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ECA POLICY BRIEF

Towards Achieving the African Union's recommendation of expenditure of 1% of GDP on Research and Development

Summary

African Heads of State and Government have committed to raising their national gross expenditure on research and development (GERD) to at least one per cent of their gross domestic product (GDP), in order to increase innovation, productivity and economic growth. However, this seemingly modest target of raising GERD to 1 per cent of GDP remains elusive. The present policy brief explores why such a noble intention remains a challenge and the policy measures that countries can put in place to meet this target. Drawing on lessons from countries that have met and surpassed the 1 per cent target, it is suggested that governments should put in place measures that raise public expenditure on research and development, and stimulate innovation in the private sector to increase business expenditure on research and development.

Highlights

Africa's gross expenditure on research and development as a proportion of GDP stands at about 0.5 per cent compared to the world average of 2.2 per cent.

Countries generally attain the 1 per cent target of GERD as a percentage of GDP when business-financed research and development surpasses publicly-funded research and development.

Countries can meet and surpass the target by:

- Establishing clear public funding mechanisms for public and private research and development projects
- Looking for public research and development contracts for their domestic research and development institutions
- Encouraging technology commercialization through clear national policies
- Supporting the emergence and growth of technopoles as drivers of research and development expenditure

I. A brief history of the 1 per cent target

The calls for increased investment in science and technology, particularly in the area of research and development, can be traced back to the Monrovia Declaration of 1979 on Guidelines and Measures for National and Collective Self-Reliance in Social and Economic Development for the Establishment of a New International Economic Order,[1] and the follow-up Lagos Plan of Action for the Economic Development of Africa (1980–2000).[2] However, it was the Eighth Ordinary Session of the Executive Council of the African Union in Khartoum in 2006 that endorsed the call upon member States, at the African Ministerial Conference on Science and Technology, to raise their national science and technology budget to 1 per cent of GDP, to ensure

1 See the Monrovia Declaration of 1979, available at: https://au.int/sites/default/files/decisions/9526-assembly_en_17_20_july_1979_assembly_heads_state_government_sixteenth_ordinary_session.pdf.

2 See the Lagos Plan of Action for the Economic Development of Africa (1980–2000), available at: https://www.merit.unu.edu/wp-content/uploads/2015/01/Lagos-Plan-of-Action.pdf.

that their programmes and projects are implemented.[3] This was further emphasized at the Ninth Executive Council of the African Union held in Addis Ababa in 2007, in a decision that strongly urged member States to promote Africa's research and development and develop innovation strategies for wealth creation and economic development, by allocating at least 1 per cent of the gross domestic product of national economies by 2010, as agreed by the Khartoum Decision.[4]

Since then, such decisions have evolved to mean *allocation* of 1 per cent of GDP to support research and development activities. For instance, the African Union Science, Technology and Innovation Strategy for Africa 2024 (STISA-2024), adopted in 2015, encourages countries to take concrete actions to *allocate* at least 1 per cent of GDP towards research and development to ensure that Africa maximizes ownership and responsibility for its own developmental path.[5]

Although the focus is often on financial expenditure, the main reason for this target in the declarations is to accelerate economic and social development. This is supported by economic research showing that an increase in research and development expenditure leads to an increase in GDP.[6] An example of such research found that "an increase in research and development expenditure as a percentage of GDP of 1 per cent would result in an increase of real GDP growth rate of 2.2 per cent".[7] Research and development is seen as critical in increasing innovation, which in turn raises productivity and leads to economic growth.

It is for this reason that countries and regional blocks set targets to increase their research and development expenditure. For example, the European Union set its research and development target at 3 per cent of GDP to be achieved by 2010, which was later revised to 2020, while Kenya has set a target of 2 per cent. For Africa, increase in research and development spending is seen as key to achieving self-reliance, economic diversification, employment and wealth creation, to meet globally agreed commitments.

