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policy brief

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How well is R&D oriented to human development in South Africa?

Summary

To measure policy progress, one key science, technology and innovation (STI) indicator has long captured the imagination of policy makers: gross domestic research and development expenditure (GERD) expressed as a proportion of the gross domestic product (GDP) of a country (GERD/GDP). In the context of South Africa, which was recently estimated to be the most unequal in the world, we need additional indicators to guide national expenditure to achieve the newly-formulated policy goals and strategies of STI for 'inclusive and sustainable development'. This policy brief proposes a design for such a complementary indicator – human development-oriented research and development (R&D) intensity – and shows how it can be used to assess progress. The goal is to shift the policy discourse to leverage a greater scale of investment in R&D oriented to human development.

Introduction: Measuring the knowledge intensity of the economy

To measure a country's progress towards a knowledge economy, standardised STI indicators are used worldwide. A key indicator popularised by the Organisation for Economic Co-operation and Development (OECD) has long captured the imagination of policy makers: GERD/GDP (Godin 2003). That is, does a country spend a large enough portion of its total GDP on formal R&D to promote economic growth?

In South Africa, as in other emerging economies, ambitious targets to achieve a ratio of 1.5% were set. Measurement systems were put in place and policy makers began an annual discussion on the conditions that facilitate or constrain progress towards the target, relative to the levels achieved by comparator countries.

In the context of South Africa, with growing poverty and unemployment for large proportions of the population (World Bank 2018), there is a need for additional indicators to guide national STI expenditure in order to achieve the newly-formulated policy goals and strategies of STI for 'inclusive and sustainable development' (DST 2019). The new White Paper (2019) reflects a strong coupling of the policy goals of economic growth *and* inclusive development, building on the policy commitment since the White Paper (1996) to STI oriented to dual goals: to create 'inclusive' growth *and* a 'better' society.

However, do current STI measures give sufficient weight to these dual

goals? It is suggested here that only using GERD/GDP targets will not provide sufficient information on a country's progress towards inclusive development. The challenge is to create additional STI indicators which reflect the developmental challenges that a country is experiencing. How can one build on the international standard measures to assess and track the gross domestic R&D expenditure oriented to drive equitable and inclusive human development?

This policy brief proposes a design for such a complementary indicator and shows how it can be used to assess progress in the national system of innovation. The data is drawn from national R&D datasets collected in line with the Frascati guidelines (OECD 2015).

The Human Development Index as the foundation for a new indicator

The challenge is to develop an equivalent, simple, easy to compute and widely applicable indicator of R&D and inclusive human development that can become enshrined in the imaginations and practices of policy makers to guide national R&D investment decisions and planning targets and to compare countries' progress.

The first step was to interrogate a range of potential global frameworks that measure human development. Table 1 is a summary of the origins, conceptual underpinnings and main dimensions of five candidate frameworks. Four of the indices do not lend themselves to the design of a simple, new high-level indicator of R&D that can be calculated using existing R&D and national expenditure data. The SDGs, for example, are particularly complex and would require data for 232 indicators. Hence, it was decided to adopt the conceptual logic of the Human Development Index (HDI), which does meet the design criteria. In the next section, we explain the technical details of the new measure.

A measure of R&D intensity for human development

The HDI is calculated from measures of three dimensions: health, education and standard of living (as a proxy measure of well-being). Therefore, by extension, to calculate the human development-oriented R&D intensity (HDRDI), it is necessary to use the components of GERD and of total national wealth associated with these three dimensions.

The proposed model for the HDRDI measure requires two steps: (i) calculating each component using the logic of the GERD/GDP indicator and then (ii) combining these, using the logic of the HDI, to create a single indicator.[1] The new aggregate human development-oriented R&D intensity index may be interpreted as the amount of R&D expenditure expressed as a proportion of total expenditure in each of the areas of health, education and well-being.

