United Nations
Economic Commission for Africa

NTIS POLICY BRIEF

DRAFT

Realizing the R&D expenditure target of “1% of GDP”?

Summary

African heads of state and government have committed to raise their national gross expenditure on research and development (GERD) to at least one per of their gross domestic product (GDP) in order to drive innovation, productivity and economic growth. However, this this seemingly modest target of raising GERD to ‘1% of GDP’ remains elusive. This policy explores why this noble policy intention remains a challenge and policy measures that countries can put in place to raise their GERD. Based on emerging continental data on R&D drawn from countries that have met and/or surpassed the 1% target, we suggest that government should put in place measures that raise public R&D expenditure and stimulate innovation in the private sector to drive business R&D expenditure.

Key highlights

Africa’s gross expenditure on R&D (GERD) as a proportion of GDP stands at about 0.5% compared to world average of 2.2%.

Countries generally attain the “1% target of GERD as a percent of GDP” when business-financed R&D surpasses publicly funded R&D.

Countries can meet and surpass the target by:

- *Establishing clear public funding mechanisms of public and private R&D projects*
- *Research public R&D contracts for their domestic R&D institutions*
- *Encourage technology commercialization through clear national policies*
- *Support the emergence and growth technopoles as drivers of R&D expenditure*

1.0 Brief history of the 1% target

The calls for increased investment in science and technology, and research and development (R&D) in particular, can be traced back to the Monrovia Declaration of 1979[1] on Guidelines and Measures for National and Collective Self-Reliance in Social and Economic Development for the Establishment of a New International Economic Order and the follow up Lagos Plan of Action (LPA) for the Economic Development of Africa (1980–2000)[2]. However, it was at the Eighth Ordinary Session of the Executive Council of the African Union of 2006 in Khartoum, Sudan that endorsed "the call upon Member States, by the Conference [i.e. African Ministerial Conference on Science and Technology], to raise their national S&T budget to 1% of GDP, to ensure that their programmes and projects are implemented"[3] and further reemphasised at the Ninth Executive Council of the AU held in Addis Ababa, Ethiopia in 2007 that "STRONGLY URGES Member States to promote Africa's Research and Development (R&D) and develop innovation strategies for wealth creation and economic development by allocating at least 1% of Gross Domestic Product (GDP) of national economies by 2010 as agreed by Khartoum Decision (EX.CL/Dec.254 (VIII)[4].

Since then, these decisions have evolved to mean *allocation* of 1% of GDP to support R&D activities. For instance, the AU's Science, Technology and Innovation Strategy for Africa 2024 (STISA-2024) adopted in 2015 encourage countries to "take concrete actions to *allocate* at least 1% of GDP to R&D to ensure that Africa maximises ownership and responsibility for its own developmental path"[5].

Although the focus is often placed on financial expenditure, the main reasons for this target in all the declarations are to drive economic and social development. This is supported by economic research findings that show increased R&D expenditure leads to increase in GDP[6]. For instance, one such research found that "an increase in R&D expenditure as a percentage of GDP by 1% would cause an increase of real GDP growth rate by 2.2%"[7]. R&D is seen as critical in driving innovation which in turn drives productivity which leads to economic growth.

It is for this reason that the countries and regional blocks set target to increased their R&D expenditure. For example, European Union set its own R&D target of 3% of the GDP to be achieved by 2010, which was later renewed to be attained by 2020 while Kenya has set a target of 2%. For Africa, increased R&D spending is seen as key to achieve self-reliance, economic diversification, employment and wealth creation and meeting globally agreed commitments.

---

[1] https://au.int/sites/default/files/decisions/9526-assembly_en_17_20_july_1979_assembly_heads_state_government_sixteenth_ordinary_session.pdf

[2] https://www.merit.unu.edu/wp-content/uploads/2015/01/Lagos-Plan-of-Action.pdf.

[3] https://au.int/sites/default/files/decisions/9639-ex_cl_dec_236_-_277_viii_e.pdf

[4] Note: 'Science and technology budget' which the decisions refer to are almost always way larger than 'research and development expenditure'.

