CHAPTER 11

Financing Research in Higher Education for an Equitable Sharing of National Revenue

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11.1 Introduction

The role of research and innovation can be traced back to the 1950s, when it became clear that the traditional factors such as land, labour and capital growth are not the only indicators of economic growth and development. According to the endogenous growth models developed by Romer (1986), technological innovation is created in the research and development sectors, using human capital and the existing knowledge stock. This innovation is used to produce final goods, which lead to increased output.

For a long time African countries have neglected academic research in higher institutions of learning. This lacklustre approach towards research in many African universities has left large knowledge gaps that will take decades to fill. The gaps are reflected not only in the individual countries' research budget as a percentage of the total gross domestic product (GDP), but also in the number of research publications and citations that emanate from the African continent.

South Africa is one of the few countries in Africa that has invested heavily in academic research, especially in the 2000s. In fact, South Africa's gross expenditure on research and development (GERD) is currently considered to be the highest in Africa. In 2009 South Africa's GERD as a percentage of GDP was more than three times that of all other sub-Saharan countries (UNESCO, 2011). However, despite a significant increase in total expenditure on research and development, South Africa's GERD as a percentage of GDP is still relatively low when compared to some BRIC countries, such as Brazil, Russia and China.

In an attempt to synergise research in higher institutions of learning, in 2003 the Ministry of Education published the new funding formula (NFF) for higher education institutions, which was published in the Government Gazette (no. 1791). The NFF became effective in 2004 and contained two key initiatives for funding research at higher institutions of learning: (i) the introduction of a funding framework aimed at improving the measurement of research outputs, and (ii) the establishment of funding programmes focused on innovation and research excellence (Ministry of Education, 2004). The National Research Foundation (NRF)[88] administers the bulk of the funds disbursed through the latter initiative.

The main aim of this chapter is to evaluate the effectiveness of the current government funding framework for higher education research. The chapter assesses whether the NFF has produced the desired outcome of increasing research outputs in South Africa.

[88] The NRF is the largest research and development institution in South Africa.

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11.2 Problem Statement

Academic research in higher institutions plays a critical role in economic growth and development. As Becker and Kennedy (2005) argue, creating and imparting knowledge are complementary activities. In fact, without rigorous scientific research, a developing country like South Africa will not be able to implement the knowledge-based economy that it aspires to build. Both discipline-based and multi-intra-trans-disciplinary research plays important roles in economic development. Yet, despite the crucial role that research plays in knowledge production and economic development, research funding (across all disciplines, e.g. natural science research, agricultural science research, engineering and technology, or social science and humanities research) has not been given the attention it deserves, especially in developing countries. Many African countries have not made the necessary investment in research and innovation, which has resulted in these countries becoming largely consumers – rather than producers – of knowledge.

According to the NFF, an institution's research output grant for any funding year is dependent on: (i) actual totals of research graduates and research publication units for the year n-2; and (ii)total research outputs that an institution is expected to produce in terms of the national benchmarks (Ministry of Education,2004). However, since the NFF was introduced in 2004 little research has been conducted to evaluate its effectiveness and whether the actual research outputs from universities and technikons have increased significantly.[89]

11.3 Methodology

The research methods used in this study were both qualitative (historical trends, comparative analysis and descriptive analysis) and quantitative (statistical and econometric analysis). This chapter follows on from the work done by the Financial and Fiscal Commission (the Commission) on the budget review of public universities in South Africa. As part of stakeholder consultation and engagement, the Commission briefed the Ministerial Committee for the Review of the Funding of Universities on issues raised and recommendations made in its Annual Submission on the Division of Revenue for 2013/14, focusing on higher education. Appendix 1 provides the Commission's responses to issues that were raised by the Committee.

11.4 The Role of Research in Economic Development

The important role that basic research plays in economic growth and development can be traced as far back as the end of World War II. More recently, many developing countries (especially in emerging economies) have adopted the "knowledge-based economy" as an integral component of their policy framework. Although at times policy-makers have difficulty quantifying the socio-economic benefit of scientific research, recent studies have shown that scientific research brings enormous and undeniable benefits. Despite the difficulty in quantifying the impact of research on economic growth, studies have shown that economies with consistently high levels of innovation also tend to have high levels of economic growth (Atkinson and McKay, 2007).

[89] This applies both to the research outputs produced from accredited publications, such as journal articles, books, book chapters and conference proceedings, and to those from the Master's and doctoral degree graduates.

Martin et al. (1996) outline some benefits of publicly funded research for economic development:

1. Research increases the stock of useful knowledge within a society. Public funding of basic research increases the amount of information that is available to firms for technological activities.
2. Research increases the pool of highly skilled graduates. Studies have shown that, by producing skilled graduates, publicly funded research has the most benefits for the private sector.
3. Research enables scientists to create new techniques and analytical methods, which are usually adopted and used by private companies. Moreover, through publicly funded research, industrial practitioners are able to solve complex technological problems.

Studies have also found a positive correlation between innovation and the stock of knowledge derived from government-funded basic research (see also Wolfe and Salter, 1997).

Given the recent strides that South Africa has made in increasing the number of its research outputs nationally, regionally and internationally, it is important to examine quantitatively the relationship between academic research outputs and economic growth, using standard econometric techniques. This following section examines the dynamic causal relationship between South African research outputs and economic growth, using the recently introduced autoregressive distributive lag (ARDL) bounds testing approach.

11.5 Methodology and Empirical Analysis

11.5.1 Cointegration analysis: the ARDL bounds testing procedure

In this analysis, the recently introduced ARDL bounds testing approach is used to examine the long-run relationship between South African research outputs and economic growth. The ARDL bounds testing approach was originally introduced by Pesaran and Shin (1999) and later extended by Pesaran et al. (2001). The ARDL model used in this study can be expressed as follows (Odhiambo, 2009a:619):

$$\Delta InGrowth_t = \phi_0 + \sum_{i=1}^{n} \phi_{1i} \Delta InGrowth_{t-i} + \sum_{i=0}^{n} \phi_{2i} \Delta In\,\mathrm{Re}search_{t-i} + \phi_3 InGrowth_{t-1} + \phi_4 In\,\mathrm{Re}search_{t-1} + \mu_1 \quad [1]$$

$$\Delta In\,\mathrm{Re}search_t = \delta_0 + \sum_{i=1}^{n} \delta_{1i} \Delta In\,\mathrm{Re}search_{t-i} + \sum_{i=0}^{n} \delta_{2i} \Delta InGrowth_{t-i} + \delta_3 In\,\mathrm{Re}search_{t-1} + \delta_4 InGrowth_{t-1} + \mu_2 \quad [2]$$

where *InGrowth*= log of real GDP; *In*Re*search*= log of research publications; *μi*= white noise error term; Δ = first difference operator.

The bounds test for the long-run relationship between economic growth and research output can be conducted in this case by using the joint F-statistic (or Wald statistic) for cointegration analysis. The analysis involves testing the null hypothesis of no cointegration among the variables in equations [1] and [2] against the alternative hypothesis. To confirm whether any long-run relationship exists between economic growth and research outputs, two sets of critical values reported by Pesaran and Pesaran (1997) and Pesaran et al. (2001) for a given significance level can

be used. One set of critical values assumes that all the variables included in the ARDL model are I(0), while the other set assumes that the variables are I(1). If the computed test statistic exceeds the upper critical bounds value, then there is evidence of a long-run relationship between the variables tested. If the F-statistic falls below the lower bounds value, then the null hypothesis of no cointegration cannot be rejected. However, if the computed test statistic falls between the bounds, then the cointegration test becomes inconclusive (see also Odhiambo, 2009a).

