

Policy Brief

Innovation in Africa: Nature and Evidence

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According to the Oslo Manual, innovation can be defined as “the implementation of a new or significantly improved product (good or service), or process, a new marketing method or a new organisational method in business practices, workplace organisations or external relations” (OECD, 2005, p. 46). For today’s middle-income countries in Africa, innovation is essential to sustain growth and promote the transition to high-income status. This paper begins by providing a summary of theoretical elements of the relationship between innovation and growth. It then does an in-depth review of the region’s innovation performance during the last three decades. In doing so it distinguishes between residents and non-residents, and outcomes at different income levels. Based on this analysis, and the broader literature on middle-income traps, policy recommendations to promote innovation are drawn.

1. Introduction

According to the Oslo Manual, innovation can be defined as “the implementation of a new or significantly improved product (good or service), or process, a new marketing method or a new organisational method in business practices, workplace organisations or external relations” (OECD, 2005, p. 46). For today’s middle-income countries in Africa, innovation is essential to sustain growth and promote the transition to high-income status. Theoretical arguments show the relationship between innovation and growth. In order to assess the impact of innovation on growth, it is important to distinguish between residents and non-residents, and outcomes at different income levels.

The purpose of this paper is therefore twofold. First, it provides “takes stock” with respect to the evidence on Africa’s innovation performance (or lack thereof) during the past three decades. Second, it studies the determinants of innovation in the region, using a comprehensive dataset based on the WIPO database.

The paper proceeds as follows. Section 2 summarizes the main theoretical elements of the relationship between innovation and economic growth. Section 3 looks at the nature of, and evidence on, innovation in Africa. It considers both global trends and the nature of innovation and intellectual property in Africa. Section 4 provides some concluding remarks.

2. Theoretical elements

One of the important lessons of the past decades is the pivotal role of innovation in economic growth. Indeed, a number of empirical studies have found a robust, positive link between expenditure on research and development (a common proxy used for innovation capacity) and the level of GDP per capita or its growth rate. This evidence includes Ang and Madsen (2011), who considered the growth experiences of six Asian miracle economies from 1953 to 2006, Guellec and van Pottelsberghe de la Potterie (2004), who used panel data for 16 OECD countries over the period 1980-1998, and Ulku (2007), who use data for 41 OECD and non-OECD countries, distinguishing between high-income and low-income, large-markets and small-markets subsamples. There is also evidence that the relationship between investment in R&D (as a share of GDP) versus GDP per capita is nonlinear; see Cireri and Maloney (2017).

The theoretical basis for this relationship, as discussed in the seminal contributions of Romer (1990), Grossman and Helpmann (1991) and Aghion and Howitt (1992) on endogenous technological change, is the impact of innovation on productivity. Most studies support the supply-driven approach of innovation-growth nexus (innovation causes economic growth). However, it is also possible that innovation activities are also equally affected by economic growth and other macroeconomic factors. Hence, innovation and economic growth cause each other in the development process; see Agénor and Neanidis (2015).

It has also been forcefully argued that innovation, beyond its broader impact on growth, plays a major role in the transition from middle- to high-income status (see Agénor (2017) and the references therein). Empirical studies have shown indeed that low-income countries (LICs) can achieve middle-income status by boosting productivity through the adoption, adaptation or imitation of foreign technology, especially in the manufacturing sector.

However, the resulting positive effects on growth tends to dissipate over time, due to the presence of barriers/major constraints when middle-income (usually lower-middle income)

status has been achieved. At the same time, the transition from middle- to high-income status requires investments that support innovation and generate ideas. Put differently, while innovation may have a positive effect on growth at all levels of development, it tends to play a particularly critical role in terms of enhancing the capacity of middle-income countries to transition to high-income status.

