Country Profile

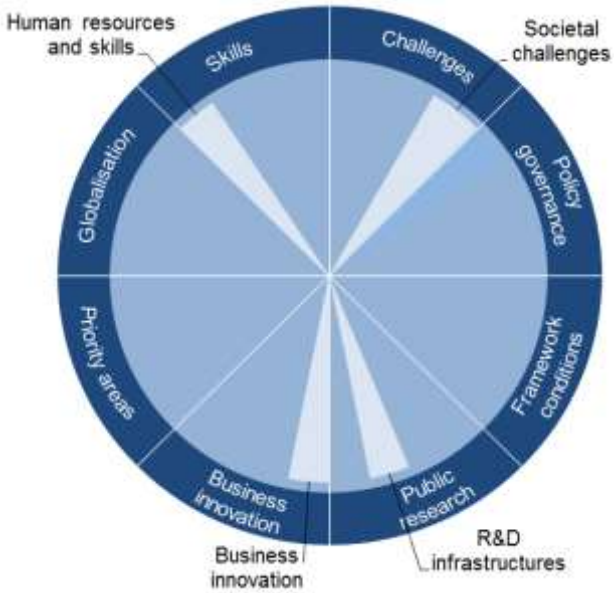
SOUTH AFRICA

South Africa has progressively shifted away from dependence on primary resource production and commodity-based industries to open up to international trade and to building capacity in some knowledge-intensive industries. However, the country's economic growth has remained weak by emerging-market standards, with GDP rising at 3.1% per year from 2000 to 2014. Employment has not risen fast enough to absorb an expanding labour supply driven by strong demographic dynamics, and unemployment has been chronically high. The exclusion of a large fraction of the population from the formal economy also contributes to maintain income inequality and pockets of poverty. Recent droughts, strikes and electricity shortages, combined with financial constraints, have weighed on economic performance in 2015 and 2016. Labour productivity has grown particularly slowly since 2011 (figure 2). The National Development Plan (NDP), A vision for 2030 (2011-30), provides a general roadmap for South Africa's transition towards a diversified economy, with innovation underpinning almost every aspect and a strong focus given to strengthening human capital. The National R&D Strategy (2002 onwards) has planned for increasing public and private investment in the science base and improving the system of S&T governance. In parallel, the Ten-Year Innovation Plan (2008-18) identified five areas of competitiveness to be developed, i.e. bio-economy (formerly pharmaceuticals), space, energy security, global change including climate change, and social and human dynamics. In that respect, the National Industrial Policy Framework (NIPF) articulates South Africa's overarching approach to industrial development and innovation.

Table 1. Gross domestic expenditure on R&D (GERD)

	ZAF	OECD
GERD		
USD million PPP, 2012	4 824	1 181 495
As a % of total OECD, 2012	0.4	100
GERD intensity and growth		
As a % of GDP, 2012	0.73	2.38
(annual growth rate, 2007-12)	(-1.9)	(+2.3)
GERD publicly financed		
As a % of GDP, 2012	0.34	0.61
(annual growth rate, 2007-12)	(-6.6)	(+2.5)

Figure 1. Major STI policy priorities, 2016



Hot issues

Addressing societal challenges (including inclusiveness)