11.5.2 The Granger non-causality test

According to Granger's definition of causality, a time series, Xt, causes another time series, Yt; if Yt can be predicted better using past values of Xt than by not doing so (see also Odhiambo, 2009a). The Granger causality method was chosen over other alternative techniques for this analysis because of its favourable response to both large and small samples (Odhiambo, 2009b; 2009c). The direction of the Granger causality between economic growth and research output can be tested by using the following model (see also Narayan and Smyth, 2008; Odhiambo, 2009a):

$$\Delta InGrowth_t = \phi_0 + \sum_{i=1}^{n} \phi_{1i} \Delta InGrowth_{t-i} + \sum_{i=0}^{n} \phi_{2i} \Delta In\,\mathrm{Re}\,search_{t-i} + ECM_{t-1} + \mu_t \quad [3]$$

$$\Delta In\,\mathrm{Re}\,search_t = \delta_0 + \sum_{i=1}^{n} \delta_{1i} \Delta In\,\mathrm{Re}\,search_{t-i} + \sum_{i=0}^{n} \delta_{2i} \Delta InGrowth_{t-i} + ECM_{t-1} + \mu_t \quad [4]$$

where ECM_{t-1} = the lagged error-correction term obtained from the long-run equilibrium relationship.

In this case, the direction of the causality is determined by the F-statistic and the lagged error-correction term. The F-statistic on the explanatory variables represents the short-run causal effect; while the t-statistic on the coefficient of the lagged error-correction term represents the long-run causal relationship (Narayan and Smyth, 2005; Odhiambo, 2009a).

11.5.3 Empirical results

Although the bounds test for cointegration does not require that all variables are integrated of order 1 [I(1)], it is important to conduct the stationarity tests to ensure that the variables are not integrated of order 2 [i.e. I(2)], or higher. When the variables are integrated of order 2 or higher, the F-test may yield spurious results – because the original F-critical values computed by Pesaran et al. (2001) were based on the assumption that the variables are I(0) or I(1) but not higher (see also Odhiambo, 2009a). The results of the stationarity tests in levels (not reported here) show that all variables are non-stationary in levels. Therefore, the variables were differenced once, as expected, in order to perform stationarity tests on differenced variables. The results of the stationarity tests on differenced variables are presented in Table 88.

Table 88: Stationarity Tests of Variables on First Difference

Variable	NO TREND	TREND
Stationarity tests of variables on first difference – Phillips-Perron (PP) test		
DLy/N	-3.469584**	-5.036170***
DLResearch	-5.78254***	-6.015734***
Stationarity tests of variables on first difference – Dickey-Fuller – GLS test		
DLy/N	-3.167016***	-4.257779***
DLResearch	-5.854577***	-6.140617***

Notes:
1)The truncation lag for the PP tests is based on Newey and West (1987) bandwidth.
*2) ** and *** denote 5% and 1% levels of significance, respectively..*
3) Critical values for Dickey-Fuller GLS test are based on Elliot-Rothenberg-Stock (1996, Table 1).

Since all the variables have now been confirmed to be integrated of order 1, and not order 2 or higher, we can now proceed with the bounds test, in order to examine the existence of a long-run cointegration relationship between economic growth and research outputs in South Africa. The results of the long-run cointegration are reported in Table 89.

Table 89: Bounds F-test for Cointegration

Dependent variable		Function		F-test statistic		
y/N		y/N(Research)		5.025**		
Research		Research (y/N)		0.102		
Asymptotic critical values						
	1 %		5%		10%	
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
Pesaran et al. (2001), p. 300, Table CI(ii) Case II	4.94	5.58	3.62	4.16	3.02	3.51

*Note: ** denotes statistical significance at the1% level*

The results reported in Table 89 show a stable long-run relationship between research publications and economic growth in South Africa. This is confirmed by the calculated F-statistic in the economic growth equation, which is found to be higher than the upper-bound critical value at the 5 per cent level of significance.

The next step is to examine the direction of causality between research publications and economic growth, by incorporating the error-correction term lagged one into the economic growth equation in a dynamic setting. The results of the causality test are reported in Table 90.

Table 90: Granger Non-causality Test

Dependent variable	Causal flow	F-statistic	t-test on ECM	R^2
Economic growth (y/N)	Research→ y/N	3.867[0.0299]**	-3.206***	0.77
Publications	Economic growth (y/N) → Publications	5.920[0.008]***	-	0.75

*Note: ** and *** denote statistical significance at the 5% and 1% levels, respectively.*

Table 90 shows that, in the short run, there is a bidirectional causal relationship between research publications and economic growth in South Africa, but in the long run research publications drive economic growth. However, this finding should be interpreted with caution because it is based on a bivariate model, which does not address the omission of variable bias. Recent studies have shown that introducing a third variable affects economic growth and research publications. In this case, a third variable may not only alter the direction of causality between research publications and economic growth, but also change the magnitude of the estimates (see also Odhiambo, 2008).

11.6 Performance of Higher Education Research in South Africa

In a bid to make research a key and valuable lever for the country's development, the White Paper on Higher Education and Training (DoE, 1997) and the National Plan for Higher Education (DHET, 2001) identified the following strategic policy priorities:

- Increasing the outputs of postgraduates, particularly Master's and doctoral graduates.
- Increasing research outputs.
- Sustaining existing research capacity and strengths and creating new centres of excellence and niche areas in institutions with demonstrable research capacity or potential.

The following subsections evaluate the effectiveness of the NFF, particularly its effect on stimulating research performance in these priority areas.

11.6.1 Graduate outputs

Since the NFF was introduced, the number of enrolments and graduates in Master's degrees at public universities has increased overall (see Table 91). During the period 2003–2011 the total number of enrolments in all public universities increased from 43 435 to 48 873, an increase of about 12.5 per cent. The number of graduates also increased, by 21.2 per cent, from 7 501 in 2003 to 9 690 in 2011.

Table 91: Enrolments and Graduates with Research Master's Degrees (2000–2011)

Year	Total enrolments	% increase in total enrolments	Total graduates produced	% increase in total graduates produced
2000	31 701	-	6 096	-
2001	34 868	9.99	6 478	6.27
2002	39 189	12.39	6 919	6.81
2003	43 435	10.83	7 501	8.41
2004	45 327	4.36	7 890	5.19
2005	44 315	-2.23	8 018	1.62
2006	42 899	-3.20	7 883	-1.68
2007	41 164	-4.04	7 513	-4.69
2008	41 711	1.33	7 514	0.01
2009	43 723	4.82	8 112	7.96
2010	46 699	6.81	8 633	6.42
2011	48 873	4.66	9 690	12.24

Source: Own computations from DHET (2012)

Following the introduction of the NFF, the total number of doctoral enrolments in all public universities increased significantly, by 54 per cent, from 8315 in 2003 to 12 832 in 2011. The number of doctoral graduates increased by 50.8 per cent, from 1045 in 2003 to 1576 in 2011.Table 92 shows the doctoral enrolments and graduates in South African public universities during the period 2000–2011.

Table 92: Doctoral Enrolments and Graduates (2000–2011)

Year	Total enrolments	% annual increase in total enrolments	Total graduates produced	% annual increase in total graduates produced
2000	6 423	-	961	-
2001	6 996	8.92	897	-6.66
2002	7 716	10.29	969	8.03
2003	8 315	7.76	1 045	7.84
2004	9 104	9.49	1 104	5.65
2005	9 434	3.62	1 189	7.70
2006	9 828	4.18	1 100	-7.49
2007	10 048	2.24	1 274	15.82
2008	9 994	-0.54	1 182	-7.22
2009	10 529	5.35	1 380	16.75
2010	11 590	10.08	1 421	2.97
2011	12 832	10.72	1 576	10.91

Source: Own computations from DHET (2012).