These issues are particularly important for Africa. Although many countries in the region are still at a low-income status, a number of them have achieved middle-income status in the last two decades. At the present time, twenty-two countries have achieved lower middle-income status, whereas five countries are considered upper middle-income.¹ However, the key challenge for these countries is to implement strategies that would ensure sustained levels of economic growth and help them transition from middle- to high-income status, and thus avoid falling into the so-called middle-income trap, characterized by a persistent growth slowdown – itself resulting from a dramatic reduction in productivity growth. As documented by the experience of various countries, escaping from a middle-income trap may prove difficult in the absence of drastic and complementary policy actions.² From that perspective, understanding how to promote innovation, as a key driver of productivity growth, is essential for many of today's middle-income countries in Africa.

3. Nature and Evidence of Innovation in Africa

As noted by a number of observers, technological advancement has been one of the key drivers of growth in today's developed economies. Indeed, the technological innovations ushered by the Industrial Revolution in the 18th century transformed agrarian European societies into economies driven by manufacturing activities (MDS Events, 2019; HISTORY, 2019b). Similarly, the second industrial revolution saw the introduction of mass production in manufacturing and consumer goods (HISTORY, 2019b), which contributed significantly to the growth of the American Economy (Scene and Scene, n.d.). A more contemporary example of this is South Korea, which invested massively in technology beginning in the 1960s and transformed it from one of the poorest countries then into the world's 13th largest economy in 2014, according to the World Bank (DW.com, 2016).

These experiences provide important lessons regarding the role of technological innovation in fostering growth and development in today's African countries. Before we do so, we begin by providing a broad overview of trends in world innovation. We then “take stock” and provide a consistent and comprehensive picture on the state of innovation in the region.

1. According to the World Bank, as of September 2021, low-income economies are defined as those with a GNI per capita, calculated using the Bank's Atlas method, of \$1,035 or less in 2019; lower middle-income economies are those with a GNI per capita between \$1,036 and \$4,045; upper middle-income economies are those with a GNI per capita between \$4,046 and \$12,535; high-income economies are those with a GNI per capita of \$12,536 or more. Two countries of the region, Mauritius (until recently) and Seychelles, are currently classified as high income. See <https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups>. According to the World Bank's classification, as of April 2021 twenty two countries (Angola, Algeria, Benin, Cape Verde, Cameroon, Comoros, Republic of Congo, Côte d'Ivoire, Djibouti, Eswatini – formerly Swaziland – Ghana, Kenya, Lesotho, Mauritania, Morocco, Nigeria, São Tomé and Príncipe, Senegal, Tanzania, Tunisia, Zambia, and Zimbabwe) had achieved lower middle-income status and five (Botswana, Equatorial Guinea, Gabon, Namibia, and South Africa) higher middle-income status. Based on trends prior to the COVID-19 pandemic, most African countries were projected to reach middle-income status by 2025, with only 13 countries (most of them fragile states) expected to remain in low-income status.

2. The term middle-income trap was coined by Gill, Kharas, et al. (2007). For a broad analytical discussion of middle-income traps, see Agénor (2017, 2021).

To have a more detailed picture of the state of innovation in Africa, the analysis turns now to a discussion of the trends of different types of Intellectual Property (IP) applications. WIPO outlines six different types of IP: Copyright, Patents, Trademarks, Industrial Design, Geographical Indicators and Trade secrets (WIPO, n.d.). In this study, we will explore the trends of Patents, Trademarks and Industrial Design applications in Africa as these are the types of IP that are most directly related to innovation. While patents (as mentioned above) are defined as an exclusive right granted for an invention, trademarks as defined by WIPO are a “sign capable of distinguishing the goods or services of one enterprise from those of other enterprises” whereas industrial design is defined as “the ornamental or aesthetic aspect of an article” (WIPO, n.d.).

