

Research in Arabic-speaking countries: Funding competitions, international collaboration, and career incentives

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Abstract

Morocco, Tunisia, Egypt, Lebanon, Jordan, and Qatar expanded research funds over the past two decades. The use of competitive calls required researchers to prepare and submit proposals for team-based projects or time-limited research units. Identification of national priorities and societal challenges sought to rally research toward real-world problems, while larger grants encouraged a wider range of research activities and greater levels of ambition. Yet, the incentives within hiring organizations still determine how researchers allocate their time and effort, including whether they even seek external funding or collaboration. Selection and evaluation criteria privileged collaboration with distant, scientifically proficient partners abroad, in order to connect with global networks and rise in international rankings of academic quality. Moving forward, countries need to consider how funding opportunities shape the size and organization of distinct research efforts, and which arrangements are best suited to making meaningful progress on different problems of societal and scientific interest.

Key words: research funding; Middle East; North Africa; careers; incentives.

1. Introduction

Numerous countries across world have created or expanded public research funds over the past two decades. Investments by Arabic-speaking countries reveal a willingness to exercise greater sovereignty over national research system, building domestic capacity and directing research efforts. The aim of such funds can vary, from enhancing the country's standing in international rankings of academic quality, to encouraging the production of knowledge and innovation considered useful for society and economy. There is particular interest in the potential for research to help realize the Sustainable Development Goals (SDGs), as poverty levels across the Arabic-speaking region remained stagnant or increased over the past two decades, exceeding 25–40 per cent in many countries (Hanief 2016). The design of funding opportunities helps shape the national research system, albeit mediated by other factors that motivate local researchers and the extent to which they seek out funding and collaboration.

This article examines six Arabic-speaking countries that created or expanded public research funds, namely Morocco, Tunisia, Egypt,

Lebanon, Jordan, and Qatar. These countries were selected to better understand research governance in middle-income countries in the region, with Qatar serving as a high-income comparison in the Gulf.¹ A meeting of research managers held in 2014, explored the potential for these funds to support research that addresses national development plans and the needs of poor and vulnerable people. Further information is drawn from a scoping study (Arvanitis et al. 2014), over thirty interviews conducted during 2013–16, and the authors' professional experience in managing and performing research. The six countries mentioned represent a cross section of Arabic-speaking countries extending from Maghreb in the West, through lower Nile basin and Mashriq countries at the Center, and to Gulf Cooperation Council to the East.² Apart from their geographical proximity and shared language, these countries have similarities in policy and institutional arrangements.

The first section briefly synthesizes key concepts from the literature, which portray funders as intermediary organizations within networks of principal–agent relationships of research governance. The second section identifies trends, including the adoption of

funding competitions, rise in international collaboration, and continuity in career incentives. The third section discusses the implications of these trends, including the persistence of the funds despite social and political turmoil, the influence of funding on the size and organization of research efforts, and how different forms of organization are suited to making progress on different problems of societal and scientific interest. Moving forward, countries can be more intentional regarding how the design of funding opportunities influences the structure and performance of the domestic research system.

2. Understanding research funders

Research funders are commonly described using the economic theory of principal–agent relations (Braun 1993; van der Meulen 2003) which cast the funder as providing payment to researchers in return for a service. Due to limited budgets and political demands, many funders tightened this relationship, becoming more prescriptive on the outcomes desired and adopting elaborate evaluation techniques to monitor the performance of grantees (Whitley and Gläser 2007; Hessels et al. 2009). Indeed while research funders can appear to be a principal to the scientific community, they are themselves an agent of powerful backers, whether governments or trustees. As intermediary organizations, funders must also satisfy political masters that control financial resources and hold certain expectations regarding the funder's performance (Meyer and Kearnes 2013). At the same time, funds must maintain credibility among the scientific community in order to attract and rally research efforts toward the funder's program. Researchers can choose to ignore funding competitions from funders that are perceived as unscientific or overly bureaucratic.