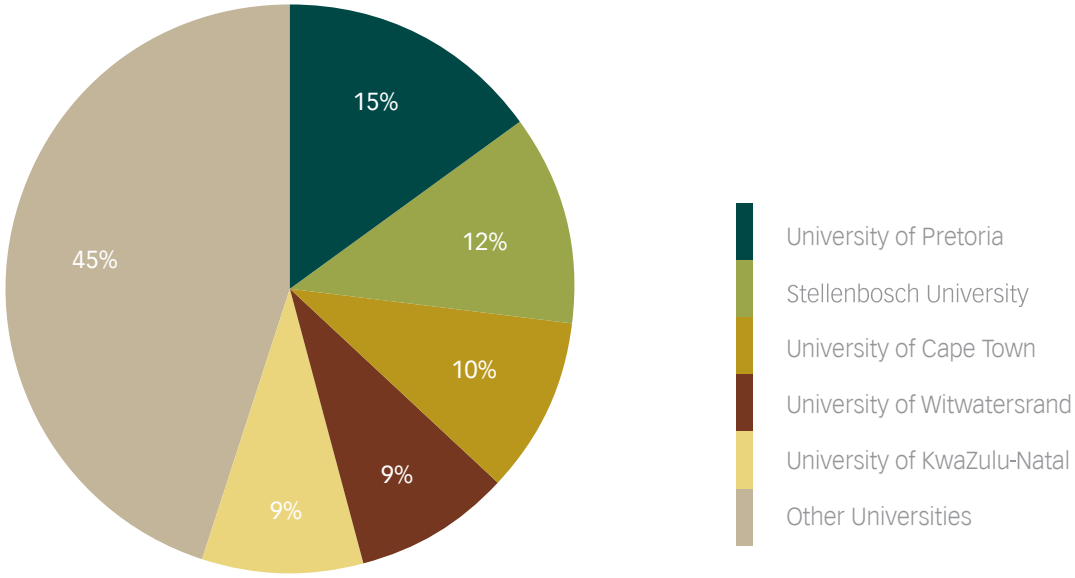
Despite an overall increase in the enrolment and graduation of both Master's and doctoral students during the period 2000–2011, the growth was not constant. For example, a significant decrease in the number of Master's enrolments during 2005–2007 led to a decrease in the number of graduates in 2006 and 2007. For doctorates, the number of enrolments decreased slightly in 2008, and graduate numbers decreased significantly in 2001, 2006 and 2008.

Several factors could have contributed to these fluctuations: (i) the re-alignment of postgraduate curriculums during this period, which could have forced some universities to phase out some postgraduate programmes; (ii) the restructuring and right-sizing during the post-merger period, which could have slowed down (to some extent) the recruitment of students and academic staff; and (iii) the way some universities implemented the NFF post-2003. For example, some universities introduced research incentives for accredited publications but failed to offer research incentives for successful supervision, which became a disincentive for effective supervision of postgraduate students.

As expected, the top five universities – Pretoria, Stellenbosch, Cape Town, the Witwatersrand and KwaZulu-Natal – dominate the overall Master's and doctoral research outputs. Figures 43 and 44 show a breakdown of the contributions of these top five, compared with the other universities.
Of the total 73 924 Master's graduates produced by South African public universities, 55 per cent (40 997) came from the top five universities. In other words, the remaining 18 universities produced only about 45 per cent (32 927) of the total number of Master's graduates.

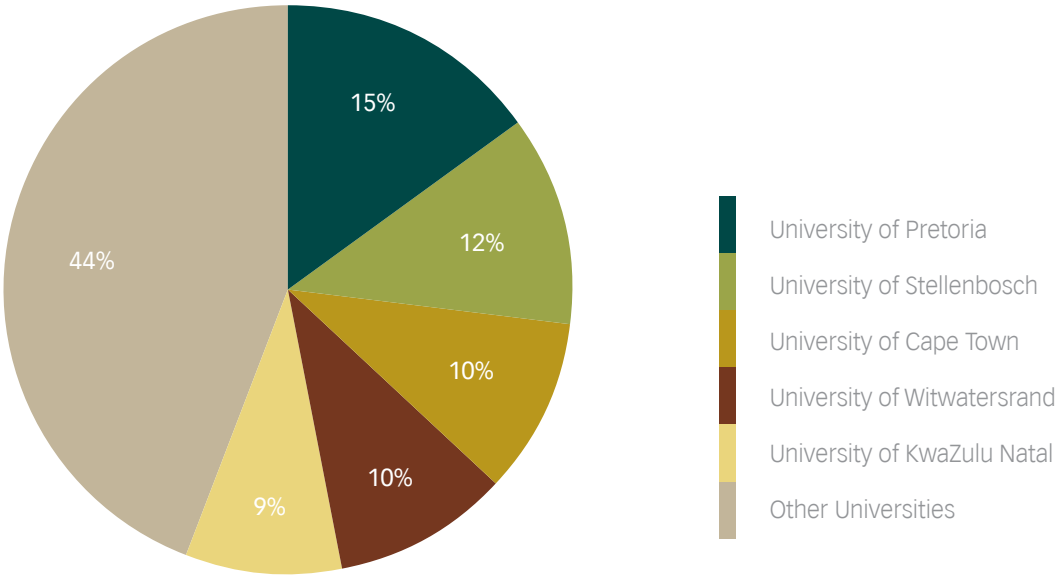
The top five universities also produced the most doctoral graduates. During the period 2000–2009, the bulk (55.47 per cent) of the 11 101 doctoral graduates came from the top five universities, with the remaining 44.53 per cent coming from the remaining 18 universities.

Figure 43: Distribution of Master's Graduates from South African Universities (2000–2009)



Source: Own computations from DHET (2012)

Figure 44: Distribution of Doctoral Graduates from South Africa Universities (2000–2009)



Source: Own computations from DHET (2012)

11.6.2 Total per capita research output

In terms of per capita output, which is the most reliable indicator for measuring research outputs, the average research outputs of all public universities increased from 0.82 units per capita in 2003 to 1.25 units per capita in 2011.[90] The research output was consistently higher after the implementation of the NFF, at an average of 1.02 units per capita for the period 2004–2011. This includes outputs from Master's and doctoral graduates, as well as accredited publications. Figure 45 shows the average per capita research output by all public universities for the period 2000–2011.

11.6.3 International visibility and quality of South African research outputs

Apart from the significant increase in the quantity of research outputs produced, evidence suggests that the quality of South African publications has also improved since the introduction of the NFF. Examples of such evidence are the number of citable documents published in internationally accredited journals and the number of newly NRF-rated researchers and the quality of their ratings. The indicators shown in Table 93 may not be perfect for measuring the quality of these research outputs but they do give some indication of their rigour.

[90] Per capita output, in this case, is measured by the total number of all research outputs produced by a university divided by the total number of permanent academic staff from the same university.

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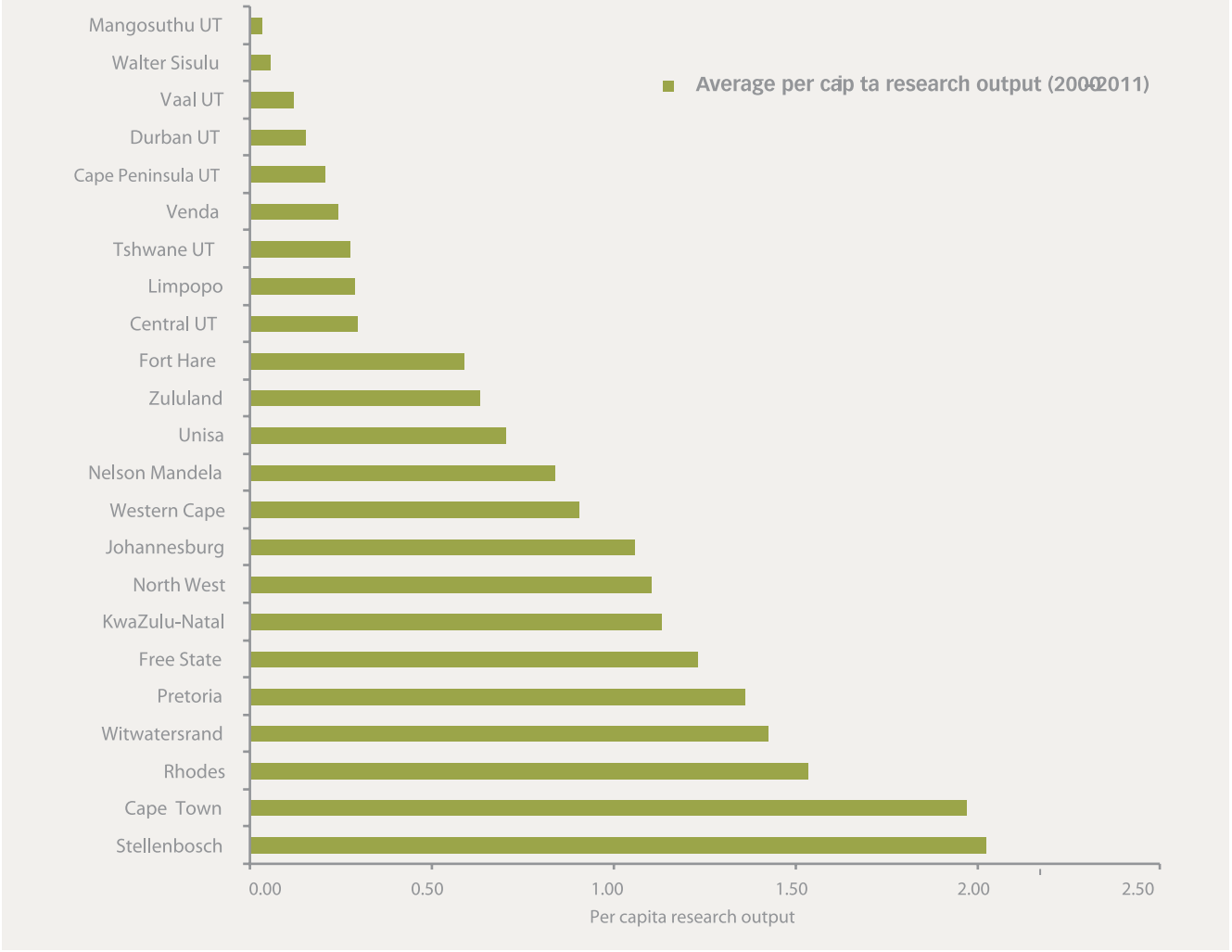
Figure 45: Average per Capita Research Output by all Public Universities (2000–2011) (M&D research outputs + accredited publications)