[5] https://au.int/sites/default/files/documents/29957-doc-stisa-published_book.pdf

[6] http://www.ekonomikyaklasim.org/eyc2015/userfiles/downloads/_Paper%20207.pdf

[7] Svetlana Sokolov-Mladenović, Slobodan Cvetanović & Igor Mladenović (2016), R&D expenditure and economic growth: EU28 evidence for the period 2002–2012 , *Economic Research-Ekonomska Istraživanja* Vol. 29 , Iss. 1

2. What is R&D and how is expenditure on R&D measured?

Research and development (R&D) 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" (OECD 2006). Basic research is largely performed higher education and public institutions and leads to publications and few patents.

b) Applied research is "original investigation undertaken in order to acquire new knowledge directed primarily towards *a specific practical aim or objective*" (OECD, 2006) or solve challenges (Sherman (1988)[8]. Largely in public research and technology organizations (e.g. agricultural and industrial research centres)

c) Experimental development refers to efforts leading towards scaling up, demonstration, pilot testing, clinical/field trials etc. 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 R&D.

Expenditure on R&D includes staff costs (e.g. salaries and associated benefits), facilities and investment in land, building and equipment incurred in support of R&D but excludes other expenditures related to scientific and technological activities such as teaching laboratories, weather monitoring stations, hospitals etc that are not necessarily involved in R&D activities. The sum of both public and private sector R&D expenditure performed within the country is termed the Gross Expenditure on R&D (GERD). Therefore, R&D expenditure provides some indication on R&D personnel, sectors of performance and sources of funding.

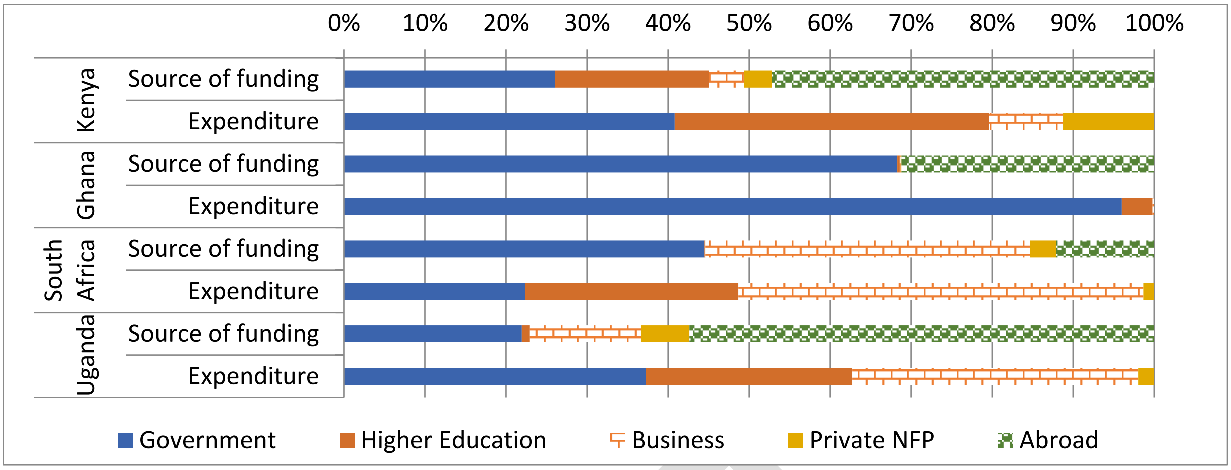
3. Current status of R&D expenditure in Africa

Despite data deficits, only Malawi has attained the '1% target' while Kenya, Tunisia and South Africa are at above 0.7% of GDP. The main sources of R&D funding are governments (e.g. 68% of GERD of Ghana) and sources abroad (e.g. 57% for Uganda GERD) and most of the R&D is performed in the public sector (government and higher education), with the exception of South Africa (50% of the R&D expenditure occurred in industry), as shown in Figure 1.

Over the period 2007-2014, only Uganda has registered significant decline from 1.1% of GDP in 2008 to about 0.23% of GDP in 2014 while R&D expenditure of most African countries has remained relatively stable (e.g. Ghana, Senegal, Malawi and Namibia) or even grown faster (e.g. Ethiopia, Egypt, Kenya and Mali). Given that African economies have registered rapid economic growth rates in recent years, it would suggest that R&D expenditure as percent of GDP has kept pace, and in some cases, even grown faster.