II. What is research and development and how is expenditure measured?

Research and development is made up of three types of scientific and technological activities:

a) Basic research — "experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, *without any particular application* or use in view".[8] Basic research is largely performed in higher education and public institutions and leads to publications and few patents;

b) Applied research — "original investigation undertaken in order to acquire new knowledge, directed primarily towards *a specific practical aim or objective*" or solve challenges.[9] This is undertaken mainly in public research and technology organizations such as agricultural and industrial research centres;

c) Experimental development — refers to efforts leading towards scaling up, demonstration, pilot testing, clinical and field trials, among others. It is largely funded and performed by firms and results in patents, trademarks and new or improved products, processes and institutional arrangements. It is also the most expensive component of research and development.

Expenditure on research and development includes staff costs (for example salaries and associated benefits), facilities and investment in land, buildings and equipment in support of research and development, but excludes other expenditures relating to scientific and technological activities such as teaching laboratories, weather monitoring stations, hospitals, among others, that are not necessarily involved in research and development activities. The sum of both public and private sector research and development expenditure performed within the country is termed GERD. Research and development expenditure thus provides some information on research and development personnel, sectors of performance and sources of funding. As such, GERD does not cover expenditure on all scientific

3 For more details, see: https://au.int/sites/default/files/decisions/9639-ex_cl_dec_236_-_277_viii_e.pdf.
4 See the Khartoum Decision (EX.CL/Dec.254 (VIII). Note that the "Science and technology budget" referred to in the decisions is very often much larger than "research and development expenditure".
5 See the African Union Science, Technology and Innovation Strategy for Africa 2024, available at: https://au.int/sites/default/files/documents/29957-doc-stisa-published_book.pdf.
6 For more information, see: http://www.ekonomikyaklasim.org/eyc2015/userfiles/downloads/_Paper%20207.pdf.
7 Svetlana Sokolov-Mladenović, Slobodan Cvetanović and Igor Mladenović (2016), R&D expenditure and economic growth: EU28 evidence for the period 2002–2012, Economic Research-Ekonomska Istraživanja, vol. 29, 1.
8 OECD 2006.
9 OECD 2006 and I.W. Sherman, "Two sides of a coin: basic and applied research", *California Agriculture*, May-June 1988.

and technological activities such as training and technical services.

III. Current status of research and development expenditure in Africa

Looking at the limited data available, only Malawi has attained the 1 per cent target, while those for Kenya, South Africa and Tunisia are above 0.7 per cent of GDP. The main sources of research and development funding are governments (for example, 68 per cent of GERD for Ghana) and sources abroad (for example, 57 per cent GERD for Uganda). Most of the research and development is performed in the public sector (government and higher education), with the exception of South Africa (50 per cent of the research and development expenditure is in industry), as shown in the figure.

Over the period 2007-2014, only Uganda registered a significant decline, from 1.1 per cent of GDP in 2008 to about 0.23 per cent of GDP in 2014. Meanwhile, research and development expenditure of most African countries has remained relatively stable (for example, in Ghana, Malawi, Namibia and Senegal) or even grown faster (for example, in Egypt, Ethiopia, Kenya and Mali). Given that African economies have registered rapid economic growth rates in recent years, it would suggest that research and development expenditure as a percentage of GDP has kept pace, and in some cases, even grown faster.

In summary, the research and development landscape in Africa is dominated by universities and public research institutions that are traditionally funded by governments and donors. In some cases, funds from abroad account for a large proportion of total research and development funding. Business-financed research and development remains lower than 50 per cent of GERD. Research and development bases in Africa are very limited, with most countries having less than 100 researchers per million inhabitants – about 12-fold smaller than the world average.