Source: Own computations from DHET (2012).

Note: Per capita research output is computed as: Per capita output = Total research outputs (i.e. M&D graduation units + All accredited publication units)/Total number of permanent academics.

Table 93: Comparison of Indicators 2003/04 and 2011/12

Indicator	2003/2004	2011/2012
Number of citable documents published in Scopus-related journals	5 123	11 505
International ranking	37	35
Number of NRF-rated researchers	1 385	2 471
Number of 'A' rated researchers	50	89

Source: SCImago (2012); NRF (2012b)

11.7 Higher Education Research Expenditure Analysis

11.7.1 Expenditure by the Department of Higher Education and Training

Under the NFF, two parameters are used to determine an institution's research grant (Minister of Education, 2004):

1. Actual totals of research graduates and research publication units produced by a university during the year n-2; and
2. Total of the research outputs that a university should produce in terms of the national benchmarks.

On the basis of these two parameters, the DHET's annual research grants to higher education institutions are divided into the research output grant and the research development grant. The research output grant (which forms the largest component of the total grant) is distributed to all universities in year n, according to their actual research outputs in year n-2. In contrast, the development grant is only distributed to universities that have under-performed, i.e. have not met their research output targets. The main motivation for introducing this development grant was to cushion under-performing universities (especially the historically disadvantaged universities) against huge subsidy losses occasioned by the introduction of the NFF. During the funding migration period (2004–2006), the development grant allocated to universities was supposed to be added automatically to their block grants. However, after the migration period, every university that was under-performing in terms of research outputs was expected to submit an application to the DHET to use its research development grant.

Between 2004 and 2012, the DHET spent R14.83 billion on higher education research, of which R13.3 billion (89.7 per cent) was spent on actual research output grants, with the remaining R1.53 billion (10.3 per cent) being spent on research development grants. The total research grant increased from about R1.1 billion in 2004/5 to about R2.4 billion in 2012/13, an overall increase of 118 per cent. Table 94 shows the increases in total research grants for this period.

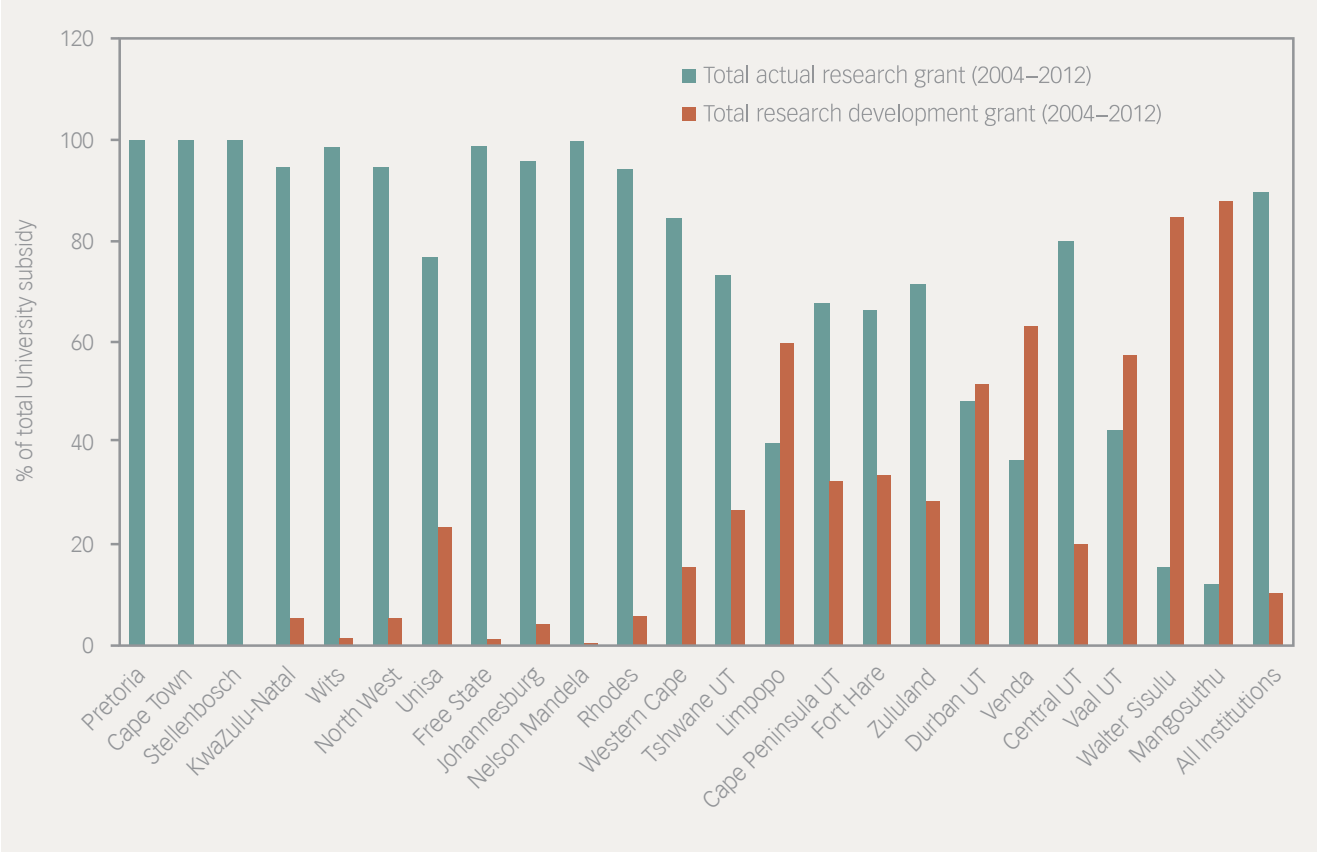
Table 94: Increase in Total Research Grants (2004–2012)

	Research output funds (R'000)	Research development grant (R'000)	Total grant (R'000)	% increase
2004/2005	849 966	244 950	1 094 916	-
2005/2006	945 073	222 697	1 167 770	6.65
2006/2007	1 088 087	192 215	1 280 302	9.64
2007/2008	1 236 836	148 364	1 385 200	8.19
2008/2009	1 347 782	174 105	1 521 887	9.87
2009/2010	1 540 604	197 358	1 737 962	14.20
2010/2011	1 836 716	166 281	2 002 997	15.25
2011/2012	2 224 568	6 808	2 231 376	11.40
2012/2013	2 226 579	176 822	2 403 401	7.71
Total	**13 296 210**	**1 529 601**	**14 825 811**	

Source: Own computations from DHET (2012)

The top five universities received the lion's share of the research output grants, which is not surprising because this grant is directly linked to the actual research outputs produced by individual universities. Figure 46 shows the percentage of actual research output and research development grants allocated to public universities for 2004–2012 (Also see Appendix 2, Table A1 and A2 for total allocations).

