

Science granting councils in Sub-Saharan Africa: trends and tensions

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Amended title: Science Granting Councils in Sub-Saharan Africa: trends and tensions

Abstract

This paper documents recent trends in science funding support in Sub-Saharan Africa (SSA). We analyse these trends at the SSA regional level alongside a summary of four case studies of science funding in four Science Granting Councils (SGCs) in East Africa. Our findings support the literature on science funding in SSA regarding low levels of funding, cross-country engagement and the need for capacity building. However, we also find there are tensions amongst funding and policy actors around the perceived ways in which investment in science will benefit society. We argue that the narratives and logics of science funders and their roots in 'Republic of Science' vs. 'Embedded Autonomy' rationales for SGC activity must be more transparent to enable critical engagement with the ideas being used to justify spending.

Keywords: Science funding; Science Granting Councils; Sub-Saharan Africa; Research excellence; Political economy

1. Introduction

The place of science, technology and innovation (STI) on the national, regional and continental policy agendas in Sub-Saharan Africa (SSA) has become markedly more prominent in recent years. Indications of this increased prominence are varied. A survey of 17 African countries found an increase in those with science and technology (S&T) or STI policies (Mouton et al. 2014). As of 2010, according to this survey, 13 out of the 17 countries had a national S&T, revised S&T, or STI policy up from 6-8 countries in the period 1986-2010. None had any S&T policies between 1960¹ and 1985. At the regional level, important policy documents – such as the African Union’s Science, Technology and Innovation Strategy for Africa 2024 (AUC 2014) – increasingly relate STI to economic growth and development in Africa.

Funding from national agencies for science and research in SSA has increased (UNESCO 2016). At the national level, Science Granting Councils (SGCs) are key vehicles for channelling such funding. The SGCs – a broad categorisation used by the Science Granting Councils Initiative² (SGCI) – include organisations such as government ministries, agencies or specific institutions that fund science³ and research.

Although we are witnessing a renewed enthusiasm for STI as a policy item and science funding in SSA, we also note a concern amongst analysts that investment in science (and even in innovation) does not automatically lead to social and economic development (Arocena et al. 2017; Cirera and Maloney 2017; Mazzucato 2013; Schot and Steinmueller 2016) and there is also evidence of the limited impact that relevant policy initiatives can have in the absence of institutional and broader human resource capability building in low and middle-income countries (LMICs) (Lee and Kim 2009).

There is considerable evidence that, over the long term, the capabilities that derive from investment in science deliver positive developmental results (Cirera and Maloney 2017) and thus uncertainties do not seem to undermine the policy case for funding science and technology overall. But they do call into question uncritical assumptions about the relationship between science and development. This in turn necessitates more careful investigation of the patterns of increased funding, and for research and scrutiny about the rationales for funding science.

This paper explores trends in investment in science in sub-Saharan Africa with a focus at the regional level, but with data and reflections on national level funding in four East African countries. It is far from a complete analysis of the SGC landscape in SSA, it serves to open up debate on the relationships between the arguments for science funding, the systems that deliver that funding, and the kinds of outcomes that can be expected.

Section 2 of the paper introduces the existing literature on SGCs in SSA, followed in Section 3 by an explanation of the study’s methodology. Our findings are then presented in Section 4 in which, first, we report on the international and SSA regional level, focussing on the main actors and recent trends in their science funding. Then, second, we examine science funding at the national level, particularly on how SGCs are evolving in their roles and the ideas that are shaping the development of science funding in East Africa. The discussion in Section 5 brings together the national and regional or international funding levels, highlighting the main tension we argue our findings make apparent: there are differing (and potentially confused or divergent) perspectives on the purpose of science funding. We discuss this tension in relation to the literature around differing science funding narratives, focussing particularly on scientific excellence and how different visions affect questions of autonomy and who guides science funding decision making. Our conclusion points to the implications of the findings for future research and public policy in science funding in Africa.

2. Literature review

2.1 What is a Science Granting Council?

Various terms have been used to describe the organisations that we are referring to as SGCs, ranging from Funding Agencies, Research Councils to various other combinations of the words research, science, funding, agency and council (see for example Braun 1998; Rip 1994). The common definitional features are that they are national level public or quasi-public organisations and they grant funding for science and/or research activities. In this role, they sit in an intermediary space between the state and the research community, where they define and execute a significant part of the state's science policy (Braun 1998). For our purposes we are also including funders of science at the regional and international level in this definition of SGCs. Examples include NEPAD and AESA.

2.2 Overview of the existing literature on science granting councils in Sub-Saharan Africa

Based on a small but emergent literature on SGCs in SSA and the relevant grey literature on SSA contained in the latest edition of the UNESCO Science Report (UNESCO 2016), the rest of this literature review provides a preliminary characterization of SGCs on the continent in recent decades.

2.2.1 A decline of national science funding and increasing dependence on international donors (circa 1980-2000)

Mouton (2008) and Waast and Krishna (2003) trace in broad terms the historical trajectory of science funding in SSA from colonial times to the 21st century. The two studies present a similar picture of the emergence in post-independence SSA of many co-ordinated and relatively well-funded national research systems that went into decline in the 1980s and 1990s following large-scale withdrawal of funding caused by economic crisis and the growing influence of free market ideology. During this period, support for higher education also fell out of favour with the World Bank and other donors as they believed that primary education created greater societal returns and so should be prioritised (Hydén 2017; Mouton 2008).

Analysing the results of this divestment from research institutions, Waast and Krishna (2003) and Mouton (2008) paint a bleak picture of scientific knowledge production in the years preceding the 2000s. Most relevant for our study, they argue that supervising bodies such as SGCs lost their prominence. They describe how “their best civil servants have left, their meetings have ceased and no-one consults them anymore” (Waast and Krishna 2003: 166). They describe examples of SGCs reduced to two members of staff and one SGC spending 8 years drawing up a plan for research with no guarantee that it could ever be financed.

A recent study on capacity needs for STI policy making in Africa suggests these issues have not yet been addressed (AOSTI 2013). The study identifies that, in addition to inadequate funding from African governments (despite commitments), official STI bodies are generally: isolated from their own governmental institutions and from non-governmental actors with STI policy capabilities; lacking adequate in-house research and analysis capabilities; lacking adequate information to assist them in evidence-based policy making; and in need of much more support from political leaders. In addition, the scrutiny of STI is weak because of capability and capacity constraints in parliaments, as well as in civil society organisations (which might also be expected to provide scrutiny). Waast and Krishna (2003) and Mouton (2008) both argue that, due to the conditions described above at the national level, researchers largely rely on international and regional funders to pursue research.