A first analysis consist of looking at patent applications trend in Africa from 1996 to 2019 across different income levels; low, lower middle, upper middle, and high income. The data indicate that, throughout the period, patent applications in upper middle-income countries (UMICs) have been the highest, spearheaded by the number of applications in South Africa. The number of patent applications in the lower middle-income countries (LMICs) has been increasing, with a slight drop in the last sub-period. This trend in LMICs as a group is also present in the data for Egypt, Morocco, and Kenya, who also show a positive trend in terms of patent applications. Low-income countries (LICs) have also followed an upward trend, but their performance has lagged significantly behind that of the MICs. Unsurprisingly, the numbers for the high-income countries are negligible as they consist of Seychelles and Mauritius which are both primarily tourist destinations and are thus not highly involved in technological innovation. Overall, although Africa’s performance in terms of patent applications lags significantly that of other regions (especially Asia), it has improved over time.

A second analysis consists of looking at the difference in proportions of patent applications across African countries at different income levels in the beginning of the period, 1996-2000, and the end of the period, 2016-2019. In the beginning of the period, the majority of patent applications, 72 percent, were filed by the region’s UMICs. Subsequently, LMICs filed around 27 percent of total patents, with the remaining being filed by the low- and high-income countries. A significant change in the proportions of patent applications being filed can be seen at the end of the period in figure 9: the proportion of patents filed by LMICs increased to 45 percent. Interestingly, there was also a slight increase in the proportion of patent filings by low- and high-income countries.

Data were also collected on information concerning trends in trademark applications in Africa from 1996 to 2019 at different income levels. The data show that, overall, trademark applications have increased over time. They are the highest in LMICs, followed by UMICs and then LICs. This upward trend for group averages can also be seen in the data for several individual countries, as is the case for South Africa, Egypt, and Morocco.

A third analysis is to look at the trends in applications for industrial design. These trends are quite different from those reviewed previously. Applications by LICs increased at the beginning of the period but have followed a downward trend post 2005. The performance of UMICs has remained weaker than that of LMICs throughout the period, but it has improved over time. In the most recent time period (2015-2019) there has been a general drop in applications, both in terms of the different groups and individual countries, although in the case of some countries (such as Egypt and Tunisia) the downward trend started in earlier periods.

The analysis also looks at the trends in applications related to utility models. Utility models are a type of patent application which protect “minor inventions” and require “compliance with less stringent requirements” (WIPO, n.d.). They are also offered for shorter terms, compared to regular patents. The data show that these applications are (almost) non-existent for the high-income countries and the UMICs of the region. They are also the highest for LICs, followed by LMICs. In both cases these applications have followed an upward trend, including for individual countries like Kenya. The more accessible and affordable nature of utility models could explain why they are more prevalent in LICs, as compared to MICs, in Africa.

When comparing the level of investment of the different types of IP at different income levels from 1996 to 2019, the data show clearly that, compared to the other types of IP applications, trademarks have the highest numbers across all income levels, with LMICs having the highest number of trademarks. This could reflect the fact that these trademarks relate more to goods and services provided, as compared to innovative or manufacturing activities. A similar trend is visible at different income levels. Although trademarks have the highest number of applications, LICs and UMICs see a dip in their numbers in the last period under review, 2015-2019. Trademark applications are followed by patent applications and then industrial design applications, which is itself followed by utility model applications across all income levels and time periods. Compared to other income classifications, the numbers for patents are higher and quite prominent in UMICs relative to the other income groups.

To illustrate the importance of innovation, it is useful to compare the distribution of IP applications by Asia and Africa at the beginning and the end of the period under review. Asia, as a region, has gone through a period of sustained high growth rates, along with an increase in innovation capacity and outcomes; the region accounts for a large number of leading science and technology clusters, based in countries such as Japan, South Korea, China and India. In many ways, Asia’s performance provides a roadmap for Africa’s future path.

The data over the periods 1996-2000 and 2016-2019 for Asia show clearly that the share of trademarks and patents has fallen due, to an increase in the share of industrial design and utility model applications. Comparing this to Africa in the same periods, the share of trademarks has increased as the shares of patents and industrial design applications have decreased. Indeed, the difference that is most striking between the two regions is that in the span of 20 years, the proportion of trademarks applied for in Asia has fallen significantly, from 48 percent to 24 percent, whereas in Africa that proportion went up, from 75 percent to 87 percent. Overall, this comparison suggests that a key characteristic of countries that are growing relatively fast is that they have a greater proportion of patent applications being filed, compared to other types of IP applications.

