/finish/13-laws-protocols/51-the-harare-protocol-on-patents-utility-models-designs.

73 The main reason given for the failure to object within the allocated time frame is the lack of capacity and resources in national intellectual property or patent offices. National intellectual property offices in the African Regional Intellectual Property Organizationregion tend to deal with a range of intellectual property matters. In addition to patents, national intellectual property offices also administer trademarks, industrial designs, utility models and often, even matters concerning company and business registrations. In some intellectual property offices (such as the United Republic of Tanzania and Zimbabwe) there is a small team of examiners (about 6–10 examiners) that rotate in dealing with trademarks, industrial designs, utility models and patents, though most of the focus is on trademark registration. Even this limited capacity may not exist in other national intellectual property offices of African Regional Intellectual Property Organization.

74 African Regional Intellectual Property Organization, Swakopmund Protocol, http://www.aripo.org/index.php/resources/laws-and-protocols/finish/13-laws-protocols/53-swakopmund-protocol-on-the-protection-of-traditional-knowledge-and-expressions-of-folklore.

75 Draft ARIPO Legal Framework for the Protection of new Varieties of Plants, http://www.aripo.org/index.php/resources/laws-and-protocols/finish/13-laws-protocols/77-draft-aripo-legal-framework-for-the-protection-of-new-varieties-of-plants.

76 Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Comoros, Congo, Côte d'Ivoire, Equatorial Guinea, Gabon, Guinea, Guinea-Bissau, Mali, Mauritania, Niger, Senegal and Togo.

77 Agreement Revising the Bangui Agreement of March 2, 1977, on the Creation of an African Intellectual Property Organization (Official translation): http://www.wipo.int/edocs/lexdocs/treaties/en/oa002/trt_oa002_2.pdf.

78 http://www.wipo.int/wipolex/en/other_treaties/text.jsp?file_id=181152.

79 COMESA Policy on Intellectual Property Rights, http://www.ip-watch.org/weblog/wp-content/uploads/2013/05/Comesa -IP-policy-May-2013.pdf.

80 SADC Pharmaceutical Business Plan, https://www.unido.org/fileadmin/user_media/Services/PSD/BEP/SADC%20PHARMACEUTICAL%20BUSINESS%20PLAN%20-APPROVED%20PLAN.pdf.

81 Regional Intellectual Property Policy on the Utilisation of Public Health-Related WTO-TRIPS Flexibilities and the Approximation of National Intellectual Property Legislation, http://www.cehurd.org/wp-content/uploads/downloads/2013/05/EAC-TRIPS-Policy.pdf.

82 South Centre (2007), *Development and Intellectual Property under EPA Negotiations*, Policy Brief No.7, March 2007, http://www.southcentre.int/wp-content/uploads/2013/06/PB6_Development-IP-under-EPA-Negotiations_EN.pdf.

83 Final Draft Statute of the Pan-African Intellectual Property Organization: http://www.au.int/fr/sites/default/files/PAIPO%20Statute%20English.pdf.

84 Assembly of the African Union (2014), Assembly/AU/Dec.522 (XXIII), DECISION ON PAN AFRICAN INTELLECTUAL PROPERTY ORGANIZATION. Available at: http://www.au.int/en/sites/default/files/Assembly%20AU%20Dec%20517%20-%20545%20%28XXIII%29%20_E_1.pdf.

85 The analysis and recommendations of the ARIA VII report should be a subject of discussion in the Specialized Technical Committee on Justice and Legal Affairs and with ARIPO and PAIPO.

86 Sectoral policies are credited for (1) driving the concentration of national efforts to achieve global leadership positions in some sectors and areas of science and technology endeavour, (2) creation of new sectors either through technology transfer or through endogenous science and technology effort, and (3) improving the efficiency and competitiveness of existing sectors like agriculture and manufacturing. However, they are also *criticized* because of their possibly distortionary effects which may result in both allocation and x-inefficiency.

87 For a thorough discussion of the rationale of science, technology and innovation policy, refer to Aghion, David and Foray (2007).

88 Ghana joined United Nations Educational, Scientific and Cultural Organization in 1958, a year after independence. It is debatable whether the creation of this institution was supply driven (Government urged by United Nations Educational, Scientific and Cultural Organization to create it) or the outcome of an endogenous process.

89 Finnemore (1993) argues that the creation of science bureaucracies in poor countries was supply-driven, it was "supplied" from outside by an international organization, the United Nations Educational, Scientific and Cultural Organization.

90 Nigeria was one of the first to create a super-ministry—the Federal Ministry of Science and Technology—in the early 1980s.

91 Variants include (d) Ministry of (Higher) Education, Science and Technology; Ministry of Environment, Science and Technology, and so on.