2.2.2 Increasing international and national commitment to science funding in SSA (circa 2000-2018)

It is clear that STI is increasingly understood to be important for achieving economic growth and development goals in SSA. This is reflected in policy and institutional developments at various levels. At the continental level, the African Union (AU) has adopted the STI Strategy for Africa *STISA 2024* (AUC 2014) intended to guide the first ten years of action towards achieving *Agenda 2063*, further detailed in its first ten-year implementation plan (AUC 2015). Institutionally, the New Partnership for Africa's Development (NEPAD) is now well-established and continues to evolve in order to more effectively implement the AU's policies (NEPAD 2013) alongside other arms of the AU such as its longstanding Scientific Technical Research Commission (AU-STRC).

There is also widespread adoption of STI policies and institutional developments in support of these initiatives at the sub-regional level (UNESCO 2016) and by many SSA nations (AOSTI 2013). These developments are happening in the context of the adoption of the Sustainable Development Goals (SDGs) by the international community, which include specific reference to STI within SDG 17 (UNGA 2015). This contrasts with the absence of explicit reference to STI in the Millennium Development Goals, which some argue may have hampered efforts to pursue STI capacity building (HOC-STC 2012). Accompanying these policy developments there has been an increase in the number of donors interested, or active, in supporting STI in Africa compared with the support of just a few during the 1990s (AOSTI 2013).

2.3 Republic of Science versus Embedded Autonomy

As documented above, the grey and academic literature clearly outlines an increased interest in funding for science in SSA at the national, regional and international level. In addition, there have been several studies in the grey literature focusing on a series of questions relevant to efforts to renew or establish SGCs. These have included studies looking at the technical capacities SGCs need and how they can be supported to build them (AOSTI 2013) and studies analysing how to institutionalise SGCs (Mouton et al. 2014, 2015). Another stream of literature has focused on monitoring scientific output from the continent and trying to understand the factors behind publication and citation rates (Confraria and Godinho 2015; Tijssen 2007).

Whilst recognising the importance of these issues, we want to draw attention to a gap in the literature relating to a more fundamental question. What are the ideas and justifications that are underlying different actor's investments in science funding in SSA?

For a long period, a "Republic of Science" narrative of public science funding was largely dominant, roughly from the period that many SGCs were established in wealthy democracies following the second world war (Rip 1994) up until around 1980 (Flink and Kaldewey 2018). In this narrative, the scientific process is understood in terms of the Mertonian norms of universalism, communalism, disinterestedness and organized skepticism (Merton 1973). Amongst adherents to this view, there is a strong belief in the potential of basic science, if funded properly and left free from 'external' interference, to follow these norms and to deliver breakthroughs that can then be tailored to address society's problems through applied research further down the 'chain'. This imagery of a production line of basic science guided by scientific norms through to applied science and commercial innovation has been described as the linear model (Kline and Rosenberg 1986; Rothwell 1994). Based on this narrative, a succession of influential authors has argued that decisions about science should be protected from the world of politics and 'external' influences and decision making (Bush 1945; Polanyi 1962). Research funding institutions in

this narrative act like a parliament for the “Republic of Science”, where scientists, through processes of peer review, are granted autonomy to make decisions on funding. There is a level of accountability through requirements to report back to the governments funding the whole process with evidence showing the value of science, but on the whole scientists are left to their own devices by governments (Rip 1994).

Since around the 1980s there has been a steady erosion of the “Republic of Science” narrative and a proliferation of narratives that contain more ambiguous accounts of the scientific process and its links to societal benefits. Increasingly, narratives have arisen that question the linear relationship between scientific activity and societal benefits, and that draw on a wide range of ideas on how to link scientific activity to the interests of society. Examples include ideas such as “mode 2” science (Gibbons et al. 1994), the triple helix (Leydesdorff and Etzkowitz 1998), national systems of innovation (Freeman 1995; Lundvall 1992), responsible research and innovation (Hellström 2003; Owen et al. 2012), and ideas that science policy makers have championed themselves such as “frontier research” and “grand challenges” (Flink and Kaldewey 2018).

From a political economy perspective, Peter Evans’ concept of “embedded autonomy” is useful to borrow here to characterize these later narratives. Evans (1995) used this term to describe developmental states, with the observation that economically successful states carefully negotiated with their comparative advantage in the global trade and production systems while maintaining a certain level of agency in choosing industrial niches. What characterizes embedded autonomy is the ability to maintain autonomy from capture by elites whilst remaining embedded and responsive to the legitimate needs of industry. Evans (1995: 12) says “they are embedded in a concrete set of social ties that binds the state to society and provides institutionalized channels for the continual negotiation and renegotiation of goals and policies.”

The narratives that have arisen since the 1980s similarly maintain a space of autonomy for science, represented by the continued prominence of peer review, but increasingly funders are taking measures to embed this autonomy in a web of accountabilities to a range of actors including industrial and commercial partners, civil society organisations and government funders themselves. For example, they are increasingly setting more elaborate criteria of peer review that include considerations of the societal impact of research and creating specific programmes of funding to guide scientific agendas.

These longstanding debates around the level of autonomy that should be given to the scientific community, characterized here as a republic of science vs embedded autonomy model, continue to echo in new conversations around specific narratives. The debate that is currently resonating is that of what should constitute research excellence. Several authors have traced the rise to prominence of the idea of research excellence and attempted to deconstruct its meaning. The next section unpacks these accounts, considering the assumptions which underlie this narrative, and how they apply in a region like SSA.

2.4 Considerations of research excellence

Benner (2011) argues that the narrative of research excellence as a model of research governance rose to prominence on the back of the concept of the knowledge-based economy where “Knowledge is recognised as the driver of productivity and economic growth, leading to a new focus on the role of information, technology and learning in economic performance” (OECD 1996: 3). The idea is that the best way to produce this economically valuable knowledge is through concentrating resources on the most academically excellent institutions, groups and individuals. To do this, it prioritizes competitive funding mechanisms based on rigorous peer review in line with academic standards.

Benner argues that the scientific excellence narrative is a mix of Republic of Science type narratives that emphasize academic autonomy and linear conceptions of innovation developed under the rubric of innovation systems that emphasize the “systemic interaction between academic research, and the economy and significance of clusters around leading universities and research environments.” (Benner 2011: 11) He explains that for the links to be made between excellent science and economic growth it requires a scientific system at the forefront of knowledge and a rich flora of intermediaries connecting the breakthroughs to competitive science-based industries such as pharmaceuticals and chemistry. As Benner (2011) explains, in this case, there is not necessarily a contradiction between scientific excellence and societal relevance, at least in many areas of science.