Figure 46: Actual and Research Development Grants Allocated to Public Universities (2004–2012)

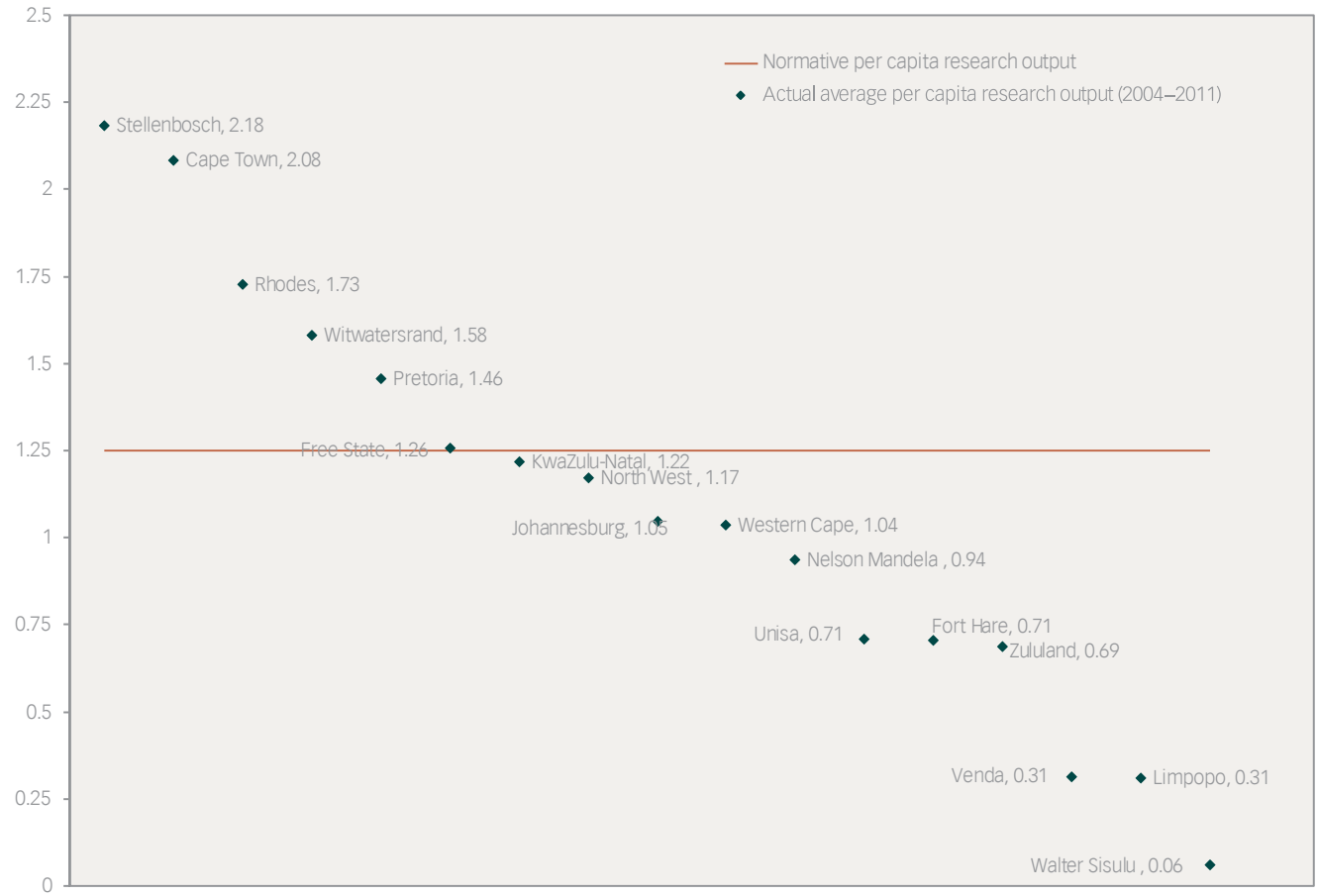


Source: Own computations from DHET (2012).

An assessment of the DHET's normative research output targets across public universities during the period 2004-2011

Although the DHET's NFF has led to a significant increase in the number of research outputs produced by many public universities, the majority of the institutions are still lagging behind in terms of meeting their per capita research output targets. As a result, some universities have ended up receiving a higher development research grant than the actual (earned) output grant – which is a clear indication of their underperformance in terms of per capita research outputs. Overall, only six of the 17 public universities managed to produce an average of at least 1.25 research outputs per capita during the period 2004-2011. These include Stellenbosch University, the University of Cape Town, Rhodes University, the University of Witwatersrand, the University of Pretoria and the University of the Free State. The situation was even worse in the universities of technology, where none of the universities' average per capita research outputs during the period 2004-2011 reached the normative target of 0.50 research outputs.

Figure 47: Actual Average per Capita Research Outputs for Universities (2004–2011)



Source: Own computations from DHET (2010).

Note: Per capita research output is computed as: Per capita output = Total research outputs (i.e. M&D graduation units + All accredited publication units)/Total number of permanent academics.

The best performing universities of technology, based on per capita research output, were the Tshwane University of Technology and the Central University of Technology, whose per capita research outputs were 0.34 and 0.31, respectively. Figures 47 and 48 illustrate the deviations of the average per capita research output from the expected normative per capital output during the period 2004–2011 – for both universities and universities of technology, respectively.[91]

Limitations of the NFF

Although the current research-funding framework is (in all fairness) more transparent and accommodating than most of the previous funding formulas, it is not without its shortcomings – like many other funding frameworks. The first and the most striking limitation relates to the fact that the formula does not incorporate the academic rank and/or academic qualification into the equation.

[91] For the sake of this analysis, all comprehensive universities are also classified as universities – because it was difficult to establish with any certainty the number of academic staff members who are only involved in technikon-type academic programmes in these institutions. According to the DHET's new funding framework, the normative targets for comprehensive universities should be based on a combination of both 1.25 research output per capita for staff members who are involved in university-type academic programmes, and 0.5 research output per capita for staff members who are involved in the technikon-type programmes. However, even if this had been done, it is unlikely that these comprehensive universities would have met their individual normative targets – given the fact that there are relatively few technikon-type academic programmes in these institutions.

Figure 48: Actual Average per Capita Research Outputs for Universities of Technology (2004–2011)

Source: Own computations from DHET (2010).

Note: Per capita research output is computed as: Per capita output = Total research outputs (i.e. M&D graduation units + All accredited publication units)/Total number of permanent academics.

Yet, research output in the academic fraternity is known to be a function of academic rank and qualification. For example, a junior staff member with an Honours degree may not be able to produce the same research outputs as a full professor with a doctorate. While many universities have linked research output targets expected from academics to academic rank, which inter alia depends on the academic qualification, the normative (expected) research outputs expected by the DHET is still a flat 1.25 units per academic staff for universities, 0.5 units per academic staff for the universities of technology, and a combination of both 1.25 and 0.5 for comprehensive universities[92], irrespective of the academic rank of the staff members employed by these institutions.

The second shortcoming is that the normative output only takes into consideration the number of permanently employed academic staff and does not include contract academic staff. Yet some institutions, especially the historically disadvantaged ones, rely partly on contract staff. These performance-based teaching contracts may be as long as five years and renewable multiple times. As

[92] Comprehensive universities are those universities that offer both university-type and technikon-type academic programmes. Currently, there are six comprehensive universities in South Africa. These include Nelson Mandela Metropolitan University, the University of South Africa (UNISA), the University of Johannesburg, the University of Venda, the University of Zululand and Walter Sisulu University.

a result, the formula reduces these institutions' total normative research output, which negatively affects their research development grant.