South Africa faces major societal challenges, ranging from persistent, albeit reduced, poverty to difficulty in achieving social cohesion among a multi-ethnic population along with severe environmental pressures. The Department of Science and Technology (DST) launched the Innovation for Inclusive Development Strategy with a view to reorienting the focus of existing initiatives dealing with societal challenges and to assessing the appropriateness of introducing new initiatives. A strong emphasis is given to gender and black representation, especially in science, technology and engineering (see the section below on human resources). Environmental issues are also pressing in South Africa. About one-quarter of the country's river ecosystems are critically endangered, and pressure on water resources is high. South Africa has adopted the Water Research, Development and Innovation (RDI) Roadmap (2015-25), which aims to make the country a leader among middle-income countries in the development and deployment of water management practices and technologies. The Water RDI Roadmap plans to improve sustainable access to water for rural communities and increase the number of SMEs operating in the water sector. In this context, a set of seven clusters were identified to push water-related R&D and demonstration forward. South Africa also has extensive "hotspots" facing serious environmental degradation. The environmental pressures are magnified in overcrowded areas where uncoordinated urban development and a lack of infrastructure are widespread. Around four million people live in informal settlements, many of them on the outskirts of large municipalities, and only half of whom are served by municipal waste collection. South Africa adopted a Ten-year Waste R&D and Innovation Roadmap (2015-25) to coordinate and manage its portfolio investment for waste R&D and innovation activity. This is an integrated resource plan that articulates with South Africa's green economy strategy and its bio-economy strategy, with a view to moving the country towards recycling and a circular economy. South Africa is also one of the most energy- and carbon-intensive economies in the world. The development of the renewable energy market is seen as essential to securing a sufficient energy supply and to further the transition to a green economy. In 2015, the DST appointed the Trade and Industrial Policy Strategies (TIPS) Research Organisation to undertake a baseline study to measure public and private investment in the green economy and to guide governmental programmes in that area as of 2016. As part of the ongoing initiatives, the Industrial Development Corporation (IDC), a national development finance institution, has invested over USD 2.6 billion PPP (14 billion South African rand – ZAR) as of mid-2015 in the Renewable Energy Independent Power Producers Programme (REIPP). In parallel, the Green Energy Efficiency Fund (GEEF), established in 2011 with USD 104 million PPP (ZAR 500 million), is continuing to assist South African companies that invest in energy efficiency and renewable energy projects through a loan with a 15-year payback period. The Department of Environmental Affairs has launched a Green Fund with USD 148 million PPP (ZAR 800 million) to implement R&D projects that can inform policy through better evidence. In addition, as part of a programme rationalisation, a review was undertaken in 2015-16 to identify the range of programmes and organisations involved in South African climate change research. The first annual report on monitoring climate change responses was presented to the Cabinet in 2015.

Strengthening public R&D capacity and infrastructure

South Africa has a relatively small science base, with a low and decreasing level of public-sector R&D expenditure at 0.34% of GDP in 2012. The country also counts fewer world-class universities and scientific publications in top-ranked international journals relative to the OECD average (figure 5[a,b,c]), but it maintains some pockets of excellence, for instance in biotechnology (figure 6) and astronomy. Existing initiatives to enhance the capacity for knowledge production, such as the Research Chairs and the Centres of Excellence, have helped increase the number and quality of scientific research outputs as well as the number of researchers. The Prime Minister announced that levels of R&D investment in the government, higher education and science sectors would be maintained in 2016 and increased if possible, although current budgetary constraints remain a major obstacle and existing funds are managed very tightly. Despite current resource constraints, further investment in research infrastructure is being pursued. The DST has begun developing a South African Research Infrastructure Roadmap (SARIR) that should be finalised at the end of the

2015/16 financial year. In 2016, the Centre for High Performance Computing (CHPC) at the Council for Scientific and Industrial Research (CSIR) set up a new super-processing computer, the fastest in Africa. Large-scale simulations and modelling have become available for domestic public and private research bodies, and the new Lengau ("cheetah") system is already used for research in climate modelling, bioinformatics, materials science and astronomy. The DST, jointly with the Department of Higher Education and Training and the National Research Foundation (NRF), have developed different models linking the output of masters and doctoral degree graduates with various public funding levels so as to inform policy making and support strategic financial planning. An initial modelling suggests that South Africa should invest at least an additional USD 1 billion PPP (ZAR 5.9 billion) per year by 2020 to achieve the NDP target of training 6 000 PhDs per year.

Encouraging business innovation and innovative entrepreneurship

South Africa's business R&D input and innovation output are low by OECD standards (figure 5[d,e,f,g]), and BERD decreased in both absolute terms and as a share of GDP over 2009 12. The latest national business survey (2014) shows, however, some improvement in business R&D investment. The policy mix for promoting business-sector R&D and innovation has remained stable, and receives continuous attention. R&D tax incentives provide 150% in tax deductions on the R&D expenditure incurred by firms of all sizes that undertake R&D in the country. A total of 914 applications were received between 2012 and 2015. The Support Programme for Industrial Innovation (SPII) supports technology development through matching grants for the late developmental or early commercialisation phases. The Technology Localisation Programme is a supply-side scheme that provides a suite of tailor-made technology interventions to develop local technology and innovation capabilities and to improve the competitiveness of the manufacturing sector in areas linked to public procurement; it has a budget of USD 84.7 million (ZAR 500 million) over 2014 17. The Competitive Supplier Development Programme (CSDP), driven by state-owned companies with support from the DST, gives local enterprises technology support to strengthen their ability to supply competitively to large public procurement projects and foreign multinationals.