IV. How countries met the 1 per cent target

In the last few decades, a number of countries have crossed the 1 per cent of GDP target, including China, Malaysia and Turkey. By 2014, the expenditure of China on research and development was at 2 per cent of GDP, while that of Malaysia and Turkey reached 1.3 per cent and 1.0 per cent, respectively. There was a corresponding rise in researchers in all the three countries, with Malaysia and Turkey crossing the research and development expenditure target of 1 per cent of GDP, when researchers per million inhabitants passed the 1,000 mark. China, despite its large population, crossed this landmark after the number of researchers in the country reached 600 per million people (see table).

Furthermore, all these countries crossed the 1 per cent target after the business expenditure on research and development (BERD) as a percentage of GERD surpassed that of the public sector (government, higher education and non-for-profit combined). Countries generally pass the 1 per cent target of GDP expenditure on research and development when business expenditure on research and development surpasses 50 per cent of total GERD. Indeed, national research and development surveys in Malaysia show that business expenditure on research and

Figure 1: Sources of research and development funding and sectors of performance (expenditure)

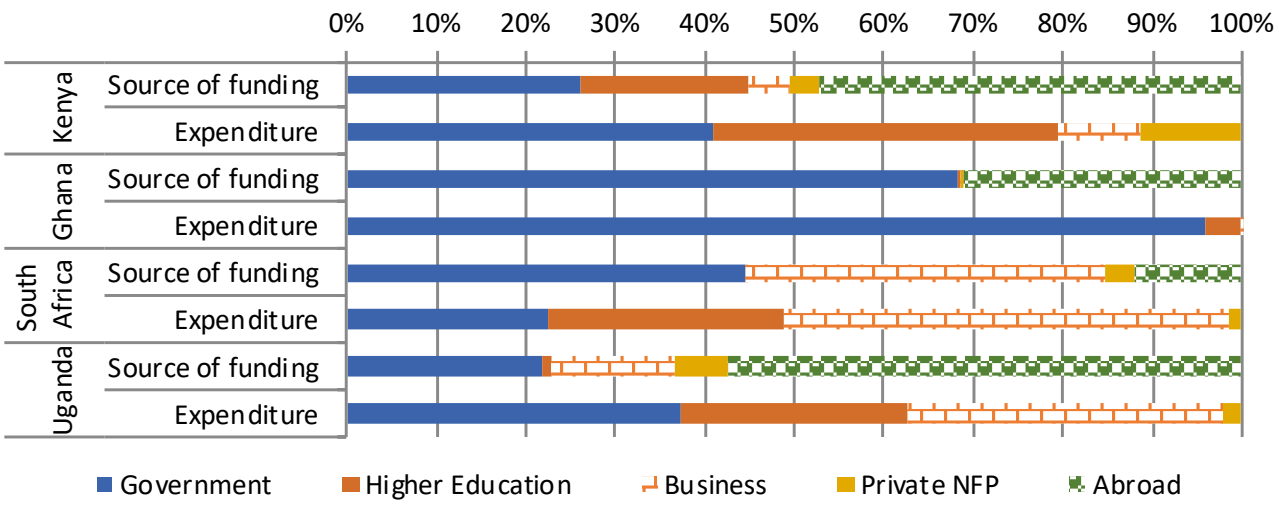

Table 1: Comparison of researchers and GERD

Country and population (millions)		1996	2000	2006	2010	2014
Egypt 95.7	Researchers per million people			430.0	496.7	681.6
	R&D expenditure (% of GDP)	0.2	0.2	0.3	0.4	0.6
Malaysia 31.2	Researchers per million people	89.1	274.2	368.4	1458.2	2017.4
	R&D expenditure (% of GDP)	0.2	0.5	0.6	1.0	1.3
China 1378.6	Researchers per million people	442.6	547.3	932.3	903.0	1113.1
	R&D expenditure (% of GDP)	0.6	0.9	1.4	1.7	2.0
Turkey 79.5	Researchers per million people	304.2	365.0	621.0	889.8	1156.5
	R&D expenditure (% of GDP)	0.5	0.5	0.6	0.8	1.0
South Africa 55.9	Researchers per million people	198.8	311.2	378.8	362.6	437.1
	R&D expenditure (% of GDP)	0.6	0.7	0.9	0.7	0.7