92 It is necessary to note that the Vienna Programme of Action of the 1979 United Nations Conference on Science and Technology for Development recommended that the "Government of each developing country should formulate a national policy for science and technology" see United Nations Educational, Scientific and Cultural Organization (1986) *Comparative Study on the Science and Technology Policy-making Bodies in the Countries of West Africa*.

93 Angola, Botswana, Ethiopia, Gambia, Ghana, Kenya, Lesotho, Malawi, Nigeria, Rwanda, South Africa, United Republic of Tanzania, Uganda, Zambia and Zimbabwe. The countries vary by colonial history; territorial, economic and population size; human capital stock and level of development; economic characteristics such as economic growth and total factor productivity growth; and rankings on global competitiveness.

94 At that time, the fight against contractionary IMF/World Bank policies was at its peak and when the impact of the information and communication technologies (ICT) revolution in western countries began to be felt in Africa, African countries realized that they needed to focus attention on science, technology and innovation if they were to become active players in this emerging new world of technologies driven by the revolution in ICT, yet were then hobbled by the HIV/AIDS epidemic. Many began a process of expanding their higher education sectors by allowing private provision. They also began to address the brain drain problem and to adopt explicit science, technology and innovation policies.

95 For instance, South Africa's priorities are biotechnology and pharmaceuticals, space science and technology, energy, global climate change technologies, and human and social dynamics undergirded by a strong knowledge infrastructure.

96 Angola and Gambia are omitted from this table due to a lack of data.

97 Federal Democratic Republic of Ethiopia (2012), p. 19.

98 Some were adopted before NEPAD (2002) or the African Union/NEPAD consolidated Plan of Action for Science, Technology and Innovation (2005–2006). Another reason is poor knowledge of continental and regional science, technology and innovation programmes at country level. Finally, the programmes identified in regional and continental initiatives are mainly regional public goods, often systematically undersupplied because of the free-rider problem among member States. See Nwuke (2005).

99 For details on the leap-frogging and late-comer concepts, see Soete (1985) and Gerschenkron (1962).

100 See Thaler and Sunstein (2008) for a discussion of Nudge.

101 http://www.eac.int/education/index.php?option=com_content&view=article&catid=27:science-a-technology&id=66:the-draft-protocol-on-the-establishment-of-the-east-african-science-a-technology-council.

102 See ECOWAS Press Release at http://news.ecowas.int/presseshow.php?nb=086&lang=eng&annee=2012

103 Founded in 1986 as the Intergovernmental Authority on Drought Development (IGADD).

104 The Treaty was adopted in 1992 in Windhoek, Namibia.

105 See African Union (2000), p. 11.

106 http://www.au.int/en/sites/default/files/ASSEMBLY_EN_29_30_JANUARY_2007_AUC_THE_AFRICAN_UNION_EIGHTH_ORDINARY_SESSION.pdf

107 See African Union (2014), p. 10.

108 Monitoring and evaluation will be undertaken by the New Economic Partnership for Africa's Development Agency and the African Observatory of Science, Technology and Innovation and the African Scientific Research and Innovation Council.

109 African Union (2015) Decisions, Declarations and Resolutions of the 25th Ordinary Session of the Assembly of the Union.

110 Including the proliferation of dedicated science and technology universities by many African governments.

111 For a discussion of South Africa's TFP problem, see for example Kaplan (2008).

112 This is where the advantages of catch-up/ late-comer policies have been exhausted and a country, if it is to become a developed country, must occupy new areas of science, technology and innovation and create new sectors. The Republic of Korea did this spectacularly, by raising science, technology and innovation expenditure (it is currently above 5 per cent of GDP) and became a leader in areas such as consumer electronics. China appears to be following that path, seeking to lead on climate change and sustainable development technologies. South Africa's Ten-Year science, technology and innovation policy seems to have the same objective.

113 It facilitated production of affordable and qualitative solutions for the people at the bottom of the pyramid; elimination of disparity and focus on an inclusive growth model; fostering of an innovation ecosystem; and encouraged the generation of new ideas (See Planning Commission of India., 2013).

114 Frugal innovations are those that respond to demand from the 'bottom of the pyramid', i.e. they provide goods and services for those on low incomes. 'Classical' innovations are concerned with newness, i.e. products or services that were not previously available to anyone, regardless of income.

115 Please see World Bank (2015a) for a definition of knowledge economy.

Assessing Regional Integration in Africa (ARIA) VII examines how the three elements of regional integration, innovation and competitiveness are interlinked. It explores the prospects for harnessing them within the framework of Africa's normative regional integration development model oriented to foster structural change. The report aims to shed light on innovation and competitiveness in the broader context of development policy and strategy in Africa.

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