Improving overall human resources and skills

A major bottleneck for South Africa's socio-economic development in general, and for the advancement of STI in particular, is the lack of a broad skills foundation. The share of the adult population with tertiary-level education is extremely low by OECD standards (figure 5[i]), and the ageing of the white male-dominated STI workforce is further weakening the skills base. To increase the pool of human capital for STI, the government has taken a series of initiatives that focus on improving access to science and mathematics education for youth and on supporting postgraduate students and researchers. University enrolment has increased by 7.7% between 2011 and 2013 to nearly 1 million in 2013, which is in line with the NDP aim to increase enrolment to 1.62 million by 2030. Postgraduate students supported by the National Research Foundation (NRF) doubled from 5 061 in 2008/09 to 11 400 in 2013/14. In addition, in order to improve participation and inclusiveness in higher education, South Africa has long adopted equity targets in its human resources development programmes and offers targeted financial support to women and the black community. Examples include the Thuthuka programme and the 2013 Guidelines for Achieving Equity in the Distribution of Bursaries, Scholarships and Fellowships. In 2016, the DST reported that by 2017/18, at least 80% of postgraduate students receiving support would be black, 55% would be women and 4% would be people with disabilities. South Africa shows a fair female participation in scientific studies by OECD standards, although the share of women graduating at doctorate level remains slightly below the OECD average (figure 4). New regulations were enacted in 2016 to support the administration and implementation of the Broad-Based Black Economic Empowerment Act of 2003. In order to determine the socio-economic impact of the DST investments in postgraduate training and the ways in which the Department could improve the efficiency of its investments, a plan for creating a postgraduate tracking system was completed and shared with the Department of Higher Education and Training and the NRF in 2016. The plan will be tested in 2016/17, and should be rolled out in 2017/18.

Some key STI performance indicators

Figure 2. Economic performance

Labour productivity, GDP per hour worked, index 2005=100

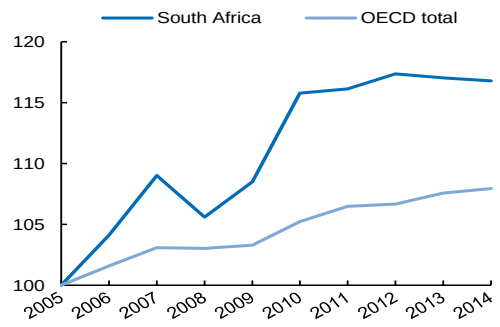


Figure 3. Environmental performance

Green productivity, GDP per unit of CO_2 emitted, index 2005=100

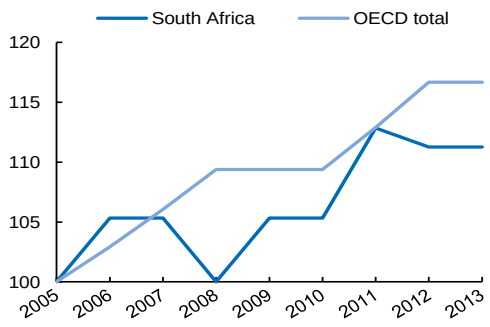
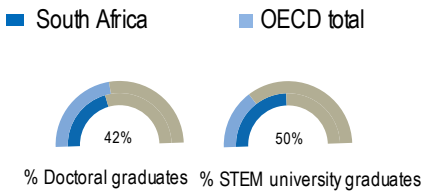