However, increasingly, the suitability of this narrative to LMICs is being questioned. Vessuri et al. (2014) argue that equating excellence with citation impact in international journals can negatively affect science systems in developing countries. In this case, it is argued that seeking to produce excellent science, evaluated according to universal standards, has the potential to take research away from being relevant to local problems, as scientists are forced to follow research agendas developed in wealthy nations where the centre of gravity of the academic world lies. Bianco et al. (2016) make similar arguments in relation to Uruguay’s research system.

The points above raise crucial issues for science funding in SSA. If the origins of the excellence narrative are in advanced economies with leading academic systems, do the assumptions that link science to economic growth apply for SSA and, if yes, to what extent? Studies looking at the impact of different funding mechanisms note the limited evidence behind claims that traditional definitions of scientific excellence have a direct connection to social and economic impact (Chalmers et al. 2014; Cirera and Maloney 2017; Lepori 2010). It is beyond the scope of this article to conduct a comprehensive review of literature on the payback to investment in science funded according to traditional norms of excellence, but it is relevant to highlight the uncertainties and concerns about how this payback occurs. It is incumbent on those making the argument that this science funding model will lead to economic development, to clarify their train of logic for how it will work in SSA.

As these concerns have started to arise, and the tensions around understandings of excellence have become clearer, there is an emerging effort to create a version of excellence that is more suited to the context in SSA. In a recent paper, Tijssen and Kraemer-Mbula (2017) reflect on the idea that research excellence has become an influential idea in guiding funding decisions in SSA, both at the national SGC level and amongst regional funders. Their survey of 106 researchers and research funding co-ordinators found a wide diversity of perceptions of excellence but was able to draw on the range of opinions to develop a coherent notion of what an Africa-centric notion of research excellence could include. They conclude (2017: 10):

Any Africa-centric notion of [research excellence] should go beyond international research publications and scientific impact in the academic community, to embrace the wider impacts of researchers in their local or domestic environments. Truly excellent researchers should also be assessed on their ability to create broader impacts such as science-based teaching and training, fund raising, networking, mobility and cooperation, commercialisation, and innovation.

This is an interesting idea that should be further explored and debated, but the underlying issues are complex and will likely be hotly contested.

Overall the literature on science funding in SSA paints a picture of decline in national research funding systems followed by a recent renewal of efforts by national governments and international funders to

further develop knowledge production and the funding institutions to support it. The study we have conducted extends these existing analyses by examining recent dynamics at the regional level together with material from four East African country case studies. It also extends the literature by analysing prominent narratives around this increasing support and relating emerging narratives to longstanding debates in science policy about what science funding is for and the impact that can be expected over short and long terms. We have summarised some of that literature. Before reporting and then discussing our findings, we explain in the next section the methodology of the study.

3. Methods

In this study we compiled and analysed relevant data on financial support to science funding organisations in SSA. We looked at available and accessible peer reviewed and grey literature and conducted semi-structured interviews to gain insight into funding trends, SGC activities, and SGCs' understanding of their own and others' activities and roles in the context of wider institutional and structural factors. Finally, to the extent possible, we researched and analysed institutions to understand how institutions set routines and patterns that enable or constrain agency of SGCs and funding agencies.

To this end, we identified existing academic work on science and research funding in SSA and complemented it with a targeted search, using Google search, for relevant literature focussed on national contexts. The search, based on keywords such as 'capacity strengthening', 'research', 'science', 'Africa', 'science and technology' and 'funding', focussed on annual reports and policy documents. For the data review, we utilised relevant reports containing funding data, such as those from the OECD, World Bank and UNESCO.⁴

We also conducted semi-structured interviews both at the regional and the national level. For the regional level, 16 interviews were conducted. Interviewees were chosen either for their knowledge as members of staff at SSA and sub-regional science funding and policy bodies, and relevant international and multilateral science funding and policy organisations, or because of their positions as policy analysts or experts in science funding. The interviewees were purposively sampled using the following methods: 1) landscape scan to identify prominent organisations and individuals working in science funding; 2) consultation with our advisory group⁵; 3) suggestions from IDRC; and, 4) snowballing from people interviewed. The regional interview protocol aims mainly gathering data on regional science and research funders, and trends in science funding.

Table 1 shows the ten themes or issues for which interviewees gave information and also shows the number of interviewees providing relevant information for each of these themes or issues. The number of respondents against each theme or issue is not necessarily a reflection of its importance; in some cases, there was insufficient time to cover all the topics.

Table 1 Regional-level issues covered and number of substantive responses

Theme or issue	Number of substantive responses (out of 16)
Differences across sub-regions	9
Nature of influence	13
African political agendas	11
Actors and initiatives	14
STI and economic development	9
Nature of expected change	14
Data and indicators	3
SGC definitions and types	4

SGC practice	9
Capacity building	12

At the national level, we originally conducted five case studies (Ethiopia, Kenya, Rwanda and Tanzania and Senegal), based primarily on interviews with the goal of examining the role of national institutional conditions and challenges that determine funding agendas and decisions of science granting councils (see Chataway, et al., 2017 for the technical report). For this paper we are referring to only the four East African cases (a total of 32 interviews with those working in the SGCs and other relevant stakeholders) as this provides for a comprehensive look into the East African situation; a sub-region that traditionally has had a strong scientific history and garners (outside South Africa) a significant amount of publications and patents. ⁶The national-level case studies complimented the regional science funding analysis by revealing the institutional arrangement of SGCs, their funding autonomy and priorities of funding and how these are determined by different narratives and interests of agents involved in national science funding.

To improve the data reliability and validity, we piloted the interview protocols by testing the questions on a member of our advisory group and made some revisions before using the revised version as the basis of interviews with other contacts. We recognise the pitfalls of relying on individual interpretations from small numbers of individuals to represent complex and multifaceted organisations. In the context of this study, however, and within the limited time and resources available, it was necessary to use this approach. Despite their limitations, the interviews provide valuable insights and a good indication of current levels of support and narratives around that support.

Our initial approach to the literature review and expert interviews was based on an expectation that funding for science would have increased over the past decade and that STI policy was occupying an increasingly important place in policy agendas in African countries, following publication of the AU's Science and Technology Consolidated Plan of Action (AU and NEPAD 2005). We also had an expectation that there would be multiple different rationales. However, we did not begin the research with a clear idea of the drivers behind the momentum for increased funding and policy prominence or the nature of various narratives associated with different actors. The research was designed to explore those issues.

4. Results

4.1 The main regional science and research funders, and trends in science funding, in SSA

The empirical data from OECD, UNESCO and websites of international bodies, combined with information gathered via interviews, provides useful insights in addressing the issue of the direction of international funds for research. Figure 1 is an attempt to capture as much of the data and information as possible to show graphically who is funding research, their collaborations, how much money is flowing, and the targets of these money-flows. The diagram is necessarily incomplete as the data are themselves incomplete or inaccessible. Furthermore, the data represented include historical, current and future flows of grant funding or loans rather than a snapshot of funding at one point in time. The diagram would be too complicated if the periods covered for each funding flow were included, so we refer the reader to the spreadsheet in the supplementary material to this article. Also given in the spreadsheet are the sources of data for the various funding flows.