[8] Sherman, I.W. (1988) Two sides of a coin: basic and applied research, *California Agriculture*, May-June 1988

Figure 1. Sources of R&D funding and sectors of performance (expenditure)



In sum, Africa's R&D landscape in dominated by universities and public research institutions that are traditionally funded by government and donors. In some cases, funds from abroad account for a large proportion of total R&D funding. Business-financed R&D remains lower than the 50% of the GERD and Africa's R&D bases is very narrow, with most countries having less than 100 researchers per million inhabitants – about 12-folds smaller that the world average.

4. How countries met the "1% of GDP target for GERD"

In the last few decades, a number of countries have crossed the "1% of GDP" target which includes China, Malaysia and Turkey. By 2014, China's expenditure on R&D was at 2% of GDP while that of Malaysia and Turkey reached 1.3% and 1.0%, respectively. A corresponding rise in researchers is noted for all the three countries – with Malaysia and Turkey crossing the R&D expenditure target of '1% of GDP' when researchers per million inhabitants passed the 1000 mark. China, despite is large population, crossed this landmark after its number of researchers reached the 600 per million people (see Table 1).

In addition, all these countries crossed the '1% target' after the Business Expenditure on R&D (BERD) as percentage of GERD surpassed that by the public sector (government, higher education and non-for profit combined). Countries generally pass the "1% target of GDP expenditure on R&D" when business expenditure on R&D surpasses 50% of total GERD. Indeed, national R&D surveys in Malaysia shows that business expenditure on R&D has been above 60% of GERD since 2002 and the decline in GERD for South Africa is related to the decline in BERD (see African Innovation Outlook II, 2014).

Table 1. Comparison of researchers and GERD

		1996	**2000**	**2006**	**2010**	**2014**
Egypt Pop: 95.7 million	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 Pop: 31.2 million	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 Pop: 1378.6 million	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 (Pop: 79.5 million)	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 Pop: 55.9 million	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

This observation is not unique to the countries referred above. Korea's GERD as a percent of GDP grew from 0.25% in 1960 to 1.2% in the 1983 and 1.87% in 1990. During that time business sector's contribution to GERD grew from a mere 3% in 1960 to about 81% in 1990 while the share of the public sector in GERD declined from 97% to 19% of GERD. The public sector expenditure on R&D did not decline in absolute terms but rather private sector expenditure rose faster than that by the public sector.

How did these countries manage to raise their R&D expenditure? Despite major national difference, a few common measures could be identified:

4.1 Establish and strengthen agencies responsible mobilizing R&D funding

The case of The Scientific and Technological Research Council of Turkey (TÜBITAK), found in 1963 is one such example. In terms of funding, until 1995, its role was restricted to provision of grants and fellowships public institutions and stimulating interest among your researchers to pursue a career in science and technology. In collaboration with the ministry of trade, TÜBITAK manages the programme that offers private firms and public enterprises R&D and innovation funding as well as other cash credit claims since 2005. In addition to promoting the growth of STI and managing 10 high-tech R&D and R&D-support institutes, TÜBITAK plays an important role in directly stimulating public and private sector R&D expenditure.

Another example is the São Paulo State Research Support Foundation (FAPESP[9]) in Brazil which, by State law, gets 1% of all the taxes collected in the Brazilian State of São Paulo. In return, FAPESP is required not to spend more than 10% of the budget on management, which leaves enough resources to invest in research and technological development. In 2013, FAPESP had a budget of about US$ 500 million of which 37% was invested in basic research, 53% in applied research and 10% in research infrastructure. A proportion of the applied research includes joint-research between academia and industry.

Other than Algeria, Kenya and South Africa, most African countries do not have such a clear funding source, management and administrative arrangements and freedom of operation. Governments may wish to create and strengthen the R&D 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 increased R&D expenditure.