As mentioned earlier, it is important to look at the trends of non-resident and resident patent applications to get a better picture of home-grown innovation in Africa.

The data show that the highest number of non-resident applications are made by UMICs, most importantly within that group, by South Africa. Applications by non-residents also dominate in LMICs. Over time, these applications have increased significantly, both for the group as a whole and for individual countries such as Morocco. In parallel, the data show that patent applications filed by residents in LMICs has increased over time, particularly between 2006-2010 and 2011-2015. Surprisingly, and somewhat worryingly, the trend has been in the opposite direction for UMICs: the number of patent applications for that group

of countries fell continuously after 2001-2005. This is particularly in the case of South Africa. Taken at face value, these data suggest that home-grown innovation has become less dynamic for that group of countries; in turn, this could reflect growing constraints on R&D activities.

To put these data in perspective, it is worth looking at the difference in proportion of non-resident and resident patent applications between Asia and Africa. The data show the shares of patent applications between non-residents and residents in Asia and Africa respectively, in 1996-2000 and 2016-2019.

The data show that Asia started off with a higher share of resident applications, at 76 percent, and a smaller share of non-resident applications, at 24 percent. This trend hasn't changed much – except that at the end of the period, the share of resident patent applications share had increased to 83 percent, whereas the share of non-resident applications had dropped to 17 percent. There is a blatant difference in these proportions when compared to those for Africa, both at the beginning and the end of the period. Indeed, although the share of resident patent applications has increased in Africa, from 14 percent to 20 percent, with a concomitant reduction in the share of non-resident patent applications, from 85 percent to 80 percent, the share of non-residents patent applications remains extremely significant. Comparing these proportions between the two regions shows that the share of resident patent applications make up more than three-quarters of their patent applications in the beginning and at the end of the period in Asia, whereas in Africa it is the opposite – the share of non-resident patent applications is more than three-quarters of total patent activity, both at the beginning and at the end of the period, although that share is decreasing. Put differently, another characteristic of fast-growing countries is stronger home-grown innovation.

Concluding remarks

Based on the foregoing analysis, the following policy lessons can be drawn together to promote innovation in Africa – both at the national and regional levels. First, targeted government subsidies to R&D may be needed, to promote specific activities with a potentially high social marginal return in the country. Second, ensuring the protection of property rights is important to promote innovation. Lack of protection of intellectual property rights may act as a deterrent to individuals and prevent them from engaging, in the first place, in innovation activities. Third, improving access to advanced infrastructure is important to promote innovation. Lack of access to advanced infrastructure may be an important barrier to the development of national and international knowledge networks. Fourth, access to finance must be improved. The micro-based studies show that financial constraints have a significant impact on firms' ability to innovate. Fifth, governments should promote a culture of innovation. For instance, for many observers one of south Africa's greatest strengths, is that the country has a strong innovation culture.

Three of these policies could also be fruitfully implemented at the regional level; fostering an innovation culture, improving access to finance, and providing greater access to advanced infrastructure.

To promote the culture to innovate, greater reliance could be put not only by promoting national tech hubs (as noted earlier) but also regional hubs. To promote access to the “right type” of finance to support innovation, namely, venture capital, regional financial markets

(in countries like Nigeria and South Africa, and Morocco, the latter with a particular focus on francophone Africa) could be further developed, again with the support of multilateral institutions. Casablanca, in particular, has seen a relatively rapid growth of venture capital markets in recent years. To promote greater access to advanced infrastructure, regional investment programs could be further strengthened, again with the support of multilateral institutions. The evidence shows clearly that boosting connectivity can increase research activity and spur innovation, by promoting knowledge networks.

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