The third shortcoming is that that the development research grant is a residual grant that depends on the number of actual publications produced by all universities, as well as the DHET budget allocation to the higher education sector. This makes the output-based research grant uncertain, unreliable and unpredictable. Moreover, since the research development grant is usually allocated after the actual research output grant has been distributed, the DHET may run short of these funds when many universities, especially the historically advantaged ones, exceed their normative targets.

11.7.2 Expenditure by the Department of Science and Technology

Apart from the funding received from the DHET, higher education institutions also receive funding for research from the Department of Science and Technology (DST). The DST also funds research at national research councils and other public entities, with the aim of enabling these institutions to train scientists, engineers and technologists, and to produce publications and patents. About 60 per cent of the DST's budget goes to public entities, and the greatest portion of the DST expenditure on research and development is geared to the natural, medical and health sciences. Unlike the DHET, which provides funding directly to universities on the basis of their actual and normative outputs, the DST channels the bulk of its research funding to higher education institutions through the National Research Foundation.

The National Research Foundation

In 1998 the NRF was established through the National Research Foundation Act (Act No. 23 of 1998), following a review conducted for the former Department of Arts, Culture, Science and Technology. The main goals of the NRF are to: (i) promote internationally competitive research as a basis for a knowledge economy, (ii) grow a representative science and technology workforce in South Africa, (iii) provide cutting-edge research, technology and innovation platforms, (iv) operate a world-class evaluation and grant-making system and (v) contribute to a vibrant national innovation system. The bulk of the NRF funding is directed towards supporting academic research, developing high-level human resources and supporting the nation's national research facilities.

The NRF's current mandate is to: (i) build research-capable human capacity within the country, (ii) support the advancement of key fields of study and (iii) address priority areas of socioeconomic development. However, unlike the DHET's research funding, the bulk of the NRF research funding is provided on a competitive basis and uses a peer-review system to arrive at decisions. Table 95 shows NRF investment in strategic pipeline programmes for the period 2008/09 - 2011/12.

11.7.3 Expenditure by the Department of Health

The Department of Health (DoH) is another key government department that funds research in higher education institutions. However, unlike the DST and the DHET, the DoH provides research funds to benefit mainly medical institutions, with the bulk of these funds disbursed though the Medical Research Council (MRC).

Table 95: NRF Funding to Strategic Pipeline Programmes (2008/09–2011/12)

	R'million			
	2008/9	**2009/10**	**2010/11**	**2011/12**
Studentship support	183.2	183.53	307.34	223
Thuthuka PhD track	5.65	4.90	4.18	5
Postdoctoral	23.09	27.41	48.30	40
Thuthuka Post-PhD track	2.38	1.96	2.41	6
Thuthuka rating track	5.67	5.98	5.75	6
Competitive funding (unrated researchers)	-	3.02	5.21	5
Incentive funding for rated researchers	10.50	44.41	70.98	84
Competitive funding for rated researchers	-	-	5.10	15
Blue-sky research	-	2.92	3.54	8
SARChI programme	100.01	108.43	141.43	156
Centres of Excellence (CoE)	51.15	63.84	68.77	72
Total	**381.65**	**446.4**	**663.01**	**620**

Source: NRF (2012b).

The Medical Research Council

Legislated in 1991, the main objective of the MRC is to promote the improvement of the health and the quality of life of the population of South Africa through research, development and technology transfer (MRC, 2012).The MRC's four strategic goals are to: (i) promote health and the quality of life through research, (ii) promote health and the quality of life through innovation, technology development and transfer, (iii) collaborate with sub-national, national, supra-national and global partners to improve health outcomes for South Africans and citizens of collaborating partners and (iv) improve organisational performance as a health research organisation (MRC, 2012).

Apart from supporting collaborative research by universities with the capacity and infrastructure to conduct medical research, the MRC also provides research grants to individual researchers on a competitive basis. This is currently facilitated through a research programme known as self-initiated research (SIR) grants. These grants are mainly allocated to health-related research and made available to researchers at higher education institutions and, to some extent, other research institutions, such as the National Health Laboratory Services, the National Institute for Communicable Diseases and the National Institute for Occupational Health (MRC, 2011, 2012). In 2011/12, grants worth R18.80 million supported a total of 158 researchers, up from 139 researchers in 2010/11.

Table 96 (page 286) shows the SIR grants made between 2007/08 and 2011/12.

Table 96: SIR Grants from the MRC (2007/08–2011/12)

Year	Annual SIRs grants	Percentage increase
	R'million	
Aug-07	12.55	-
Sep-08	14.7	17.1
Oct-09	15.9	8.2
Nov-10	16.9	6.3
Dec-11	18.8	11.2
Total	78.85	

Source: Own computations from MRC (2012)

11.7.4 Expenditure by the private sector and non-governmental organisations

In addition to the research funding provided by the DHET, the DST (through the NRF) and the DoH (through the MRC), other sources of research funding include business enterprises, non-profit organisations and international organisations.

Figure 49 shows the major sources of funding of South Africa's GERD (gross expenditure on research and development) during the period 2001–2008. The business sector provided 42.65 per cent of the total GERD in 2008, compared to 42.25 per cent for government and higher education. The remaining 12.1 per cent came mainly from abroad (11.38 per cent), while private non-profit organisations contributed less than one per cent (0.72 per cent).

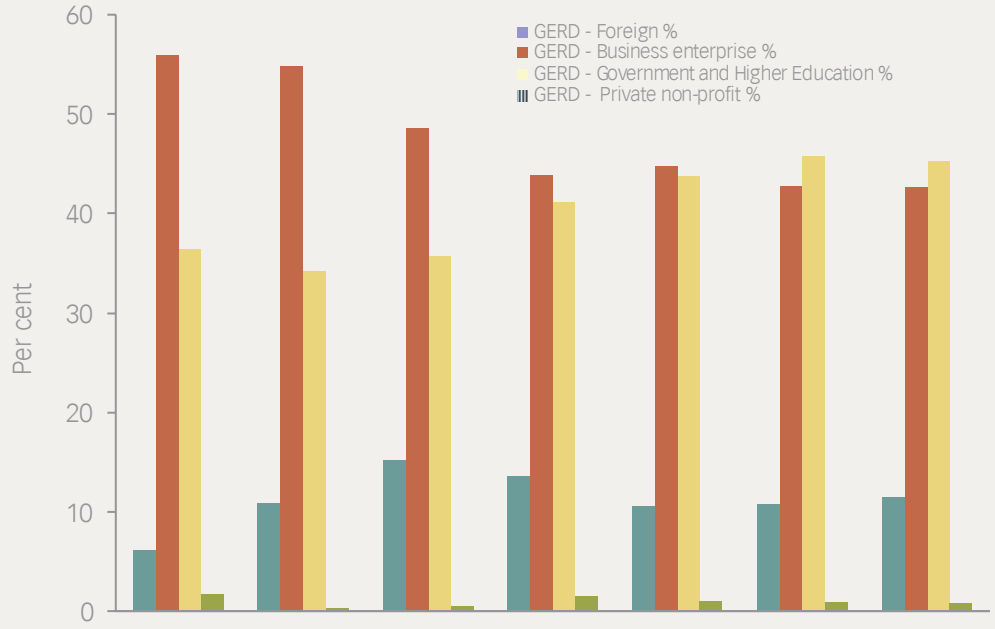
Although the business sector is one of the top funders of research and development in South Africa, many universities have not been able to tap its funds, largely because businesses provide funding mostly for applied research, unlike the government, which funds pure research. Because business funding for research is driven mainly by the profit motive, very few businesses are willing to fund research whose aim is knowledge production and whose benefits in terms of profits cannot be ascertained. They prefer to focus on research that may provide new techniques and products. Yet many aspects of applied research depend largely on the cumulative outcomes of pure research.