Operationalising the new indicator

To operationalise the domestic R&D expenditure variables, the South African National Survey of Research and Development for the period 2003 to 2015 is used. The Frascati manual (OECD 2015: 333–339) contains a classification

1. The formula is expressed as $HDRDI = (IHealth.\ IEducation.\ IWell\text{-}being)$. Each component is calculated as:

$$I_{Health} = \frac{Health\_RD}{Health\_Total}$$

Table 1: Potential frameworks to measure human development

	Origins	Conceptual underpinnings	Main dimensions and indicators
Human Development Index	1990 United Nations Development Programme	Human capabilities approach (Anand & Sen 2000a, 2000b)	Three dimensions, each with a single measure: a long and healthy life, knowledge and a decent standard of living
Index of Economic Well-being	1998 Centre for the Study of Living Standards in Canada	More effective measures of economic well-being (Osberg & Sharpe 1998, 2002, 2012)	Effective per capita consumption flows (6 measures); net societal accumulation of stocks of productive resources (6 measures); income distribution and equality (2 measures); and economic security (4 measures)
Social Progress Index	2013	Social progress: the capacity to meet basic human needs, enhance and sustain quality of life; all individuals to reach their full potential (Sterne et al. 2018; Sterne et al. 2014)	Three dimensions: Basic human needs, Foundations of well-being and Opportunity. Each has four main components.
OECD's Better Life Index	OECD 2010	What makes for a good life? Reflects on both people's material living conditions and the quality of their lives (OECD 2017).	11 dimensions on a balanced scorecard shaped by each country's context
Global Indicator Framework for measuring the achievement of the 2030 Agenda for Sustainable Development	2017 Inter-Agency and Expert Group on SDG Indicators, United Nations	Countries must undertake major transformations of education, health, energy systems, land use, urban development and many other dimensions (Bertelsmann Stiftung and Sustainable Development Solutions Network 2018).	17 SDGs, 232 indicators Indicators are classified into three tiers according to their level of methodological development and the availability of data at the global level.

system to identify the socioeconomic objectives or main purpose of a R&D programme. The South African R&D Survey's classification system was adapted from the Australian and New Zealand Standard Research Classification, which was in turn adapted from the OECD classification. This contribution uses the socioeconomic objective classifications related to the total R&D expenditure on health (Health_RD), the total R&D expenditure on education (Education_RD) and the total R&D expenditure on well-being (Well-being_RD). It uses the socioeconomic objective of R&D on 'social development and community services' as a proxy for well-being, because it is the closest measure of well-being (standard of living) among the available socioeconomic objectives.

To operationalise the national expenditure variables, data from a range of global databases and national statistical sources (Table 2) are used.

Table 2: Operationalising variables and data sources

Variable	Definition	Data source
Health_RD	Total R&D expenditure on health	R&D Survey SEO expenditure on health for the period 2003–15
Education_RD	Total R&D expenditure on education	R&D Survey SEO expenditure on health for the period 2003–15
Well-being_RD	Total R&D expenditure on social development and community services	R&D Survey SEO expenditure on social development and community service for the period 2003–15
Health_Total	Total domestic expenditure on health Current health expenditure per capita (US$) × Population × ZAR–Dollar exchange rate	World Health Organization: Current health expenditure per capita (US$), StatsSA: Population, South African Reserve Bank: ZAR–Dollar exchange rate
Education_Total	Total domestic expenditure on education = Basic and higher education national expenditure totals	Basic and higher education national expenditure totals: South African National Treasury GDP: South African National Treasury
GNI	Total domestic gross national income (GNI) = GNI per capita × Population × ZAR–Dollar exchange rate	GNI per capita: World Bank StatsSA: Population ZAR–Dollar exchange rate: South African Reserve Bank GDP: South African National Treasury

Using the HDRDI indicator in the South African context

The value-add of such 'symbolic' indicators for policy making is that they can inform decisions about trying to change the scale and orientation of R&D investment.

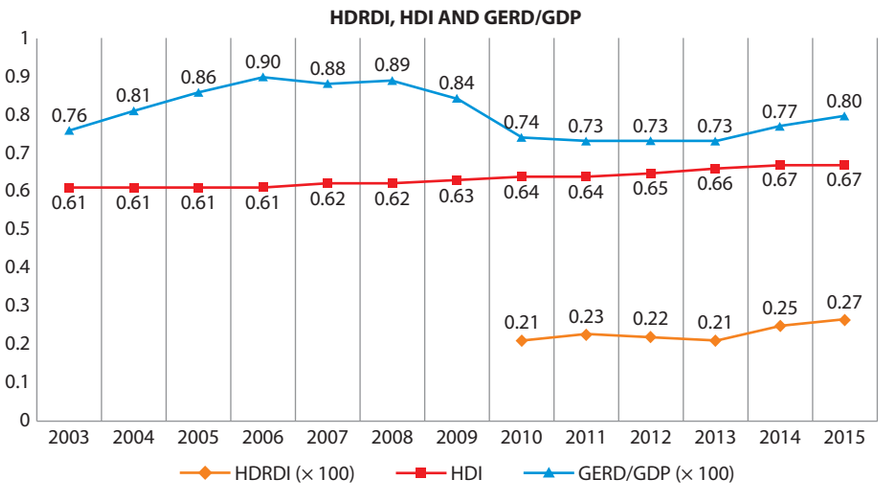
Figure 1 shows the trajectories of three STI indicators over time: GERD/GDP, the HDI and the new HDRDI indicator. How might these trajectories be interpreted in terms of their high-level policy implications for R&D investment?