Figure 4. Women in science

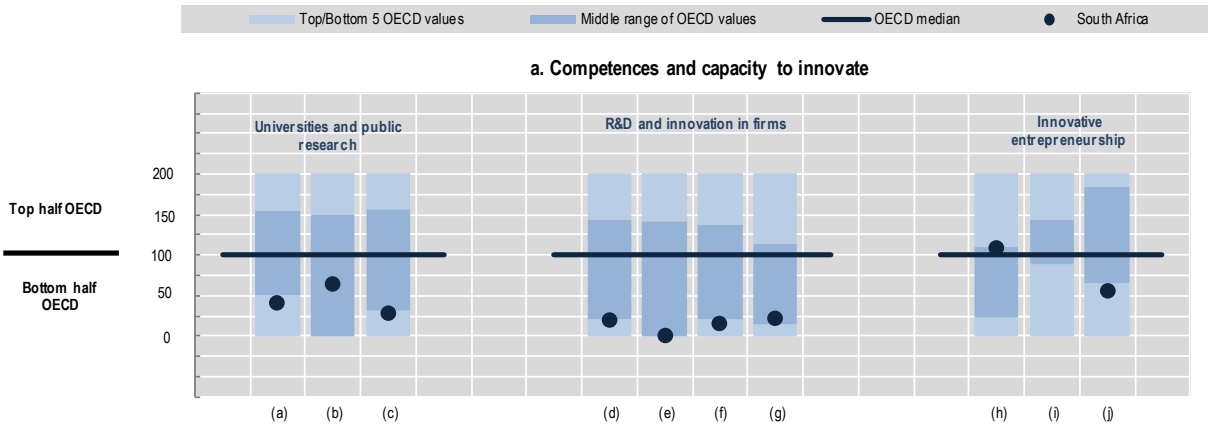
2013 or latest year available



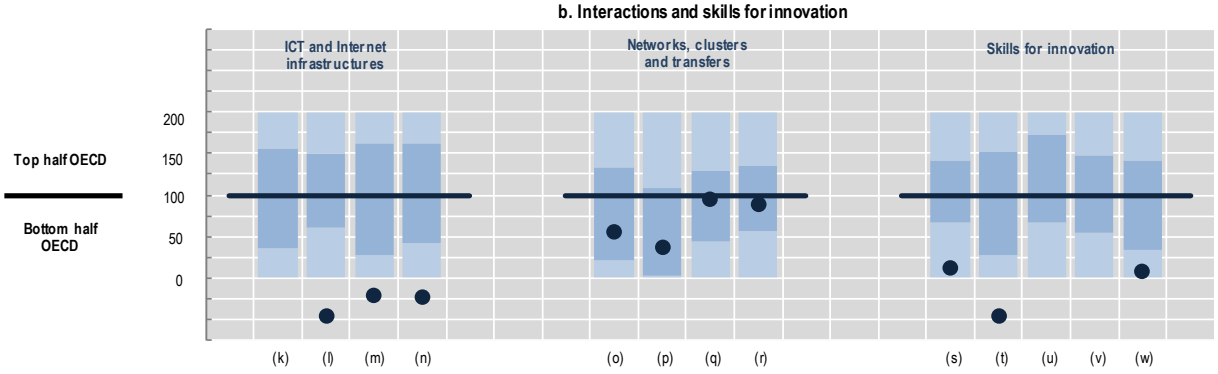
Benchmarking national STI systems

Figure 5. Science and Innovation in South Africa

Comparative performance of national science and innovation systems, 2016



(a) Public R&D expenditure (per GDP)
(b) Top 500 universities (per GDP)
(c) Publications in the top journals (per GDP)
(d) Business R&D expenditure (per GDP)
(e) Top 500 corporate R&D investors (per GDP)
(f) Triadic patent families (per GDP)
(g) Trademarks (per GDP)
(h) Venture capital (per GDP)
(i) Young patenting firms (per GDP)
(j) Ease of entrepreneurship index



(k) ICT investment (per GDP)
(l) Fixed broadband subscriptions (per population)
(m) Wireless broadband subscriptions (per population)
(n) E-government development index
(o) Industry-financed public R&D expenditure (per GDP)
(p) Patents filed by universities and public labs (per GDP)
(q) International co-authorship (%)
(r) International co-invention (%)
(s) Tertiary education expenditure (per GDP)
(t) Adult population at tertiary education level (%)
(u) Top adult performers in technology problem-solving (%)
(v) Top 15 year-old performers in science (%)
(w) Doctoral graduate rate in science and engineering (%)

Note: Normalised index of performance relative to the median values in the OECD area (Index median=100).
Please note that for South Africa, 2012 values was used for the indicator Wireless broadband subscriptions (per population). It is compared to values of December 2015 for OECD countries.