[9] Website of FAPESP (http://www.fapesp.br/en/6026)

4.2 Reserve a proportion of the public contracts for R&D institutions

While budgetary allocation is key, many R&D centres grow their budgets, network and linkages through public and private contracts. In the short-term, government needs to invest in infrastructure and skills needed to make their public R&D institutions the preferred contractors and partners of public and private contractors. Governments, as a major consumers of R&D related services such as exploration, feasibility studies, environmental impact assessments and a host of 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 (CSIR) in South Africa is revenue from public sector research contracts. As a result, its R&D expenditure has continued to grow.

Governments can also stimulate such private sector contracts by encouraging collaboration. For instance, Malaysia's Industrial Linkages Program included special vouchers that covered the cost of hiring public R&D institutions to provide technical services to domestic firms to enable them meet the requirements of foreign invested firms and international markets. Government funded 100% the first few days and then 50% the next few days. Thereafter, firms interest in continued support will sign independent agreement with the public sector providers at their own cost. Such measures help firms to learn how to fund and mange R&D and help academia to get a better understanding of challenges faced by firms. A similar program has been tried in Africa for a number of services – entrepreneurship, legal, financial and technology support.

4.3 Encourage technology commercialization

While China has been cited often for its large expenditure on R&D, China's R&D 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 R&D institutions to commercialize their outputs. For instance, a number of institutions of Chinese Academy of Sciences set up dozens of start-ups and production units. According to the Chinese Academy of Sciences, "over 700 CAS *spin-off* companies have grossed about RMB 350 billion (US$56 billion)"[10] in 2014 alone. It is these high-tech spin-offs and their institutions that have attracted the interest of private firms and are collectively driving R&D expenditure.

Africa may not compete at the high-tech end as China or Korea. However, clearer technology commercialization policies at national level can induce specialized centres in agriculture, energy, health and mining, among others, to strategically invest in R&D activities that are likely to result in marketable products and firms and pursue R&D alliance with industry and government.

4.4 Innovation and technology hubs/poles as tools for raising R&D expenditure.

The number of place and spaces that call themselves innovation hubs in Africa exceed 250. However, very few of these are serving the purpose of inducing increased R&D

[10] http://english.cas.cn/about_us/introduction/201501/t20150114_135284.shtml

expenditure in public or private sector. Two approaches have been used. In the first case, governments can bring together existing departments and units with the needed basic R&D to create a critical mass of researchers that can then be supported centrally.

For instance, Cuba's biotechnology pole emerged by making all departments with some biotechnology capacity part of a national health biotechnology initiative that was fully funded by government, and overtime new units for testing, production and marketing were developed – creating a closed loop that encouraged knowledge sharing and technology commercialization. Within two decades, the Cuban biotechnology sector had 12,000 researchers and 30,000 workers in 210 research institutions and 33 university department and generated at least 160 medical products – pushing Cuba's GERD as a percent of GDP to 1.2%.

The second approach is to build science and technology parks, industrial zones and multi-facility economic zones, among others, at tools to attract foreign and domestic investment in areas of interest and host technology spin-offs. For instance, China designated Shenzhen, a then fishing community of 30,000 inhabitants as one of four special economic zones (SEZs) with special tax benefits and preferential treatment to FDI. By the 2016 population of Shenzhen reached 12 million and developed into technology hub whose R&D expenditure as a percentage of GDP stood at 4%. The city seeks to reach the target of 4.7% of GDP expenditure on R&D by 2020 with "biotechnology, internet, new energy, new materials, IT and cultural and creative industries expanding to account for 42 per cent of the city's GDP"[11].

Conclusion

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

All the countries that wished and have managed to raise their R&D expenditure as a percentage of GDP focussed on driving innovation and development of high-technology firms. All our three countries 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, these countries are all emerging as major spenders and performers of R&D.

Therefore, African countries that wish to meet the "1% target" may wish to focus on building the scientific and technology base, promote technology commercialization, encourage emergency on technology hubs and reserve a proportion of public contracts for R&D institutions. All these measures often take a long time before they can bear fruits.

[11] http://www.scmp.com/news/china/policies-politics/article/1907998/chinas-economic-powerhouse-shenzhen-banks-rd-bring-it