The trend for GERD/GDP has been variable, with a steady increase from 2003 hovering around the high point of 0.9% for the period 2006 to 2008, then a decline hovering around the 0.73 mark for the period 2010 to 2013 before a slow rise again to 0.8 in 2015. This must be interpreted in the context of the decline in GDP in recent years, which may push R&D intensity upwards (IDEA Consult 2008).

South Africa's knowledge intensity in 2015/2016 is low relative to high-income countries such as Japan (3.28), Finland (2.90), Germany (2.88) and the USA (2.79). It is also low relative to the majority of its BRICS counterparts. China (2.07), Brazil (1.17) and Russia (1.13) have attained the 1% target; although India (0.63) has a lower indicator, the size of the population makes comparison with South Africa difficult. South Africa outperforms comparator countries on the African continent such as Senegal (0.54) and Uganda (0.5) – and Mauritius (0.18), although it is in a comparable range to Egypt (0.72).

The policy message is clear: in the past five years, South Africa's domestic expenditure on R&D may have been growing but the country needs to increase the scale of investment at a faster rate to contribute to economic growth.

Figure 1: Comparing the three indices in South Africa, 2003–15



In contrast, South Africa's HDI has been very steady over the entire period, increasing only minimally from 0.61 in 2003 to 0.67 in 2015 (and 0.699 in 2017). The UNDP (2018) notes a steady improvement in human development globally: 'average HDI levels have risen significantly since 1990 – 22 percent globally and 51 percent in least developed countries'.

South Africa has not followed this trend at all. Moreover, with inequality adjustment, in 2017 the IHDI stood at 0.467. Significantly, the inequality coefficient (30.3%) for South Africa was higher than the average for medium HDI countries (25.1%) and equal to the average for sub-Saharan Africa (30.8%).

Here, the policy message is essentially that in aggregate, while the life expectancy, education and standard of living of the population may not have worsened significantly since 2003, there has not been improvement in line with comparator countries and there is significant loss of opportunity for human development due to inequality.

How does the new indicator compare and what additional insights does it allow? Over a five-year period, the HDRDI remained essentially static, increasing very slowly, with a few downward dips from 0.21 in 2010 to 0.27 in 2015. Of course, it largely mimics the GERD/GDP trend for the same period.

The policy message is that knowledge intensification that can promote human development is growing extremely slowly and on too small a scale; therefore, a stronger focus on STI policy, and higher levels of investment, is required.

Using the new indicator to leverage resources towards STI for inclusive development

The policy aspiration to create a knowledge economy is intensified by the emergence of what the World Economic Forum terms the 'fourth industrial revolution' (Schwab 2016). This builds on the digital advances of the knowledge economy, but previously unimaginable technological integration between the physical, the digital and the biological is achieved. The exponential pace and scale of these technological disruptions are provoking a total questioning of global economic growth models, STI policies and understanding systems of innovation. In this context, the need to orient STI policies to human development *and* growth becomes ever more acute and urgent.

The danger of a symbolic indicator like GERD/GDP is that it can lead to simplistic forecasts that do not take into account sufficiently the complexity required for effective innovation policies (Carvalho 2009; Castro-Martinez et al. 2009). Nevertheless, countries actively use comparative performance with competitor countries to leverage and influence government resource allocations to STI in powerful ways. And it is this kind of usage of the new indicator that is proposed, as a way to draw attention and leverage resources to STI in ways that are informed by our inclusive development challenges. Routinely reporting and comparing HDRDI ratios can serve to shift the policy discourse in order to leverage a greater scale of investment in R&D oriented to human development purposes. It signals the government's commitment and provides an indicator of improvements in the scale of such an endeavour over time.

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