Highlights of the South African STI system

New sources of growth

South Africa is one of the world's leading mining and mineral-processing countries and holds the world's largest deposits of platinum, manganese, chromium and gold. The country has gone through a premature de-industrialisation, the relative share of services in total value added being especially high given its stage of economic development. The National Development Plan (2011-30) recommends that special attention should be given to develop areas of competitive advantage in water, power, marine, space and software engineering. The seventh annual Industrial Policy Action Plan (IPAP 2015/16 - 2017/18) aims to further transform the industrial base, to increase the national competitiveness of manufacturing exports and to improve South Africa's positioning in global value chains. The 2014 Emerging Industries Action Plan (EIAP) was already aimed at providing a policy and funding framework for the technological maturation and commercialisation of large R&D projects with the potential to create substantial new industries. Major R&D led programmes are focusing on mining, platinum, advanced metals, chemicals, energy, additive manufacturing, automotive (with incentives to attract global equipment manufacturers), aerospace and ICT. In 2014, South Africa also adopted the Advanced Manufacturing Technology Strategy (AMTS), which sets out a vision for the South African manufacturing sector and aims to develop technology roadmaps for aerostructures, smart and affordable automation, advanced photonics and additive manufacturing. The government launched Operation Phakisa to support its economic transformation programme; this addresses national key priority areas such as poverty, crime and unemployment. This initiative is initially being implemented in two sectors, the ocean economy and the health sector, especially clinics. Starting from 2014, the Ocean Economy Phakisa subprogramme has built on a strategic public-private partnership to unlock the potential of the oceans to boost economic growth and create jobs. The government is focusing on four priority sectors: marine transport and manufacturing activities, offshore oil and gas exploration, aquaculture, and marine protection services and ocean governance. South Africa also published an Agricultural Policy Action Plan (APAP 2015-19) with a view to creating close to one million new jobs in the sector by 2030. The APAP addresses issues related to skills development, agricultural R&D capacity, the realignment of extension programmes, and the creation of an integrated knowledge and information management system.

STI policy governance

South Africa lags behind OECD standards as regards ICT and Internet infrastructures. The coverage of fixed and mobile broadband networks remains weak, and the e government index is very low as per OECD standards (figure 5[l,m,n]). South Africa has also a low revealed advantage in ICT (figure 6). The DST established an ICT Industry Innovations Partnership Programme in 2014 with a view to both encouraging investment in ICT-related R&D and innovation by private sector companies and attracting the R&D centres of global ICT multinationals. The programme aims to establish R&D and innovation platforms and laboratories; to develop human capital development, both high-end and technical skills; to support the development of innovation and technology-based SMEs; and to encourage the diffusion of technology. In response to the security and privacy issues raised by the Internet and the use of big data, South Africa adopted a cybersecurity strategy and a Protection of Personal Information Act in 2013, parts of which came into effect in 2014, including the establishment of an information regulator. With respect to the development of domestic capacity, the government launched another plank of Operation Phakisa: ICT in Education, with a view to transforming teaching and learning through the appropriate use of ICTs and to producing ICT capable learners.

Technology transfer and commercialisation

Industry-science ties, as measured by industry funding for public research and patent applications by universities and PRIs, remain relatively thin in South Africa (figure 5[o,p]). The government recognises the importance of strengthening links between the S&T and business communities for setting agendas and

stimulating investment in STI. The DST and the Department of Trade and Industry (DTI) have embarked on a process of reviewing the portfolio of incentives and support instruments for R&D, commercialising innovations and improving science and industry linkages. The DTI's Technology for Human Resources in Industry Programme (THRIP) is continuing to support hundreds of research projects at universities and science councils on the principle of a public-private partnership and co-funding by both industry and the DTI (with funding of about USD 11 million PPP – ZAR 180 million – per year). In parallel, the government implemented three instruments for accelerating the commercialisation of research downstream, i.e. the Technology Innovation Agency (TIA 2010) to support innovative start-ups, the National Intellectual Property and Management (NIPMO 2011) to support PRIs in patenting activities, and the Intellectual Property Rights from Publicly Funded Research and Development Act (2013) for encouraging a more effective use of IP and the deployment of Technology Transfer Offices.

Clusters and regional policies

The government has placed strong emphasis on strengthening South Africa's international attractiveness as a location for biotechnology companies, a sector where it has a large and increasing revealed technology advantage (figure 6). The Cape Health Technology Park is a new world-class facility for pharmaceutical companies, research institutes, clinical trial facilities and health-related academic and government programmes. It aims to reinforce South Africa' specialisation in biotechnology and provide support to local manufacturers to integrate global biotech value chains. The Biosciences Park is continuing to assist biotechnology start-ups in developing marketable products and incubating innovative approaches. Following the National Science Park Development Plan (NSPDP 2009), some initiatives are also underway at provincial levels. The Innovation Hub in Pretoria, supported by the Gauteng Provincial Government, has been set up to promote local socio-economic development and competitiveness through innovation. The Hub provides funding to establish core infrastructure and incubation facilities in the region.