Thus research funders are not fully autonomous, but rather embedded in networks of public management, or 'performance regimes' (Talbot 2008). These networks expose managers and trustees to outside ideas from government or philanthropy. The work of selecting projects and administering grants can coincide with responsibility for setting national policy and strategy, or accounting for science budgets and performance (Mouton et al. 2015). Research funders vary in their ability to command the attention of the scientific community. The conceptual framing of principal–agent relations assumes the principal is able to exert an influence upon the behavior of the agent. Yet where diverse funding opportunities exist, researchers can select among these opportunities to further their own curiosity and careers (Shove 2003). This is particularly acute where multiple funds compete for the attention of the scientific community, or where researchers have the option to access international funding opportunities. Diversity among funding sources is generally viewed as contributing to a more vibrant research landscape, by encouraging diverse ideas and creating opportunities for different teams and approaches (Ely and Leach 2010). Invariably it also means that some funding opportunities will be more attractive than others, and more able to command the time and attention of the research community. Conversely, how funding opportunities are designed and implemented can have important implications for the scientific community, that stretch beyond who gets funded to do what.

Networks of principal–agent relationships are embedded in distinct models of research governance. For example, Brenner (2011) contrasts Anglo and continental European models. While France tended to combine funding and performing of research, the UK separated these roles, stemming in part from distinct approaches to public management. The *Centre national de recherche scientifique* (CNRS) includes public research-performing arrangements and provides scientists with a career as civil servants. In contrast, publicly-

funded research in the UK largely moved into universities, supported by a dual structure of research funding through block grants and the research councils. Morocco, Tunisia, and Lebanon incorporated elements of the French tradition of research governance, while Egypt and Jordan adopted elements of the British tradition. In contrast, Gulf Cooperation Council countries tend to look toward the USA and Asia, establishing branch campuses of American universities and fostering links with industry. It is easy to overstate these traditions or their influence in the region. Especially as France began to distinguish research performers and funders in the 2000s (Hubert and Louvel 2012), the region has sought to create distinctly Arab institutions despite continued use of French and English as a *lingua franca* in natural sciences and some teaching.

National research priorities and 'challenge' mechanisms grew in prominence within Western countries due to political pressure for greater transparency in the allocation of funding and greater scrutiny of the results obtained from that funding (Buchsbbaum et al. 2016). The language of 'challenges' implies high stakes in the potential cost or benefit to society, phenomenon covering a wide geographic scale, and a scope of effort that exceeds the capacity of individual organizations or nations working in isolation (Kallurd et al. 2013). This language is partially rhetoric: serving to justify increases to public spending, to narrow the research agenda on a limited set of problems, and to increase the ambition regarding what science is expected to deliver to society. Challenge mechanisms appear to work best when the problems addressed and desirable solutions can be clearly defined in terms of engineering or design criteria.³ Yet societal challenges are often 'wicked' problems characterized by uncertainty, driven by complex causality, and defying easy solutions (Rittel and Webber 1973). Consequently a challenge mechanism is less suited to problems that are deeply polemic or socially taboo and are less amenable to research. For example, finding the causes of—and solutions to—sexual violence requires political will and public values, and not merely empirical evidence and technological innovation.

The key point is that the way research is funded matters. Different opportunities require the research community to organize their efforts in certain ways, such as project proposals, bids, contracts, or research strategy. Additionally funders selectively reward research efforts based on various criteria, included qualifications, past productivity or potential to publish, or perceived contribution to policy goals. Funding opportunities thus exert an influence on the structure of the national research system and shape performance expectations among researchers.

3. Trends in research funding

Before identifying recent trends in Arabic-speaking countries, it is useful to examine what motivated the creation and evolution of these research systems. National universities and research centers were established in the late nineteenth and early twentieth century. These institutions combined inspiration from how science was organized in colonial or protectorate powers, with nationalist visions of teaching and research in service of self-sufficiency following independence. After independence, many countries expanded public education. For example, Egypt saw the number of university students increase four-fold between 1952 and 1965. The goal was to generate a skilled workforce needed to run the country, underpinned by a social contract that promised public jobs for graduates. Even when employment in government slowed, student numbers continued to rise. Many graduates thus found themselves without employment, over 30 per cent in Egypt, Tunisia, and Jordan (Hanieh 2016).