Source: WDI, 2017.

development has been above 60 per cent of GERD since 2002, and the decline in GERD for South Africa is due to the decline in BERD.[10]

This observation is not unique to the countries referred to above. As a percentage of GDP, GERD of the Republic of Korea grew from 0.25 per cent in 1960 to 1.2 per cent in 1983 and 1.87 per cent in 1990. During that period, the contribution of the business sector to GERD grew from a mere 3 per cent in 1960 to about 81 per cent in 1990 while the share of the public sector in GERD declined from 97 per cent to 19 per cent. The public sector expenditure on research and development did not decline in absolute terms, but rather, private sector expenditure rose faster than that of the public sector.

How did these countries manage to raise their research and development expenditure? Despite major national difference, a few common measures could be identified:

Establish and strengthen agencies responsible for mobilizing the funding for research and development

The case of the Scientific and Technological Research Council of Turkey (TÜBITAK), founded in 1963, is one such example. Until 1995, the role of the Council in the area of funding was restricted to the provision of grants and fellowships to public institutions and to stimulating interest among young researchers to pursue careers in science and technology. In collaboration with the Ministry of Trade, TÜBITAK has been managing the programme that offers private firms and public enterprises research and development and innovation funding, as well as other cash credit claims since, 2005. In addition to promoting the growth of science, technology and innovation, and managing 10 high-tech research and development-support institutes, TÜBITAK plays an important role in directly raising public and private sector research and development expenditure.

Another example is the São Paulo State Research Support Foundation (FAPESP)[11] in Brazil, which by State law, gets 1 per cent of all the taxes collected in Sao Paulo. In return, FAPESP is required to spend not more than 10 per cent of the budget on management, which leaves enough resources to invest in research and technological development. In 2013, FAPESP had a budget of about $500 million, 37 per cent of which was invested in basic research, 53 per cent in applied research and 10 per cent in research infrastructure. Part of the applied research includes joint research between academia and industry.

Apart from Algeria, Kenya and South Africa, most African countries do not have a clear funding source, management and administrative arrangements and freedom of operation. Governments should create and strengthen the research and development funding agencies to enable them to build public trust and a reputation of investing wisely and cultivating a culture that encourages innovation and collaboration with industry, which, in turn, may lead to an increase in research and development expenditure.

10 See *African Innovation Outlook II*, 2014.

11 More information on FAPESP is available at: http://www.fapesp.br/en/6026.

Reserve a proportion of public contracts for research and development institutions

While budgetary allocation is key, many research and development centres generate their budgets, network and linkages through public and private contracts. In the short term, governments need to invest in the infrastructure and skills needed to make their public research and development institutions the preferred contractors and partners for public and private contractors. Governments, as major consumers of research and development-related services such as exploration, feasibility studies, environmental impact assessments and a host of other services for security, education and health, should reserve a portion of their contracts for public institutions. For instance, nearly a third of the budget of the Council for Scientific and Industrial Research in South Africa receives its revenue from public sector research contracts. As a result, its research and development expenditure has continued to grow.

Governments can also initiate such private sector contracts by encouraging collaboration. For instance, the Industrial Linkages Programme of Malaysia included special vouchers that covered the cost of hiring public research and development institutions to provide technical services to domestic firms to enable them to meet the requirements of affiliated foreign firms and international markets. Government funded 100 per cent the first few days and then 50 per cent the next few days. From then on, firms interested in continued support had to sign independent agreements with the public sector providers at their own cost. Such measures help firms to learn how to fund and manage research and development and help academia to get a better understanding of challenges faced by firms. A similar programme has been tried in Africa for a number of services – entrepreneurship, legal, financial and technology support.

