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# Sensitivity of GERD/GDP to time academics spend on R&D in South Africa, 2022/2023

This short communication estimates the impact of the time academics spend on research and development (R&D) on the research intensity of South Africa. Research intensity is indicated by the R&D expenditure as a percentage of the gross domestic product (GDP). A country's research intensity is indicative of technological progress and global competitiveness, which arises from improved productivity and efficiency across various industries. Furthermore, the indicator is used for the attraction of foreign investments. Research intensity is of particular importance in South Africa as it is used by the country's government as a target to propagate the country's socio-economic development. The Science, Technology and innovation Decadal Plan 2022–2032 (South African Department of Science and Innovation, 2022) identifies the research intensity of various sectors as targets, and political authorities have reported that the ratio of the gross expenditure on research and development (GERD) to GDP should be 1.5%. However, the current value of the indicator is 0.61%. The higher education sector is a main contributor to research intensity in the country and the time that academics spend on R&D is the major factor in the sector's intensity. In undertaking the R&D Survey in South Africa, the Human Sciences Research Council estimates a research coefficient for academics of 22%. However, other surveys estimate a much lower ratio. The current investigation has identified that if the research ratio of academics is 7%, the country's research intensity is 0.48%. This is substantially lower than the current estimate and requires the urgent attention of government authorities.

**Significance:**

- Research intensity is the most cherished indicator among the set of indicators in the context of science, technology and innovation in a country. In South Africa, the issue is of critical importance as the political authorities use the indicator for policy targets and the administrative system appears to overestimate the size of the indicator.
- The current intensity of 0.61 appears to political authorities to be adequate and so they reduce the budgets related to research and development. However, this article identifies that South Africa's intensity may be closer to 0.48. South Africa has not seen such indicators for more than 20 years.

## Research intensity and time academics spend on R&D

Research and development (R&D) expenditures as a percentage of the gross domestic product (GDP) serve as a critical indicator of a country's commitment to innovation, economic growth and societal progress. By investing in R&D, nations can foster a culture of creativity and discovery, driving technological advancements and enhancing competitiveness in the global market. This investment not only leads to the development of new products, services and industries but also addresses pressing challenges such as climate change, health care and sustainable development.[1]

The use of R&D expenditure as a percentage of GDP as an international metric has its roots in the mid-20th century. The Organisation for Economic Co-operation and Development (OECD) played a significant role in standardising this measure through the Frascati Manual, first published in 1963. The metric gained further prominence with the establishment of the United Nations Educational, Scientific and Cultural Organization (UNESCO) Institute for Statistics, which began collecting and publishing data on R&D expenditures globally.[2]

In South Africa, the recently published report *South African National Survey of Research and Experimental Development*[3] provides findings of the relevant survey with commentary, standard summary tables of the overall findings from 2022/2023, and time series from previous instances of the survey.

Table C148[3] of the Survey provides data for researchers' headcount and full-time equivalent (FTE) per university in the country. The ratio provides the average research coefficient (time academics spend on R&D for the particular university). Inaccurate estimation of the research coefficient leads to inaccurate estimation of the resources invested in R&D in the higher education sector and may have serious consequences for policy. For example, overestimating the expenditures for R&D

- will underestimate the productivity of the sector;
- may affect the national allocation of resources between higher education institutions and other R&D performers (e.g. government laboratories);
- may affect the allocation of resources between research and teaching; and
- will overestimate the gross expenditure on research and development (GERD), GERD/GDP and so on.

Underestimating the R&D expenditures will have the reverse consequences. Similarly, the consideration of the science and technology institutions as a system means that emphasis should be placed differently on the weakest part of the system. An overestimation of the R&D coefficients could easily mask the weakness of the higher education system, with adverse repercussions for the whole national system of innovation.

Table 1 shows the headcount, the FTE and the relevant ratio per university for 2022/2023.

The average ratio of all the universities is 0.22 for 2022/2023 – down from 0.239 for 2019/2020. While a 2% decline is of policy interest, what is probably more important is that the estimated coefficient of 22% does not coincide with an investigation by the then Department of Science and Technology (DST)[4] which shows that academics declare that they spend only 7% of their time on research (FIG10.2). It is mentioned that these values are supported by international empirical research.[5]

There are also interesting findings in the detailed analyses per university. The University of Pretoria appears to have the second smallest coefficient at 12.8%. This is approximately half the average of all the universities. On the other hand, North-West University has a coefficient of 85% (up from 29.9% during 2019/2020). The private universities declare an average coefficient of 30% (down from 43.7% during 2019/2020).

For comparative purposes, the University of Fort Hare has a coefficient of 30%, the University of Limpopo 38% and Stellenbosch University 29%.

If these data are correct, we have to redefine the research intensities of the universities, and investigate how North-West University was able to increase their research intensity so drastically in a short time. The University of Pretoria should investigate the negative forces in the institution resulting in the second smallest coefficient, and so on.