A subsequent expansion in the number of private universities, made possible by a turn toward more liberal economic policy, responded to a perceived decline in the quality of public education and promise of skills in demand within the labor market. Research was well established in older private universities, such as the American Universities of Beirut (AUB) and in Cairo (AUC), yet squeezed under high teaching workload in public universities and practically non-existent in many newer universities. Meanwhile public research centers became more of a burden than source of pride, and suffered under a lack of funding and purpose. Few such centers were closed outright, but many struggled with limited budgets that barely cover meager salaries and operating costs, leaving precious little for research expenses.

Arabic-speaking countries are responsible for about 1 per cent of world research yet are home to 3 per cent of world population. [Waaast \(2010\)](#) even questions whether one can speak of a scientific community or research system within many of these countries given modest levels of research expenditures and outputs. Recent estimates suggest that Arabic-speaking countries spend in the order of USD 10 billion on research, of which half is in the Gulf States, one-third in Egypt and the Levant, and the remaining one-fifth in the Maghreb ([Clarke et al. 2015](#); [UNESCO 2015](#)). This amount is comparable to the research spending of Belgium or Mexico, or the combined spending by Iran and Turkey (USD 7 and 3 billion). Some caution is warranted with these figures, as the available data were neither gathered under a common standard, nor by a common observatory ([Aksnes et al. 2016](#)).

Researchers recount having multiple demands on their time and relying on limited intramural flows within their hiring organizations, rather than seek external grants. Policy and funding focus predominantly on natural sciences, including application in agricultural, energy, and medical sciences. Recent policy emphasizes the instrumental value of research and its potential to create products that permit the country to enhance its production and insert itself into global value chains. Consequently, there is less attention to the conceptual value of research, of generating concepts and theories that allow society to better understand social, economic, and political phenomena. Indeed there are clear sensitivities regarding research on such topics as well as research critical of government policy or political figures.

Recent decades witnessed numerous reforms in how Arabic-speaking countries fund research, particularly after 2007. While overall funding levels remain relatively modest compared to worldwide spending, reforms introduced changes in how funding is organized and what is expected of existing research systems. The next sections examine pairs of Arabic-speaking countries to identify three features of these reforms, namely adopting funding competitions and fostering international collaboration while largely ignoring careers incentives.

3.1 Funding competitions

Morocco and Tunisia demonstrate how competitive calls for proposals influence the scale and structure of research activities. Seen as lagging behind Egypt at the end of the twentieth century, both countries launched policy reviews in early 2000s, and over the next fifteen years tripled research expenditures. Tunisia Gross Expenditure on Research and Development doubled between 2004 and 2009 from the equivalent of USD 280–520 million. This rise in funding coincided with quadrupling the number of publications over the two decades between 1995 and 2015, apparently outpacing the overall growth in world scientific publications ([Organisation for Economic Co-operation and Development \(OECD\) and SCImago Research](#)

[Group 2016](#)).⁴ With historic periods as French protectorates, both Morocco and Tunisia maintained links to France as a destination for graduate training, collaboration, and ideas for organizing science. Both countries created a dual funding structure, with long-standing core funding to universities and public research establishments, and a more recent introduction of competitive calls. Yet, each country pursued distinct reforms to their domestic funding opportunities.

Established in 1976, Morocco's *Centre national pour la recherche scientifique et technique* (CNRST) adopted its present name and a new mission following a change in legislation in 2000. While it has intramural research performing units, CNRST also promotes science and technology beyond its walls, and plays an increasing role in research funding through competitive calls. An initial scientific research support program distributed the equivalent of USD 4 million between 1997 and 2007, with an average value of USD 18,000 per project. This was accompanied by three thematic calls between 2000–4 which distributed close to USD 11 million, with average value equivalent to USD 28,000 per project.⁵ A subsequent national research support fund⁶ began to offer three levels of grants: up to the equivalent of USD 120,000 for fundamental research, up to USD 480,000 for activities for socioeconomic development, and up to USD 1.2 million for research consortiums involving multiple organizations.