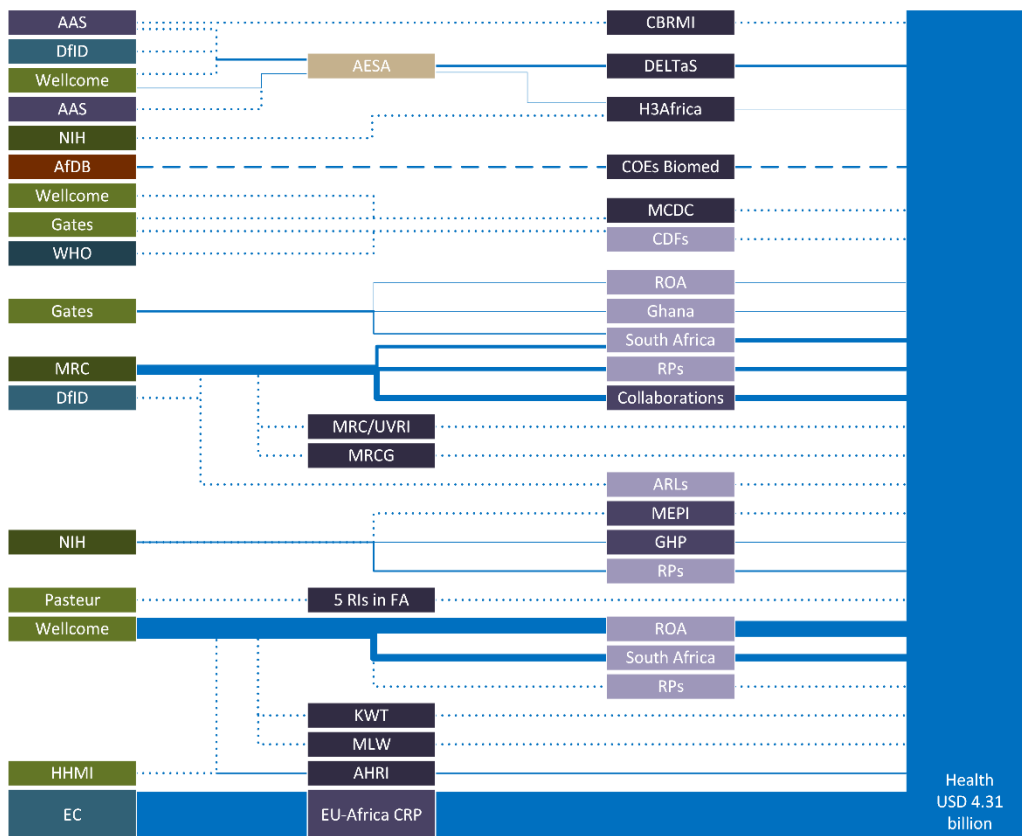
By far the largest funding flows, at USD 4.31 billion, are into the health sector but, at almost USD 1 billion, agriculture also receives significant funding. In addition to these two large funding flows, the 'Mixed' category (USD 1.9 billion) is likely to include money for health and agriculture, as well as

other sectors, but these are difficult to disaggregate from the information available. The findings also show that the main science and research funders in SSA are the European Commission, DFID, MasterCard, Wellcome Trust, Gates Foundation and the World Bank, although data on specific quantities of funding are not available in many instances. Perhaps one of the main messages arising from this first attempt to systematically catalogue science and research funding in SSA is that there is a clear and overwhelming bias towards a few sectors, and there is only a handful of significant sources of funding (all of which are external to SSA). What Figure 1 does not show, however, is the type of funding within each sectoral focus. Several interviewees commented on the importance of this data gap and considered that most of the funds for example would be in biomedical research rather than on health systems research. This is considered important because there is evidence that without health systems research the ability of national funders to use research results is constrained (Cochrane et al. 2017).

Analysis of funding trends shows there is support for producing individual scientists and research, and support for organisations, as well as support for initiatives that aim to improve the environment within which research takes place in SSA. According to interviewee Reg-J⁷, “The difference here is that there is much more about funding institutions and not so much about funding individual scientists, which is not always very sustainable. So, I think there is a shift to say let’s take the best research centres and best research universities and put money in them”. Relatedly, the document review shows a wider range of donors are now interested in promoting the formulation and implementation of national STI policies. This is another example of the shifting pattern of STI support, from individuals and organisations, to initiatives that support the science and research environment.

How these new organisations create their own narratives and establish their own legitimacy and credibility becomes increasingly important. Interviews and policy documents show that references to the production of excellence feature strongly in narratives but the potential tension between excellence and relevance to national development challenges is difficult to resolve. We come back to this in the discussion section below.

Figure 1 (Part A): STI actors, initiatives and funding flows to and in sub-Saharan Africa