In investigating the methodology of the Human Sciences Research Council, it becomes apparent that, while the OECD[6] recommends

**Table 1:** Researcher headcount, full-time equivalent (FTE) and ratio of South African higher education institutions for 2022/2023

| Higher education institution | Researcher headcount | Researcher FTE | Ratio |
|---|---|---|---|
| **Private universities** | 110 | 35.5 | 0.3227 |
| **Universities** | 20 968 | 4898.8 | 0.2336 |
| **North-West University (NWU)** | 411 | 352.7 | 0.8582 |
| **University of the Western Cape (UWC)** | 683 | 291.8 | 0.4272 |
| **University of Cape Town (UCT)** | 1065 | 434.7 | 0.4082 |
| **University of Limpopo (UL)** | 807 | 307.7 | 0.3813 |
| **University of Fort Hare (UFH)** | 336 | 100.8 | 0.3000 |
| **Central University of Technology (CUT)** | 259 | 77.7 | 0.3000 |
| **Stellenbosch University (SU)** | 1652 | 481.4 | 0.2914 |
| **University of the Free State (UFS)** | 695 | 198.1 | 0.2850 |
| **University of KwaZulu-Natal (UKZN)** | 2452 | 536.5 | 0.2188 |
| **Tshwane University of Technology (TUT)** | 875 | 175.0 | 0.2000 |
| **University of Zululand (UZ)** | 334 | 66.8 | 0.2000 |
| **Sefako Makgatho Health Sciences University (SMU)** | 713 | 142.4 | 0.1997 |
| **Rhodes University (RU)** | 425 | 82.1 | 0.1932 |
| **University of South Africa (UNISA)** | 1975 | 379.8 | 0.1923 |
| **University of Johannesburg (UJ)** | 2055 | 368.4 | 0.1793 |
| **University of the Witwatersrand (WITS)** | 3926 | 697.0 | 0.1775 |
| **Cape Peninsula University of Technology (CPUT)** | 666 | 115.1 | 0.1728 |
| **Universities of (science) and technology** | 4570 | 752.1 | 0.1646 |
| **University of Mpumalanga (UM)** | 58 | 9.0 | 0.1552 |
| **Durban Institute of Technology (DUT)** | 749 | 114.8 | 0.1533 |
| **Walter Sisulu University of Technology and Science (WSU)** | 910 | 136.5 | 0.1500 |
| **Vaal University of Technology (VUT)** | 399 | 58.8 | 0.1474 |
| **Nelson Mandela Metropolitan University (NMU)** | 920 | 132.7 | 0.1442 |
| **Mangosuthu Technikon** | 243 | 31.7 | 0.1305 |
| **University of Pretoria (UP)** | 2461 | 317.0 | 0.1288 |
| **University of Venda for Science and Technology (UNIVEN)** | 469 | 42.5 | 0.0906 |
| **TOTAL** | **25 648** | **5686.4** | **0.2217** |

*Source: Original data from the Centre for Science, Technology and Innovation Indicators (CeSTII)[3]*

the estimation of the relevant coefficients from custom surveys, the Human Sciences Research Council in South Africa asks the universities to provide the relevant information. It is apparent that the university administrations do not have such information about their staff and the information provided by the universities is more guesswork than reliable information. The time academics spend on R&D is defined by the OECD and it requires relevant expertise. For example, issues of specialised health care; patent and licence work; policy-related studies; and routine software development are excluded.

While a cost-efficient approach would be for a large-scale survey with the objective of identifying the time academics spend on R&D in the country, an alternative is for each university to estimate the relevant coefficients for their own staff through relevant surveys.

The next issue to address here is the ratio of R&D expenditures/GDP in South Africa if the time academics spend on R&D is not 22% (the current assumption) but actually 7%.[4] It should be emphasised that higher education performs approximately 40% of the country's R&D and, hence, a change in the sector will have a substantial impact on the total R&D statistics of the country.[7]

The higher education sector R&D expenditure by accounting category (Table C131)[3] identifies that the labour cost, including specific categories of R&D personnel cost for 2022/2023, is 81.9%. As the time of academics is adjusted from 22% to 7%, this drop of 68% will affect the 81.9% of the expenditures. (Hence 68% x 81.9% = 55.76%.)

The higher education contribution to GERD is 36.4%. Hence, the drop of 55.76% will affect the 36.4% of GERD. (55.76 x 36.4% = 20.29%.)

Consequently, the ratio GERD/GDP of 0.61 will decrease by 20.29% and will be 0.48%. This is a substantially low R&D expenditure, and if it is not corrected soon it will destroy the country's infrastructure and any hope for competitiveness, economic growth and creation of employment.

## Data availability

All the data supporting the results of this study are included in the article itself.

## Declarations

I have no competing interests to declare. I have no AI or LLM use to declare.

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