11.8 Conclusion

Since the implementation of the NFF in 2004, the number of Master's and doctoral enrolments and graduates has increased overall, and the number of publications from South African public universities has increased significantly. Also of note are the increase in citable articles published by South African researchers in international and local journals, the improvement in the country's international research ranking and the increase in the number of NRF-rated researchers.

Although many South African higher education institutions have increased their research outputs significantly, the majority of these institutions have not been able to meet their per capita targets.

Figure 49: South Africa's GERD (%) by Major Sources of Funds



	2001	2003	2004	2005	2006	2007	2008
GERD - Foreign %	6.09937	10.86764	15.25857	13.55266	10.57388	10.66944	11.38169
GERD - Business enterprise %	55.82324	54.76172	48.61601	43.86693	44.79083	42.66497	42.64755
GERD - Government and Higher Education %	36.38241	34.14609	35.60633	41.15186	43.66145	45.77635	45.24746
GERD - Private non-profit %	1.68133	0.22426	0.49783	1.42855	0.97477	0.88925	0.7233

Source: Compiled from UNESCO (2012).

NB: Data for 2002 was not readily available.

In fact, between 2004 and 2012 only six of the 17 universities met or surpassed the target of 1.25 research outputs per capita, while none of the universities of technology met their target of 0.5 units per capita. This suggests that the targets set by the DHET in 2004 were too high for some institutions, especially historically disadvantaged universities.

Although universities that fail to meet their targets receive research development grants based on the shortfalls, the study found that the research development grant in its present form is a very unreliable and unpredictable subsidy. This is because the research subsidy is a residual grant that depends on the number of actual publications produced by all universities and the DHET budget allocation to the higher education sector. Moreover, since the research development grant is usually allocated after all the actual research output grants have been distributed, the DHET may run short of these funds when many universities, especially the historically advantaged institutions, exceed their normative targets.

11.9 Recommendations

With respect to **financing research in higher education,** the Commission recommends a review of the current funding framework for higher education and that the DHET:

- Redesigns and allocates specific funds in the MTEF budget to the research development plan.
- Reassesses the appropriateness of targets and, if necessary, adopts different targets for each university/university of technology.
- Revises the formula used to calculate research outputs to take into consideration the profile (rank and qualification) of academic staff at the universities.

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Appendix 1: FFC response to concerns and issues raised by the Ministerial committee for the Review of the Funding of Universities

As part of its stakeholder engagement, the FFC briefed the Ministerial Committee for the Review of the Funding of Universities on issues that may be of relevance to its work. The Commission gave a presentation on issues raised and recommendations made in its Annual Submission on the Division of Revenue for 2013/14, focusing on Chapter 3, which examines and assesses the current state of budgeting for the South African higher education system, framed within the broad themes of equity and development.

Main points raised in Chapter 3 of the Annual Submission

The chapter analyses the funding framework, which has been used in South Africa's public university system since 2004. Because the principle that government funding must be linked to performance is an essential feature of the current framework, the chapter assesses the performance of the public university system as regards the goals of the 1997 Education White Paper 3 (DoE, 1997) and the 2001 National Plan (DHET, 2001) which deal with:

- Improving access opportunities;
- Increasing the participation of disadvantaged students and women;
- Ensuring that enrolments increase in academic programmes linked to economic development, and in postgraduate programmes at Master's and doctoral level;
- Improving the quality of teaching and research by enhancing the qualifications of academic staff;
- Increasing the numbers of graduates produced by the university system; and
- Increasing the outputs of high-level knowledge products in the form of doctoral graduates and research publications.

The analyses in the chapter show that the performance of universities as regards these goals differ widely. As a result, the South African public university system has become one which can be differentiated on the basis of institutional performance.

The chapter also reviews the total income of universities from government and other sources. It concludes that the income flows of universities are linked to their places in a performance-differentiated system. This indicates that the following crucial issues will have to be addressed:

- Determining appropriate levels of government funding for public universities;
- Resolving funding inequalities between universities; and
- Making institutional differentiation a central feature of public higher education policies.

The chapter concludes by recommending that Government should consider introducing a differentiated funding framework for a differentiated public university system.

Concerns and issues raised by the Ministerial Committee

1. Data issues: The Committee raised concerns about higher education data used by the Commission. It was highlighted that using Centre for Higher Education Transformation (CHET) headcount data is confusing as it encompasses both distance and contact education. This leads to skewed

headcount results. It was also highlighted that CHET data are skewed towards the counting of medical doctors. The implication is that the Commission needs to think more carefully about how universities with medical schools are treated compared to those without medical schools.

- **FFC response:** The data used by the Commission were the official returns submitted annually by universities to the DHET. No privately obtained data were employed. The Commission selected quantitative data which, as mentioned above, could be used as indicators of the performance of universities as regards national equity and development goals. In the case of students, the most appropriate indicators are head counts because, unlike full-time equivalent (FTE) records, they include personal details of students, such as gender and population group. A further point which should be noted is that the division of head counts into contact programmes and distance programmes cannot be relevant to the measurement of performance as regards the first three of the six goals listed above. The issue of distinguishing medical schools from other enrolments is also not relevant to the broad equity goals.

2. Analyses of costs: The Committee indicated that the FFC has based its analysis on revenue, excluding the cost. It was highlighted that the analysis should also take into account the cost.

- **FFC response:** In its review of the current funding framework, the Commission noted that an explicit government policy is that it pays universities for delivering because merely reimbursing actual costs rewards inefficiency. However, it is important that payment for the delivery of teaching and research services be appropriate in terms of the minimum efficient cost of delivering these services. Because the payment for service delivery is central to performance-based funding, the Commission did not consider it necessary to analyse actual institutional costs.

3. Institutional differentiation: The Committee approved of the CHET analysis and principle on the clustering of universities that the Commission had adopted. However, the Commission's analysis appears to have used this as a hierarchy for funding, which is problematic and will perpetuate debate. What is needed is that universities should be differentiated according to mission and funded accordingly.

- **FFC response:** The clustering proposals adopted by the Commission stemmed from analyses based on objective, quantitative performance indicators. The Commission favours the principle of clustering on the basis of objective criteria and the actual clusters referred to were merely illustrative. The comment that universities should be "differentiated according to mission" has clear links to proposals on "institutional self-differentiation", which have not been accepted by government. The main reason why differentiation linked to missions is inappropriate is that the current missions of many public universities in South Africa are reflections of institutional aspirations and dreams, rather than of the reality of their current situations.

4. Future funding of universities: The Ministerial Committee asked how university education could be funded without increasing government funding, taking into account that donor funding has decreased.

   • **FFC response:** This concern is noted by the Commission but was not germane to the aims of Chapter 3 of the Submission which were to examine and assess the current state of budgeting for the South African higher education system, framed within the broad themes of equity and development.

5. Exclusion of social sciences and humanities: The Ministerial Committee asked why the Commission had excluded humanities and social sciences from its analyses.

   • **FFC response:** The Commission was certainly not signalling that these are "unimportant fields of study". The Commission believes that they are crucial to the full social and cultural development of South African society. However, in most African countries, national economic development policies are closely linked to university-level studies in (i) agricultural sciences, life and physical sciences, engineering, health and clinical sciences, and (ii) economics and management sciences. The Commission accepted these emphases and, as a result, did not include humanities and social sciences in its initial performance assessments.

6. Clustering of universities: The Ministerial Committee asked what the rationale was for the clustering of universities.

   • **FFC response:** The public universities are grouped into three clusters, based on comparing each university's average for each input and output indicator. The methodology used was simple, but possibly controversial. A four-point rating scale was used:
   4 = meets or exceeds target
   3 = average is in range 75% to 99% of target
   2 = average is in range 50% to 74% of target
   1 = average is less than 50% of target

   Then for each university, separate average ratings were calculated for the five input and five output indicators. These average scores were sorted first by average for the five output indicators and then by the combined average for input plus output indicators. Finally, the universities were placed in the clusters using these criteria:
   Cluster 1: either an output average above 3, or an input plus output average above 3
   Cluster 2: output or input averages above 2, and an overall average of 2
   Cluster 3: either an output or input average below 2

   The three clusters were the outcomes of the Commissions analyses of the performances of universities as regards the goals of the 1997 White Paper and the 2001 National Plan. These analyses showed that the South African university system was in fact a differentiated one, and that this should be recognised when funding proposals are developed.