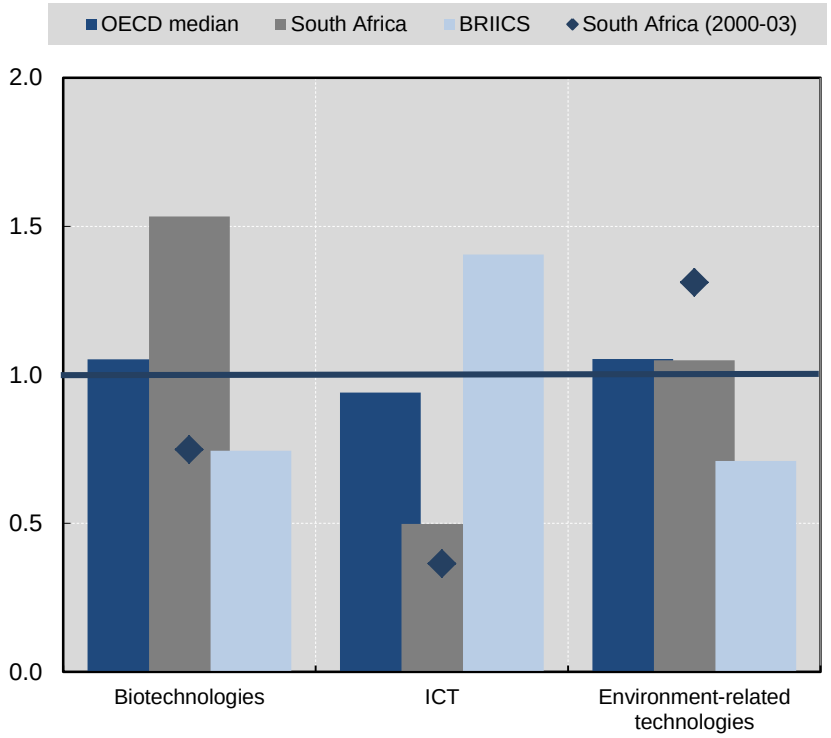
Globalisation

South Africa's integration into international knowledge networks is in some aspects as good as the OECD average (figure 5[q,r]). South Africa participates actively in various international R&D programmes, especially within the EU Framework Programme, and has signed bilateral and multilateral agreements to support the international mobility of researchers. The NRF offers international research grants to encourage the internationalisation of South African research institutions and their staff, and the Technology Localisation Programme aims to improve the capability and competitiveness of domestic firms (including SMEs). Particular efforts have been made recently to reinforce regional cooperation in the Southern African Development Community (SADC), where South Africa plays a prominent role in developing the SADC STI Strategy. The SADC Policy Training programme aims to support S&T policy development within the Community. The country is also involved in joint calls for proposals with other African partners, in joint STI agreements and in exchange programmes across Africa. South Africa is also a major partner of the African Union's STI Strategy for Africa 2024 (STISA 2024), which places STI at the epicentre of the region's socio-economic development and growth. This is the first of the ten-year incremental phasing strategies that aim to have STI make an impact across critical sectors, such as agriculture, energy, environment, health, infrastructure development, mining, security and water. The Square Kilometre Array (SKA) project, one of South Africa's major cross-border initiatives, entered its final pre-construction phase in 2015, with construction to begin in 2018 and key science projects to start in 2020. This is an international effort to build the world's largest radio telescope, with one square kilometre of collecting area to be located in South Africa and Australia.