LEGEND: COLOUR-CODING, LINES AND ABBREVIATIONS

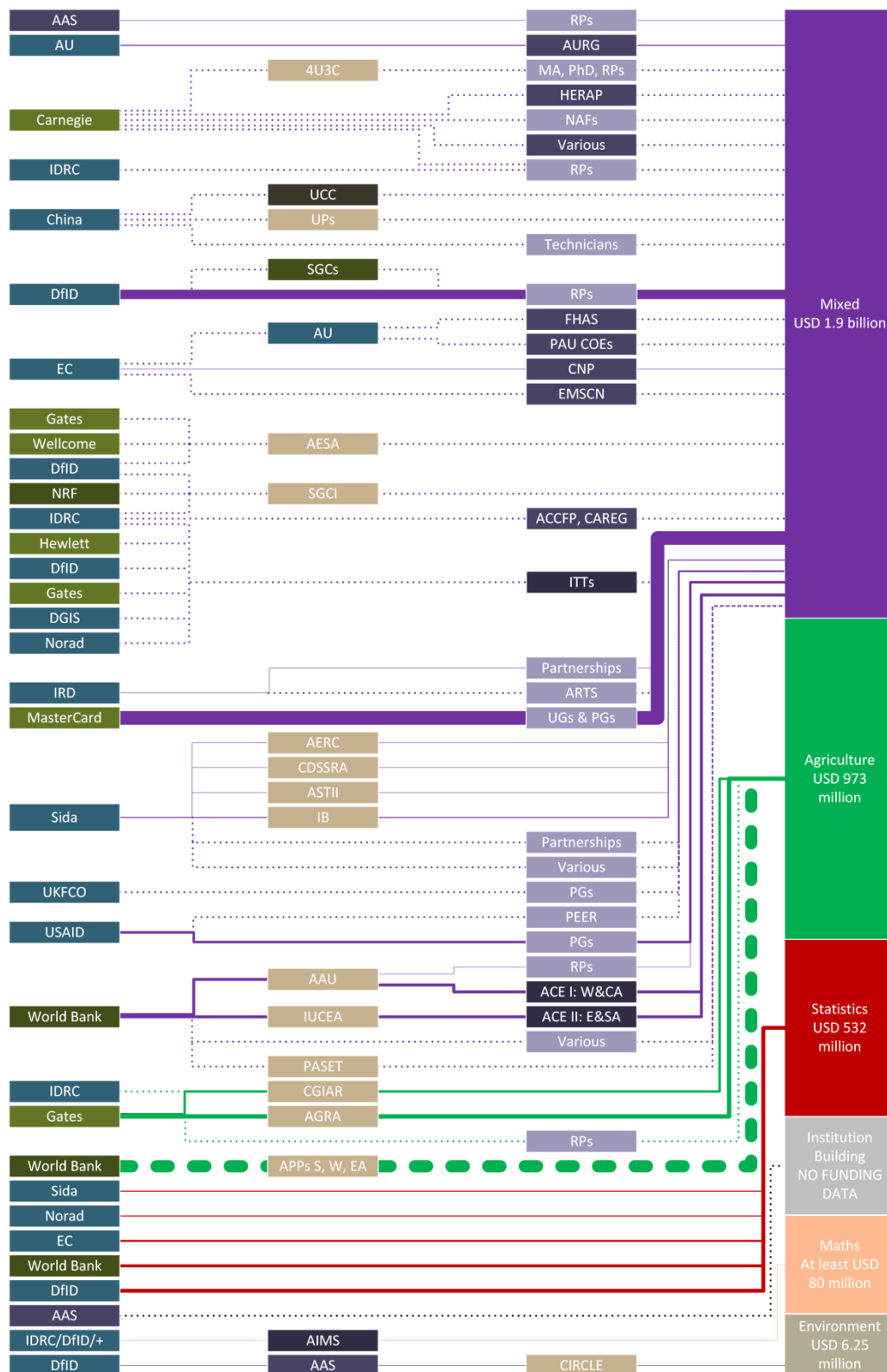
Actors, Programmes, Projects	Association	Donor	Foundation	Bank	Multilateral
	Research Council	Institute	Initiative	Programme	Research Project
Funding Flows	Quantified funding		Quantified lending	Unquantified funding	

Note: Line thickness reflects quantity but is not to scale; historical and future funding flows are mixed

Abbreviations and Acronyms

- 4U3C: 4 universities in 3 countries
- AAS: African Academy of Science
- ACCFP: African Climate Change Fellowship Program
- ACE: African Higher Education Centre of Excellence
- AERC: African Economic Research Consortium
- AESA: Alliance for Accelerating Excellence in Science in Africa
- AfDB: African Development Bank
- AGRA: Alliance for a Green Revolution in Africa
- AHRI: Africa Health Research Institute (South Africa)
- AIMS: African Institute for Mathematical Sciences
- APP: Agricultural Productivity Program
- ARL: African Research Leaders
- ARTS: Allocations de Recherche pour une Thèse au Sud
- ASTII: Africa Science, Technology and Innovation Indicators
- AU: African Union
- AURG: African Union Research Grants Programme
- CAREG: Canada-Africa Research Exchange Grants
- Carnegie: Carnegie Corporation of New York
- CBRMI: Cell Biology and Regenerative Medicine Initiative
- CDf: Career Development Fellowship
- CDSsRA: Council for the Development of Social Science Research in Africa
- CGIAR: Consultative Group on International Agricultural Research
- CIRCLE: Climate Impacts Research Capacity and Leadership Enhancement
- CNP: CAAST-Net Plus
- COE: Centre of Excellence
- CRP: Collaborative Research Programmes
- DELTA: Developing Excellence in Leadership, Training and Science
- DfID: UK Department for International Development
- DGIS: Dutch Directorate-General for International Cooperation
- EC: European Commission
- EMSCN: Erasmus +, Marie Skłodowska-Curie and Nyerere
- FA: Francophone Africa
- FHAS: Funding Harmonisation and Quality-Assurance Schemes
- Gates: Bill and Melinda Gates Foundation
- GHP: Global Health Program for Fellows and Scholars
- H3Africa: Human Heredity and Health in Africa
- HERAP: Higher Education and Research in Africa Program
- Hewlett: William and Flora Hewlett Foundation
- HHMI: Howard Hughes Medical Institute
- IB: Institution Building
- IDRC: Canadian International Development Research Centre
- IRD: French Institute of Research for Development
- ITT: Independent Think Tank
- IUCEA: Inter-University Council for East Africa
- KWT: KEMRI-Wellcome Trust Research Programme
- MCD: Malaria Capacity Development Consortium
- MEPI: Medical Education Partnership Initiative
- MLW: Malawi-Liverpool-Wellcome Trust Clinical Research Programme
- MRC/UVRI: UK Medical Research Council/Uganda Virus Research Institute
- MRC: UK Medical Research Council
- MRCG: MRC Unit The Gambia
- NAF: Network Initiatives and Fellowships for African Academics
- NIH: US National Institutes of Health
- NRF: South African National Research Foundation
- PASET: Partnership for Skills in Applied Sciences, Engineering, and Technology
- Pasteur: Institut Pasteur
- PAU COE: Pan-African University Centre of Excellence
- PEER: Partnership for Enhanced Engagement in Research
- RI: Research Institute
- ROA: Rest of Africa
- RP: Research Project
- SGC: Science Granting Council
- SGCI: Science Granting Councils Initiative
- UCC: Universities and Colleges Construction
- UKFCO: UK Foreign and Commonwealth Office
- UP: University Partnership
- Wellcome: Wellcome Trust
- WHO: World Health Organization
- W, S, C, EA: West, Southern, Central, Eastern Africa
- UG/PG/MA/PhD: Scholarships

Figure 1 (Part B): STI actors, initiatives and funding flows to and in sub-Saharan Africa



Source: Authors. Legend applies to both parts A and B

Although the data suggest a continuing focus on health and agriculture at the regional level, interviewees suggested that this may change over the coming years. Several reasons were mentioned but one important factor stated was the speculation that as national agendas evolve there will be a diversification of research funding with more money dedicated to areas with direct economic, social

and environmental impact. This may mean more funds going to areas other than health or agriculture or, related to the previous point, a change in the nature of funding priorities in these areas. Several interviewees mentioned the importance of moving away from research priorities determined by the international cutting-edge research agenda to locally defined priorities. As national funders grow in presence and power, a number of interviewees considered either that they would or should come to have a greater impact on the direction of funding by traditional donors at the regional level.