The increase in grant value under these competitions reveals an increasing ambition in the size and complexity of research sought. Previously, a significant amount of research activity was restricted to more theoretical or desktop activities, using existing data or whatever meager means researchers had at their disposal. In contrast, larger amounts of funding encourage original data collection and permit greater use of experimental methods, prototyping, and piloting. Whereas the expected outputs under smaller grants might be a working paper or seminar, larger grants encourage more sophisticated outputs including technology, designs, and patents.

Beyond the national research support fund, Morocco has also established numerous sectoral funding opportunities ([Gaillard 2014](#)), and CNRST held joint calls with industry and philanthropy for research on phosphates, agriculture, and cancer with Office chérifien des phosphates Foundation, Managem mining company, and Lalla Salem Foundation. CNRST manages science cooperation agreements with France, Germany, Spain, Portugal, and Italy, primarily for mobility of individual scientists and graduate students. In 2015, Morocco was also discussing scientific cooperation with Turkey, China, Malaysia, and Egypt.

Meanwhile in Tunisia, new legislation in 1996 introduced a taxonomy for describing and funding research teams that stretches across disciplines, universities, and research centers. The approach is similar to that used in France for designating research units and fostering collaboration between universities and public research centers. Under the Tunisian scheme, “laboratories” contain twelve or more senior personnel, while research ‘units’ have smaller teams with fewer personnel. Tunisia recognized and funded 71 such laboratories and 257 units by the new millennia, and expanded to 250 laboratories and 330 units by 2009 ([Hanafi and Arvanitis 2016](#)). Applicants prepare a four-year proposal, including details on activities, budget, equipment, and methods. The Ministry of Higher Education and Scientific Research launches the call and manages funding. Under the ministry, responsibility for reviewing these applications and selecting recipients lies with the *Comité national d'évaluation des activités de recherche scientifique* (CNEARS). Up to 65 per cent of funding can cover salaries and other operating

costs, while the remainder is invested in equipment or research expenses. Funded laboratories and units are subject to midterm and final evaluations after two and four years. Thus recipients receive both *ex ante* assessment during the initial proposal, as well as *ex post* assessment of performance ahead of potential renewal. The current four-year cycle is anticipated to cover the period 2017–20.

Beyond the laboratories and units, government ministries can provide funding to commission research for their own purposes, whether through external grants, contracts, or support to their affiliated public establishments. For example, the Ministry of Agriculture provides support for an array of schools and research centers under the *Institution de la recherche et de l'enseignement supérieur agricoles* (IRESA). Additionally, in 2008 Tunisia created the *Agence nationale de la promotion de la recherche* (ANPR) intended to assist industry and small enterprises through national research programs, support on intellectual property, as well as acquisition of expensive research equipment and infrastructure. Whereas the laboratories and units are predominantly oriented toward scientific excellence and publications, the government affiliated centers and ANPR efforts are oriented toward economic value and real-world application by citizens and in business.

Morocco and Tunisia thus differ with respect to the building block considered within funding competitions. The former retains a project focus which places primary attention on the research problem and proposed activities, while the latter adopted a quasi-core funding approach that places significant emphasis on the personnel and infrastructure involved. The apparent success of the Tunisian model, in terms of expanded publications and rising in international ranking, speaks to overcoming isolation and fragmentation by gathering people into teams working on a common project or program of work. The advantages of this taxonomy of laboratories and units include the potential for continuity in teamwork over multiple years, provision of operating costs that are often excluded from project funding, and the explicit opportunity for collaboration among researchers based in different organizations. Researchers in these laboratories and units adopt a double identify, supplementing an initial affiliation with their hiring organization with also being part of the funded team, thus bridging the traditional barriers between organizations.