Encourage technology commercialization

While China has been cited often for its huge expenditure on research and development, the country's research and development was centrally managed until the mid-1980s. To encourage commercialization and academia – industry linkages that are key in a market-oriented economy, China allowed researchers in public institutions to set up their own "tech" businesses in their spare time, undertake consultancies for private firms and encouraged public research and development institutions to commercialize their products. For instance, a number of institutions of the Chinese Academy of Sciences (CAS) set up dozens of start-ups and production units. According to that Academy, "over 700 CAS spin-off companies have grossed about RMB 350 billion ($56 billion)" in 2014 alone.[12] It is high-tech spin-offs of that kind, and their institutions, that have attracted the interest of private firms and are collectively raising research and development expenditure.

Africa may not compete at the high-tech end alongside China or the Republic of Korea, however, clearer technology commercialization policies at the national level can encourage specialized centres in agriculture, energy, health and mining, among others, to invest strategically in research and development activities that are likely to result in marketable products and firms and pursue research and development alliance with industry and government.

Innovation and technology hubs and poles as tools for raising research and development expenditure

There are over 250 places and spaces that call themselves innovation hubs in Africa. However, very few of these serve the purpose of encouraging an increase in research and development expenditure in the public or private sectors. Two approaches have been used. In the first, Governments can bring together existing departments and units with the needed basic research and development to create a critical mass of researchers who can then be supported centrally. For instance, the biotechnology pole of Cuba emerged by making all departments with some biotechnology capacity part of a national health biotechnology initiative that was fully funded by the Government, and, over time, new units for testing, production and marketing were developed, creating a closed loop that encouraged knowledge sharing and technology commercialization. Within two decades, the biotechnology sector in Cuba had 12,000 researchers and 30,000 workers in 210 research institutions and 33 university departments and generated at least 160 medical products, thus raising GERD for Cuba as a percentage of GDP to 1.2 per cent.

The second approach is to build science and technology parks, industrial zones and multifacility economic zones, among others, as a means to attract foreign and domestic investments in areas of interest and host technology spin-offs. For instance, China designated Shenzhen, a fishing community of 30,000 inhabitants at the time, as one of four special economic zones (SEZs) with special tax benefits and preferential treatment for foreign direct investment. By 2016, the population of Shenzhen had reached 12 million and developed into a technology hub whose research and development expenditure as a

12 More details are available at: http://english.cas.cn/about_us/introduction/201501/t20150114_135284.shtml.

percentage of GDP stood at 4 per cent. The city seeks to reach the target of 4.7 per cent of GDP expenditure on research and development by 2020 with "biotechnology, the internet, new energy, new materials, IT and cultural and creative industries expanding, to account for 42 per cent of the city's GDP".[13]

V. Conclusion

While several African countries, including Kenya, Mauritius, Nigeria, Tunisia, South Africa and Zambia, offer several generous incentives for enterprises that qualify for research and development, the institutional arrangements for implementing and monitoring the effectiveness of such incentives are missing or still in the process of formulation. While the incentives are important, it should be noted that most African firms are predominantly small and the large ones have limited research and development units or experience to effectively utilize the measures and generate the intended outcomes. In addition, most research and development is predominantly funded and performed by the public sector.

All the countries that wished to and have managed to raise their research and development expenditure as a percentage of GDP focused on driving innovation and development of high-technology firms. All the countries highlighted here such as China, Malaysia, the Republic of Korea and Turkey are today major suppliers of automobiles, household electronics, industrial machinery and equipment, builders of ships and aircrafts, among others. While each one took a different route, they are all emerging as major spenders on and performers of research and development.

Therefore, African countries that wish to meet the 1 per cent target should focus on building a scientific and technology base, promoting technology commercialization, encouraging emergent technology hubs and reserving a proportion of public contracts for research and development institutions to stimulate research and development in the private sector. All these measures often take some time to bear fruit.

13 For more information on Shenzhen, see: http://www.scmp.com/news/china/policies-politics/article/1907998 /chinas-economic-power-house-shenzhen-banks-rd-bring-it.

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