Expanding on this point, the findings, based on both interviews and document review, suggest that future trends will include more funding for, amongst others, ICT, energy, climate change and a greater presence of actors from Asia, e.g. Japanese and Chinese-supported science and research activities.

In terms of agenda setting, findings from interviews and document review indicate a greater tendency at the regional level towards ‘science for science’, i.e. excellence in science as defined by academic criteria and publication and in top journals. One interviewee (Reg-L) went as far as to say “...there are no two models of research excellence. There is one model. We aim to fund the generation of data that is re-doable and can be published anywhere. We are very careful to insist on benchmarking with the best science. Science is science. Period”.

This approach is reflected in norms and operational procedures of emerging regional actors such as the Alliance for Accelerating Excellence in Science in Africa (AESA) and many others. AESA is committed to funding based on scientific merit alone. Whilst active in funding workshops and activities to enhance capacity of researchers to bid for grants, AESA does not see that funding decisions should be made on equity criteria or in relation to national agendas. Scientific excellence is perceived to be evidenced by publication in top journals and other indicators of academic recognition. The idea that investment in excellent science will deliver social and economic benefits in a linear way, fundamental to much post-second world war science policy in the West, underpins this narrative about how excellence should be defined. In this view, scientists and researchers play the key role in determining the direction of funding and investment. ‘Responsive mode’ mechanisms are core to structuring funding calls, but certain amounts of funding may be designated to priority subject areas.

The interviewee Reg-L comment above on excellent science is perhaps the most straightforward example of the ‘Republic of Science’ narrative at play in SSA, and the operational procedures of actors such as AESA are perhaps the clearest institutionalisation of this narrative. Whether this push for excellent science will deliver social and economic benefits in any traceable way remains to be seen but one interviewee (Reg-O) commented that the excellence debate “is a bit of a rabbit hole” and is based on a false dichotomy. The same interviewee went on to say there is “that excellence that is rooted in Cambridge and Oxford notions of what constitutes excellence. It isn’t clear what the alternative is but clear that you don’t have to chuck it all out to do something different”.

Other interviewees mostly expressed mixed narratives in their comments and so the evidence for the presence of different narratives is less clear. However, examining some of those comments, and policy statements such as those in STISA 2024, we can infer what some of the assumptions are underpinning ideas about science and its links with development outcomes. For example, a relatively clear expression of linear-model assumptions was given by interviewee Reg-M who said, “[t]he private sector is important because we need to be able to translate what we do in the lab to be able to work outside in the private [sector]”. But other interviewees expressed both systemic and linear ideas about the place of science in relation to achieving development benefits and, as such, demonstrate Benner’s (2011) argument about the scientific excellence narrative (see the discussion in Section 2.4). Interviewee Reg-C, for instance, talked about strengthening the coordination of institutions, providing policy support, facilitating collaboration, and improving the mobility of researchers, as well as providing support for

countries to reach the continentally-agreed target for R&D spending of 1% of GDP. From these comments, we can infer systemic assumptions (e.g. improved institutional environment through policy support and coordination, relationship-building through collaboration and increased mobility), as well as more linear notions such as increased R&D spending (i.e. the input to the science-to-society knowledge-production line). Interviewee Reg-I hinted at a systemic environment but saw this as being built upwards from scientific practice, talking about developing “environments in which we can build capacity ... not through training but through good science”.

More ambiguously, interviewee Reg-G, commenting on STEM capacity needs, argued that “in engineering, we need to start with long-term capacity building ... we are not going to get excellent science, and we have problems linking it up with industry, etc., because [the base] is not yet there”. Here, it is unclear whether the aspired links with industry are assumed to be unidirectional channels for delivering scientific outputs or whether they are assumed to be bidirectional, reflecting a systemic understanding. But other comments by the same interviewee suggest an interpretation that leans towards the more linear understanding and something of the Republic of Science narrative: “if you want good science you need good people ... use competition that is open to talent across the region so you want talent to flow to the centres that make sense”. The “centres that make sense” would be those that interviewee Reg-J described as “the best research centres and best research universities”, as we cited earlier in this section.

Looking to regional policy, the AU’s STISA 2024 also displays something of the mixed narratives we argue are at play. For example, from AUC (2014, p31, emphasis added):

Increasing networking and collaboration between education and research, private and public-sector stakeholders (at both national and regional level) will facilitate co-creation, adaptation and *commercialisation of research and innovation outputs* while ensuring research and innovation programmes are regularly valorised for impact and alignment with national and regional policy objectives as these continue to evolve.

Such commitment to national and cross-border coordination of research and innovation actors will strengthen the socio-economic situation of the continent through local ownership and wider utilization of research outputs ... Taking a systematic approach to technology transfer and knowledge sharing, co-creation and adaptation of new products, services, processes, business models and policies and *commercialization of research and innovation outputs* will stimulate local, national and regional Innovation ecosystems.

Whilst there are several references in the cited text to systemic notions (networking, collaboration between diverse stakeholders, and use of the term “innovation ecosystems”), the italicised text “commercialisation of research and innovation outputs” is suggestive of a linear understanding in which research feeds outputs into the market. Interestingly, there are also ideas in the cited text that reflect the embedded autonomy notion we discussed in Section 2.3, where we referred to a “web of accountabilities”, when the text mentions valorisation for impact and alignment with evolving policy objectives.

At national level, as discussed below, the importance of academic excellence in science is acknowledged; nevertheless, there is a significant push towards making science more relevant to national goals and priorities. This finding is supported by evidence from a recent study by Tijssen and Kraemer-Mbula (2017) discussed in section 2.4 above.

4.2 National science funding trends in SSA from case studies of four countries

In this section we summarize the results from case studies in Ethiopia, Kenya, Rwanda and Tanzania. At the national levels, funding remains low. Despite commitments by countries to increase funding for science and research, none of the case study countries has reached their own target spend. Table 2 provides an overview of key country-characteristics that were considered in case selection.

Table 2 Comparison of case study countries' spend on R&D and mandated targets

	Current (as of 2017) spend on R&D (% of GDP)	Target spend on R&D (% of GDP)
Ethiopia	0.60	1.5
Kenya	0.79	2.0
Rwanda	0.17	0.5
Tanzania	0.53	1.0

Source: <http://data.worldbank.org>, http://www.costech.or.tz/?page_id=1616 (accessed 18 May 2017) and key informant interviews

However, the trend is a move towards increasing funding either through direct public funding for science and research or through engagements with international donors (e.g. DfID, Gates, Wellcome, and the World Bank) or regional funders (e.g. AESA). This trend is due in part to increased pressure from the African science community on governments and other actors, such as the private sector, to fund science better, and also support decision making and policy making.