7. Unitary and multiple funding frameworks: The Ministerial Committee asked why the Commission recommended that funding should shift from a unitary system to multiple funding frameworks.

   • **FFC response:** The Commission demonstrated in its Chapter 3 that the flow of funds (government and private) to universities is closely linked to the performance clusters in which they are placed. Furthermore, it showed that these differences in income flows had undermined a basic principle of the current government funding framework: that all universities, comprehensive universities and universities of technology should be funded equally. The view of the Commission was that the current inequalities in funding were serious, and that they could be overcome if different sets of performance targets were set for universities in the three clusters it has identified.

8. Performance and government funding The Ministerial Committee asked if the Commission is suggesting that the funding formula should be based on performance.

   • **FFC response:** Government funding, as is the case with the current framework, should be based on institutional performance, but in the context of different goals being set for different clusters of universities. The Commission has not argued that all government funding should be based on output performance, such as the production of graduates and research publications. Provision will have to be for input performance, related to issues such as the enrolment of disadvantaged students and the recruitment of staff from disadvantaged groups.

Appendix 2: Trends in grants received by South African universities, 2004-2012

Table: A1: The trends of actual research grant received by South African public universities during the period 2004–2012a

UNIVERSITY	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total Grant (2004–2012)
	(R'000)	(R'000)	(R'000)	(R'000)	(R'000)	(R'000)	(R'000)	(R'000)	(R'000)	(R'000)
PRETORIA	146 717	144 049	175 113	184 563	189 726	219 723	259 970	291 920	285 017	1 896 798
CAPE TOWN	91 759	92 242	111 525	165 935	149 639	188 203	220 689	263 160	258 654	1 541 806
STELLENBOSCH	100 410	108 276	137 436	142 551	152 379	168 384	216 752	256 403	258 875	1 541 466
KWAZULU-NATAL	90 919	122 816	112 276	136 632	155 275	156 471	205 036	258 927	247 355	1 485 707
WITWATERS-RAND	75 791	81 176	109 995	117 494	130 414	165 720	175 185	219 262	199 516	1 274 553
NORTH-WEST	48 924	61 597	64 882	73 559	94 994	108 885	126 880	151 385	158 180	889 286
SOUTH AFRICA	57 488	60 276	76 188	78 689	83 362	94 900	111 509	119 797	118 028	800 237
FREE STATE	59 422	62 979	59 615	67 325	73 964	91 813	94 225	127 125	124 051	760 519
JOHANNESBURG	51 877	64 877	78 031	72 951	75 779	77 940	103 546	114 596	119 528	759 125
RHODES	32 382	25 820	33 786	39 093	48 132	56 317	63 143	72 051	73 428	444 152
NELSON MANDELA	20 218	29 669	31 854	36 369	39 941	44 854	59 101	64 305	78 338	404 649
WESTERN CAPE	17 185	24 371	28 871	36 945	39 162	45 994	56 458	74 552	79 632	403 170
TSHWANE UT	10 330	11 064	13 087	16 468	23 998	23 791	31 566	42 140	42 907	215 351
LIMPOPO	10 885	13 376	14 184	16 265	24 108	27 453	24 644	32 229	31 149	194 293
FORT HARE	4 656	7 790	4 113	7 864	10 863	14 373	19 412	37 238	43 781	150 090
CAPE PENUT	3 695	6 737	7 143	11 280	11 655	13 259	20 341	31 902	32 489	138 501
ZULULAND	12 896	9 897	13 356	10 566	18 322	14 688	14 836	21 616	20 842	137 019
DURBAN UT	6 601	5 600	5 826	6 116	7 122	7 934	7 814	13 028	13 956	73 997
VENDA	1 141	3 796	2 326	5 603	5 732	6 381	10 445	11 311	17 692	64 427
CENTRAL UT	3 171	4 695	5 323	4 619	6 827	8 034	7 720	9 925	7 525	57 839
VAAL UT	1 553	1 349	1 361	2 818	3 641	3 386	4 608	7 403	7 963	34 082
WALTER SISULU	1 850	2 160	1 430	2 867	2 171	1 957	2 653	3 767	6 769	25 624
MANGOSUTHU	96	462	366	262	575	145	185	525	903	3 519
All Institutions	849 966	945 073	1 088 086	1 236 836	1 347 782	1 540 604	1 836 716	2 224 568	2 226 579	13 296 210
% increase (all institutions)		**11.19**	**15.13**	**13.67**	**8.97**	**14.31**	**19.22**	**21.12**	**0.09**	

Table A2: The trends of research development grant received by South African public universities during the period 2004–2012

UNIVERSITY	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total (2004-2012)
	(R'000)	(R'000)	(R'000)	(R'000)	(R'000)	(R'000)	(R'000)	(R'000)	(R'000)	(R'000)
LIMPOPO	39590.37	41423.97	34732.22	31751.48	34726.13	34405.71	34094.10	1528.38	39090.49	291342.85
SOUTH AFRICA	30339.32	34036.97	27050.52	23120.90	28132.94	31616.97	26644.74	1517.13	40258.06	242717.55
WALTER SISULU	18676.53	18481.80	15493.89	13814.48	17044.71	18499.02	17229.91	878.75	21035.65	141154.75
VENDA	16354.65	15362.92	13833.65	10500.45	13242.92	14463.60	12342.60	649.29	14430.93	111181.01
KWAZULU-NATAL	21663.06	6511.56	14892.55	7923.18	10664.62	19706.88	4418.03	0.00	0.00	85779.88
DURBAN UT	10817.47	10731.65	8909.38	7670.29	9627.25	10629.23	10369.85	401.04	9806.23	78962.39
TSHWANE UT	14042.71	15139.96	11986.94	9611.68	7478.07	9004.96	5926.16	153.63	4905.95	78250.05
WESTERN CAPE	15649.71	14618.65	10375.01	5725.89	7285.95	9973.23	7722.58	159.38	2442.22	73952.62
FORTHARE	8151.25	9779.89	10865.36	7609.41	9744.15	11402.33	11862.12	319.16	2154.57	71888.24
CAPE PENUT	10758.72	9702.98	8110.19	6939.04	9207.09	10102.00	8133.55	241.75	7137.37	70332.70
ZULULAND	7428.06	9396.36	4432.57	5832.80	3606.57	7381.20	7969.81	310.51	8640.16	54998.03
NORTH-WEST	11761.78	10231.93	6737.30	3750.27	2724.66	2535.77	3528.41	132.51	9856.27	51258.89
VAAL UT	6695.98	7336.44	6197.55	4794.08	5117.61	5601.80	4695.59	216.90	5447.91	46103.85
JOHANNESBURG	7995.99	8001.24	7260.43	1122.23	4574.32	4321.24	0.00	0.00	0.00	33275.46
MANGOSUTHU	3450.79	3466.31	2980.03	2728.32	3114.06	3274.39	2701.85	140.23	3703.35	25559.34
NELSON MANDELA	7734.84	2776.81	6753.92	3629.27	1259.57	2731.45	0.00	57.01	0.00	24942.86
WITWATERS-RAND	12618.27	3573.17	0.00	0.00	5031.85	0.00	0.00	0.00	0.00	21223.29
CENTRAL UT	1220.63	456.37	1603.35	1840.60	1523.02	1708.42	2080.50	102.81	3964.87	14500.56
FREE STATE	0.00	0.00	0.00	0.00	0.00	0.00	6561.04	0.00	3943.47	10504.51
RHODES	0.00	1667.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1667.91
PRETORIA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.14	4.14
CAPE TOWN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
STELLENBOSCH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ALL INSTITUTIONS	244950.11	222696.89	192214.85	148364.39	174105.47	197358.21	166280.83	6808.48	176821.65	1529600.88
	-	**-9.1**	**-13.7**	**-22.8**	**17.3**	**13.4**	**-15.7**	**-95.9**	**2497.1**	