3.2 International collaboration

Jordan and Qatar demonstrate the identification of national priorities and societal challenges as a means for fostering international collaboration and narrowing the research agenda. Jordan was one of the Arabic-speaking countries around the Mediterranean that benefited from European efforts to foster international science collaboration. Germany, France, Spain, and the UK have significant presence across the region offering scholarships, bilateral cooperation, and as models for educational curricula. The European Union (EU) invested in strengthening ministries of scientific research in 'Mediterranean partner countries' of the Middle East and North Africa with a view to facilitating its participation of these nearby countries in under the Framework Programs for research, including Horizon 2020. These efforts included workshops in proposal writing and establishing contact points in key universities across the region to disseminate information on funding opportunities. Unsurprisingly, as EU research funding embraced the language of societal challenges, this framing cascaded into such efforts and the thinking of ministry officials and university administrators.

The discourse of 'challenges' imply a need to change the relationship between science and society, directing the curiosity and imagination of scientists toward certain ends through research policy and

funding. For example, responding to critiques in the late 2000s, the European Research Area (ERA) was recast as helping solve 'the problems that society recognizes as central'. The intent was to gain the attention and support of politicians and the public, addressing timely topics in public debate, including climate change, energy supply, water resources, ageing societies, and healthcare (Wissenschaftsrat 2015). The initial design for Horizon 2020 earmarked nearly 40 per cent of funding for these societal challenges, and in 2015 the UK created a GBP 1.5 billion Global Challenge Research Fund. Similarly, Jordan and Qatar also adopted national research priorities and challenges as a basis for allocating public funding.

With support from the EU, Jordan's Higher Council for Science and Technology focused on challenges of food, health, energy and water. A Scientific Research Support Fund (SRF) was created 2007 within Jordan's science ministry to 'direct researchers towards... the needs of Jordanian society'. Initial financed by a levy on the profits of state-owned enterprises, SRF distributed more than USD 18 million in its first six years, of which 70 per cent went to projects in energy, water and health care (UNESCO 2015: 451). Yet domestic policy and funding remained more extensive and nuanced, with a longer list of national research priorities spanning across tourism, security, ICTs, social sciences, economics, agriculture, medicine, engineering and more (HCST 2010). The language of challenges nonetheless exerted a real influence on Jordanians and others across the region, as they focused the interest of potential collaborators in Europe. Given the modest size of domestic opportunities, entrepreneurial Jordanian researchers seek to collaborate with scientifically proficient peers abroad in order to gain access to funding and international networks. As the EU embraced the language of societal challenges, applicants began to describe their work in these terms in order to remain eligible for such funding opportunities.

Meanwhile the Qatar National Research Fund (QNRF), created in 2006, funds opportunities for 'original, competitively selected research' as part of a national vision of becoming a knowledge-based economy. Part of the Qatar Foundation, QNRF supports a National Research Strategy and plays a dual role of financing research and guiding efforts of the foundation's three institutes (environment and energy, computing, and biomedicine). The initial design for QNRF was inspired by the competitive mechanisms used by US National Science Foundation, National Institutes of Health (NIH), and Defense Advanced Research Projects Agency (Culbertson et al. 2012). This choice was intentional, to both encourage research at branch campuses of foreign universities, and expose domestic universities to procedures used by potential collaborators abroad. QNRF's national priorities research program holds regular calls for proposals, to fund projects valued between USD 20,000 and 250,000 per year (for up to three years). By 2014, the previous list of twelve national priorities was narrowed to four grand challenges centered on water reuse and desalination, on-grid photovoltaic energy, cyber security, and personalized medicine and non-communicable diseases. Each challenge is led by one of the three Qatar Foundation research institutes and is intended to both organize the institute's internal activities as well as encourage external collaboration across the Foundation and with outside partners.