Figures in the UNESCO Science Report (UNESCO 2016) show that Ethiopia, Kenya, and Tanzania⁸ have funding from government allocated to research and development. Government is the major source of funding for Ethiopia (approximately 80%) and for Tanzania (58%) while others such as Kenya only receive around 25 per cent from government. International donors and foreign universities provide over 40 per cent of R&D funding in the case of Kenya, and Tanzania. No country has large amounts of funding from the private sector to conduct research although interviewees (e.g. Ken-E, Ken-H, Eth-G, Tan-D, Tan-H) from national SGCs and other stakeholders spoke about the importance of the private sector as a funder and there are some interesting examples of other funding sources being pursued⁹. For example, Tanzania has a telecoms fund, which means a percentage of money made by the mobile phone operators in Tanzania is given directly to the National Fund for the Advancement of Science and Technology. However, due to the sources and nature of funds from the regional level, there are pressures on domestic researchers to focus on work that may not necessarily be a local priority, but rather dictated by the agendas of international funders.

A key finding from our national case studies was the importance of political will in determining how much, and for what purpose science funding was given. The basis of the political momentum is largely related to narratives which emphasise social and economic gains from research in the short term. Key informants, for instance, in Ethiopia reported that there is a strong will by the Government to make scientific research relevant to local development (Eth-B, Eth-D, Eth-C, Eth-G). An interviewee suggested that there was a desire by the Ethiopian Government to increasingly finance development research that targets socio-economic challenges (Eth-B). This was mainly due to increasing financial capability of the Government because of recent economic growth as well as increasing number of technocrats in Government positions (Eth-B). Government's will was also reflected in national policy. For example, the Science, Technology and Innovation (STI) policy of Ethiopia included strengthening research among the 11 critical issues and strategies of science and technology intervention in Ethiopia.

As such, it suggested key strategies to strengthen national research in Ethiopia, which include supporting research institutes to ensure efficient learning, transfer, adaptation and utilization of technology, nurturing collaborative research among research institutes, and ensure linkage between research institutes and industries (FDRE, 2012). The apparent political will had resulted in the drive in research funding for applied research in recent years in Ethiopia.

Similarly, interviewees in Rwanda stressed the “strong place of STI in politics” because it sat within the Office of the President, signifying the political commitment placed on STI in the country (Rwa-A, Rwa-B, Rwa-C, Rwa-D, Rwa-G, Rwa-H). Additionally, interviewees highlighted the commitment of the Rwandan government to science and technology more broadly by the following cases. First, an interviewee from the National Industrial Research and Development Agency (NIRDA) indicated that the Government has allocated significant amount of financial resources for technology research and acquisition to support value-adding manufacturing in dairy, honey, banana, potato, and ceramics (Rwa-E). The Rwandan Government targets each of its 30 districts to have at least one factory based on available raw materials, skills and other sets of competitive advantages by 2021. This requires a significant applied research (Ibid). This may partly explain why the Government recently re-structured the National Council of Science and Technology to be a national research funding commission. Second, Rwanda has adopted a university training system in which 80% of new undergraduate students are enrolled in Science, Technology, Engineering and Mathematics (STEM) fields, which will directly support local scientific research and industrialisation. This is planned to be increased to 90% progressively (Rwa-D). In short, Rwanda and Ethiopia have conspicuously put harnessing the ‘developmental’ value of state-supported scientific research among their key policy agenda in line with their ‘developmental state’ narratives (Matfess, 2015).

In addition to issues of ‘political will’ were issues of ‘political cycles’. Several key informant interviews across the case study countries highlighted the importance of – and challenges from – political cycles (for example Eth-B, Eth-G, Eth-A, Rwa-G, Rwa-F, Ken-C, Ken-D, Tan-C, Tan-D, Tan-G and Tan-H). An interviewee in Kenya (Ken-D) stated that “because of the change of government which happens every five years we get a shifting of priorities regularly. Each government comes with different priorities (some are passionate about research and others are not).” Similarly, in Tanzania there was a strong sense that STI policy was influenced by the governments’ development strategy resulting in an initial focus on STI and science funding related to agriculture because the government promoted a development strategy putting agriculture first (known as ‘Kilimo Kwanza’). More recently, attention has shifted towards technology and manufacturing being supported because the latest development strategy aims to create an “Industrialised Tanzania”. Similarly, there is evidence in the case studies conducted of national development strategies, as well as international development strategies (the MDGs and now SDGs) being used as “focussing devices” with positive impacts in Kenya and Rwanda. For example, Kenya’s development strategy, Vision 2030, makes STI a pillar for economic and social development success and sets out various STI related flagship projects providing a highly visible focus on STI matters at government level (Ken-B, Ken-D). However, although the institutionalisation patterns differ across countries, interviewees from all countries identified a common problem with stability and lack of funding.

Finally, the case studies highlighted a desire for science which contributes to immediate social and economic challenges or has ‘impact’. This was mentioned frequently by interviewees in all four case study countries while the issue of high quality publications or patents was not. A comment (paraphrased) by a respondent in Tanzania sums up this sentiment: ‘it’s not how much is invested in R&D but what is done with it that is the key’. Linked to this was a debate that came up across all case study countries as to the relative merits of funding basic or applied research. In Rwanda it was made

clear that a decision had been made to move from funding of basic research to applied research while in Ethiopia the government focused on funding applied research. In Tanzania and Kenya there was a lot more debate on the relative merits of funding applied research at the expense of basic research. In general, there appears to be an overwhelming focus now on applied research which is often sector focused with agriculture and health getting significant levels of funding. There also appears to be an increasing focus on research that is multi-disciplinary (although sometimes still within the overarching confines of a sector approach). It should be noted however that there was no real consensus of what is meant by 'applied' or 'multi-disciplinary' research. Finally, one interviewee in Ethiopia highlighted the need for user engagement in defining priority areas. While no other interviewee appears to have focused on this, there is an underlying theme that comes out of the interviews and secondary data review of a 'turn' towards demand led research or the rise in rhetoric of this nature; especially in terms of funding efforts meeting development goals and where there are problems facing a country's population.

5. Models of science funding and the challenges for science granting councils

Our study shows that SGCs in SSA are likely to face difficult decisions in terms of what kind of science funding model to adopt, adapt, develop and prioritise. These decisions are not simply technocratic matters that can be based on ideas of merit alone. Instead, for each SGC, their choice of which direction to take their institution will align them with some actors in the science system while potentially alienating them from others.