Structural aspects and specialisation

Figure 6. Revealed technology advantage in selected fields, 2011-13

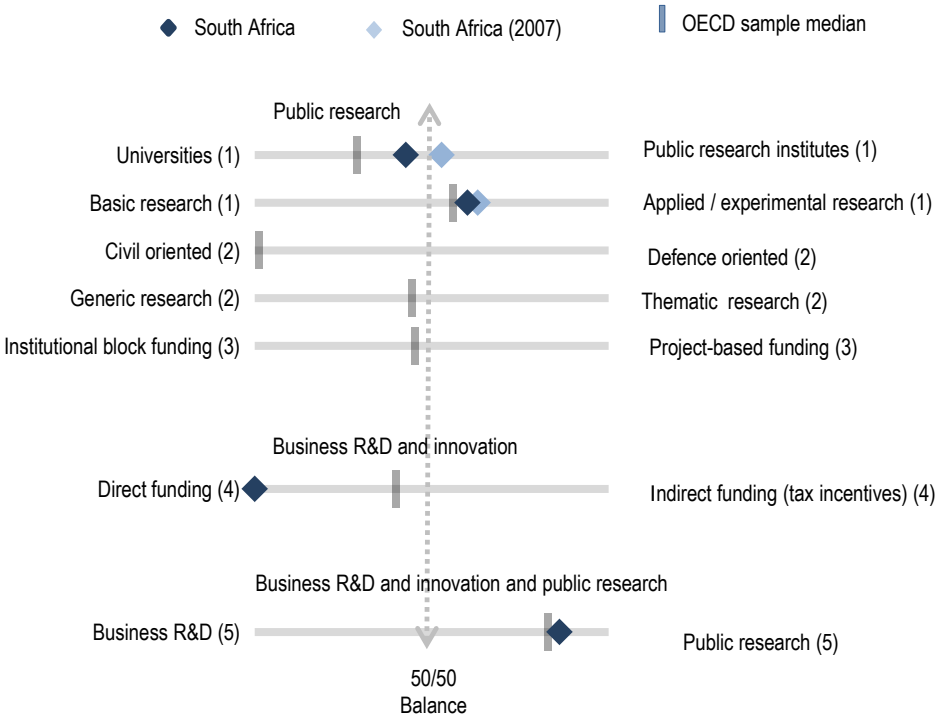
Index based on IP5 patent families applications



National STI policy mix

Figure 7. Allocation of public funds to R&D, 2014 or latest year available

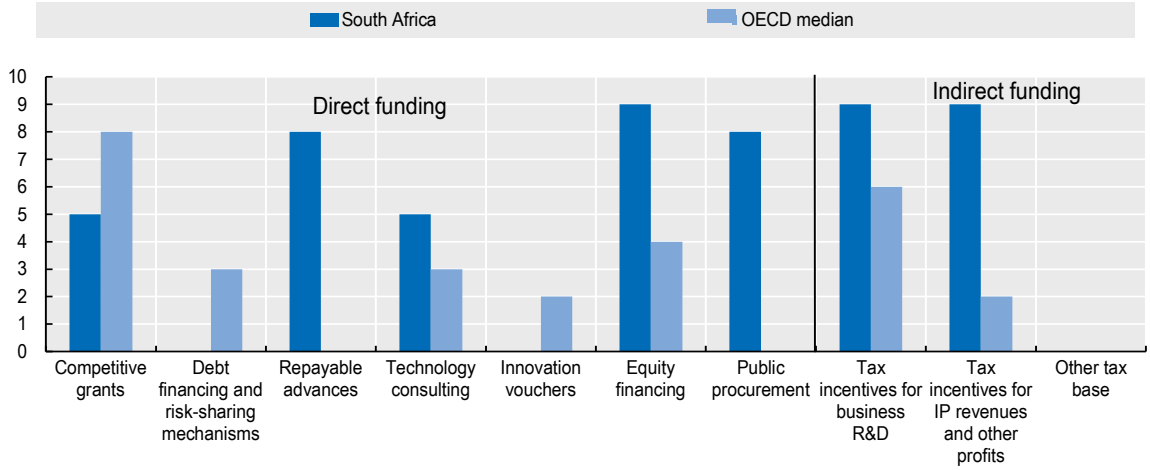
By sector, type of R&D and mode of funding



(1). Balance as a share of both higher education (HERD) and government (GOVERD) R&D expenditure.
(2) Balance as a share of total government budget appropriations and outlays for R&D (GBAORD).
(3) Balance as a share of total funding to national performers.
(4) Balance as a share of both indirect funding (through R&D tax incentives) and direct funding (through grants, procurement, loans, etc.).
(5) Balance as a share of publicly-funded HERD and GOVERD and components of (4).

Figure 8. Most relevant policy instruments of funding for business R&D, 2016

Country self-assessment, index (9 = high and increasing relevance to 0 = not used)



Note: Policy information comes from country responses to the EC/OECD International Survey on STI Policies (STIP) 2016 and 2014. South Africa's responses are available in the EC/OECD International Database on STI Policies, edition 2016 at http://qdd.oecd.org/DATA/STIPSurvey/ZAF...STIO_2016.

Source: See the reader's guide and methodological annex.

StatLink http://dx.doi.org/10.1787/888933434063

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