QNRF is keen to support international collaboration, with a focus on locating projects within national organizations and linking with advanced economies. During its first decade, grant agreements under the fund required that two-thirds of project spending and half of the person-hours were performed within the country. Given Qatar's modest size, with one major city and a total population of 2.2 million persons, these requirements concentrated funding in a

few organizations, with the largest shares at Qatar University and Texas A&M. After 2015, the fund added a requirement that the principal investigator reside in Qatar, resulting in the number of proposals declining by over one-half, from 869 to 350. Nonetheless, QNRF supported 590 international collaborations during its first decade. The overwhelming majority of these involved science-leading countries in North America, Europe, and Asia. Only the United Arab Emirates and Oman participated in QNRF research grants, with other Arabic-speaking countries participating only through smaller value grants for student and researcher mobility. QNRF also entered into joint calls with US NIH on infectious diseases and with the 'Belmont Forum' of funders of global environmental change research. In each case, QNRF limited its financial obligation to funding Qatari nationals involved in winning projects.

Jordan and Qatar thus demonstrate a pattern of privileging connections to distant 'best-in-world' locations, over partnering with nearby Arabic-speaking countries despite similarities in the challenges they face. In the case of Jordan this pattern is driven by scarcity of domestic funding opportunities which requires researchers to search abroad for means of supporting their work. In the case of Qatar, there is a deliberate emphasis on establishing the country as a hub within global networks for science collaboration. This pattern is prevalent beyond these two countries. With the exception of Egypt–Saudi Arabia, less than 6 per cent of total publications from researchers in Arabic-speaking involves other Member-States of the Organization of Islamic Cooperation (OIC) while overall international collaboration accounts for up to 40 per cent of research publications (Hassan et al. 2016).⁷

3.3 Careers incentives

Egypt and Lebanon demonstrate the importance of the incentives within hiring organizations, specifically whether researchers are rewarded for publications or obtaining funding. With recent origins and often limited resources, domestic funding competitions in many Arabic-speaking countries still exercise little influence on how researchers allocate their time and effort. The existence of a grant competition is insufficient to attract numerous high-quality proposals. Researchers also require a supportive work environment, one that provides time for research and encourages its outputs. Within universities and research centers, staff often struggle under teaching and administrative duties, leaving research as an optional activity that is additional to an already high workload. Where years of experience, or seniority, is a key factor in promotion decisions, career advancement does not require substantial research work or numerous publications. Some universities even limit faculty hiring to previous graduates, which privileges a continuity of intellectual tradition, over the introduction of original thinking and circulation of talent.

Egypt created a Science and Technology Development Fund (STDF) in 2007 within the Ministry of Scientific Research. It quickly introduced competitive funding to the domestic scene, offering a new avenue for researchers whom had until then largely relied on intramural funds, or limited support through the Academy of Scientific Research and Technology. Researchers recount that access to funding used to depend on one's resume and exciting a decision maker in their idea, rather than a detailed description of the work being proposed. Few researchers had experience competing for funds, and those that did either had graduate training abroad or sought out opportunities from foreign funders, such as the EU. The majority of researchers simply had no experience in seeking grants or preparing detailed proposals, much less managing budgets and submitting progress reports (Bond et al. 2012).

STDF began with project grants for individuals or teams to undertake basic and applied research, each valued at up to roughly USD 120,000 over three years. While nominally open to a range of scientific disciplines, the majority of funds are awarded to the fields of engineering, medicine, and agriculture. Recipients are required to submit biannual progress reports and quarterly financial reports. STDF soon added competitions for acquiring or maintaining research equipment and infrastructure (up to USD 600,000), for centers of excellence (up to USD 1.2 million over three years), and a series of targeted thematic calls. Competitions are nominally open to applicants based at universities, research centers, non-profit organizations as well as small and medium-sized enterprises. Yet the majority of funding awarded goes to public universities and government-affiliated research centers. This means private universities and industry largely obtain their funding from other sources or are largely not engaging in research. Interestingly, STDF encourages English-language applications submitted electronically, only permitting Arabic language proposals related to social sciences and humanities. Researchers are not permitted to propose work already supported under by other grants, STDF limits its collaboration with others funders to formal joint calls.