If they choose to follow the traditional research excellence model, essentially following the traditional Republic of Science narrative, this could have the benefit of aligning them with powerful regional emerging actors such as AESA. It could also lead to ease of collaboration with regional and international academic partners and have implications for reputation amongst international science funding and policy actors. It could also align them to elements of their domestic scientific communities who are seeking to be recognised according to international metrics of excellence, and who are seeking to strengthen their position in international science and research networks. However, if this produces a funding system that is seen to be aloof from national priorities and in the end may fail to produce the promised economic payoffs within a timescale governments expect, it could damage SGCs' ability to secure political support for stable and continued funding in the long term.

If SGCs adopt a strong version of embedded autonomy, where a range of conditions is put on funding to guide science towards national priorities and goals, this could also put them in a difficult position. It is clear from the literature and the findings of our study that many in the scientific community in SSA receive relatively large amounts of funding from international sources. This means that scientists who have the reputations and ability to gain international funding and have an interest in maintaining their autonomy from government direction could (seek to) bypass emerging national level SGCs and seek funding from the regional and international level if their interests do not align.

At the moment there seems to be a mixture of narratives at the national level. Our study finds that whilst national SGC decision makers may agree with and use aspects of the traditional 'scientific excellence' narrative, they also express the view that science should reflect capacity building agendas and national priorities. This finding, indicating a preference for a mixed approach, is an important outcome that should have implications for shaping the future of SGCs and their roles in SSA, and SGCs in other LMICs. Many of the national decision makers that we interviewed were keen to stress the need for increased integration between scientific agendas and broader social and economic goals. This is similar in many ways to the Africa-centric notion of research excellence described above. But it is unclear how actual funding mechanisms and decision making will reflect these inconsistencies. This set of decisions is made much harder by the relative lack of resources at the national level in SSA, making it difficult to

pursue multiple strategies successfully at the same time. Although difficult given the emergent nature of SGCs, careful consideration of strategic intent in funding decisions and closer collaboration with regional bodies may be necessary.

6. Conclusion

This paper has documented current increased policy and resource commitments to science funding in Sub-Saharan Africa. At regional and national level, a variety of established and new actors are renewing their efforts to support science. However, the paper demonstrates that the rationales behind these efforts are diverse and that there are differences regarding thinking about how science can best contribute to society.

On the one hand, there is a set of arguments that justify science funding based on committing resources to excellent science as defined in traditional ways by publication in high impact journals with decisions informed by peer review. In this view, science is more self-contained and, although narratives are modified, the importance placed on scientific (or research) excellence can be traced back to those intellectuals and policymakers who broke new ground in science policy by articulating the norms and conventions of a Republic of Science.

On the other hand, there are strong calls for science and research funding that is more immediately aligned with social and economic agendas. In this case, conventional peer review and assessment of academic outputs will have their place in decision making but a range of other criteria and stakeholders are thought important. This view seems more aligned with a notion of Embedded Autonomy and to science being more explicitly related to broader social and economic goals rather than having its own Republic. Considered in this way, there are not only differences in perspectives in SSA about what science granting councils are for, but also differences in expectations about who should benefit.

More embedded approaches may therefore imply that research funders and, by extension, academics accept that their performance will be judged by the extent to which they contribute to social and economic goals rather than purely academic achievement. This topic has been the subject of much debate in High Income Countries (HICs) in recent years. Many of the more general features of the debate in SSA are the same, but the scarcity of resources available means that the implications of decisions are different. In HIC contexts, there is enough resource available to allow for different approaches, norms and measures of success to sit alongside each other. In SSA, local research funding is much more limited. Regional bodies, as we have seen, sit in a difficult position between aiming to produce academic outputs that attract international endorsement, and get published in high impact journals, and meeting local needs. The limited scale of SGCs in the case study countries and the relatively small number of research active academics in SSA also adds profound challenges in trying to deliver on both Republic of Science and Embedded Autonomy agendas. Our research points to the need to understand much more about how different elements of agendas can be prioritised in policy and institutional agendas and how those agendas reflect coherent ideas and policy narratives. In doing this, we need to understand the emergence of SGCs not only in relation to their place in structures and political-economic systems but also in relation to their alignment with and articulation of ideas and narratives associated with science funding.

This research is far from a complete account, but we have built on scarce literature and made contributions to opening this field. There are no clear formulas on how science funding should operate and how SGCs should constitute or govern themselves. At a time when new national and regional commitments are being made to supporting and using science, it will be important for analysts and policy makers to monitor and evaluate how SGCs are evolving, how relationships with other national

bodies and with regional and international funders are taking shape, and how this is impacting on SGCs being able to meet the aims and objectives of their funding programmes.

Finally, this study has used national-level case studies from Eastern Africa only. Although we had conducted a light-touch case study in Senegal (and reported it in Chataway et al., 2017), we did not include it in this paper due to methodological and empirical limitations. We believe that detailed national-level case studies on the science funding dynamics of the Western Africa region would be an asset considering that the region has a long experience with science funding and policy. This could be an arena for future research.

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- Reg-J, University management, interview.

Reg-L, Regional SGC management, interview
Reg-O, Civil Society representative, interview
Reg-M, Regional SGC management, interview

Notes

¹ 1960 is the year around which many Sub-Saharan African countries gained their independence.

² The SGCI in Sub-Saharan Africa ‘aims to strengthen the capacities of science granting councils in Sub-Saharan Africa in order to support research and evidence-based policies that will contribute to the continent’s economic and social development’ (Source: <http://www.sgciafrica.org/> accessed 16 July 2017). The SGCI is a project co-funded by the United Kingdom Department for International Development (DFID), Canada’s International Development Research Centre (IDRC), and South Africa’s National Research Foundation (NRF).

³ We use “science” and “research” interchangeably in this paper, and the terms refer to activities in the natural and social sciences, as well as the humanities.

⁴ The list of sources consulted for the data review are contained in Supplementary Data file available online only. Information was taken from organisation’s websites, publicly available datasets and the grey literature. Where funding information for an activity could not be found the box is left blank. The list of organisations that we looked at was compiled in consultation with our project advisory group. In addition, we looked at organisations that were referred to by the regional level interviewees.

⁵ Our advisory group was made up of five senior academics with experience of working with science funders and granting councils across Africa.

⁶ A full list of interviewees for the regional and national levels and grouped by type and country is provided with the online version of this article at Supplementary Data 2.

⁷ Details of the interviewee references in brackets are provided in the bibliography and in Supplementary Data table 2 available with the online version of this article.

⁸ No data were available for Rwanda.

⁹ These are data from the 2015 UNESCO Science Report. The research team did however receive anecdotal evidence that the private sector is a large investor in some sectors: for example, research in the biotechnology field in Kenya. Such evidence highlights the need for more robust data capture and the difficulty of high level indicators to capture the nuances of the reality on the ground in many African countries.