STDF coordinates Egypt's formal participation in bilateral science cooperation, organizing joint calls with other countries including Germany, USA, UK, France, Italy, Japan, and South Africa. The majority of these calls focus on particular themes including agriculture, health, water, climate, ICTs, and renewable energy. Social science and humanities are notably absent, yet presumably aspects of human design and social impact of these themes could be considered within a proposal. Joint calls operate on the basis of matched funding, with each country paying for the costs associated with their nationals. Under recent calls, Egyptian participants were offered up to the equivalent of USD 30,000 over three years for work with South Africa, and up to USD 210,000 over two years for work with Germany. Such proposals necessitate an agreed division of labour regarding activities and budget, which invariably favours researchers with established connections, such as those who received their graduate training in the partner country. Beyond STDF, an online Egyptian Knowledge Bank was launched in 2016 and provides all citizens with full text access to peer review literature from a variety of publishers, including Elsevier, Sage, Thomson Reuters, and Oxford University Press (www.ekb.eg).

In Lebanon, government support is managed through a research grants program under the CNRS. Created in 1963, CNRS is not only a funding agency, but also coordinates national research activities, and manages research-performing centers. CNRS includes centers dedicated to research on geophysics, remote sensing, marine science, and atomic energy. The research grants program provided USD 3.4 million during 2000–06, with an average of just over USD 5000 per project (Gaillard 2010). This amount increased to USD 1.1 million in 2013, yet individual project grants still varied between USD 10,000 and USD 30,000. In comparison, this grants program is equivalent to the annual intramural research budget of either of the two leading research intensive universities: AUB or Université Saint-Joseph (USJ).

In both Lebanon and Egypt, a few key institutions dominate the research system. The AUB alone accounts for half of Lebanon's research publications, and the top three Lebanese universities spend more than five times on research than the entire CNRS, including its centers and grant program (Hanafi and Arvanitis 2016). Egypt has a more extensive research system, yet Cairo University and Ain Shams University account for almost one-third of research publications (Table 1). Sizable

Table 1. Comparison of select Arabic-speaking countries.

	Morocco	Tunisia	Egypt	Lebanon	Jordan	Qatar
Population ^a (million)	34.4	11.1	91.5	5.9	7.6	2.2
Publications ^b	35,045	52,601	123,296	19,266	21,279	12,793
	45,902	66,133	154,096	23,246	30,844	16,789
Per cent of world publications ^c	0.16	0.24	0.57	0.08	0.09	0.11
Key funder	CNRST	CNEARS	STDF	CNRS	SRF	QNRF
Key legislation	Law 01-00 80-00	Law 1996-6 2008-60	Decree 218/2007		Law 4/2005 23/2009 42/2010	
Top two research producers	Mohamed V Cadi Ayyad	Sfax Tunis-el Manar	Cairo University Ain Shams	AUB Lebanese University (LU)	University of Jordan Jordan University of Science and Technology (JUST)	University of Qatar Texas A&M
Per cent of country's publications ^b	17 31	28 24	30 31	68 68	55 65	53 76

Data Sources:

^aWorld Bank.

^bWeb of Science followed by Scopus.

^cSCImago for 2015.

research performers command sizable intramural funds, and encourage grant seeking by staff and faculty, attracting further extramural funding and consolidating their top-tier position in the national research system.

Hiring organizations remain very influential in how researchers decide to invest their time and energy. Internal practices recognize and reward certain forms of performance more than others—such as teaching, administration, graduate supervision, advising and outreach—as well as the expected quantity and prestige of scientific publications. When these practices differ between organizations, it inhibits collaboration among them. For example, there is relatively little joint work between Cairo University and American University in Cairo (AUC) located 30 km from each other, or AUB and USJ separated by a mere five kilometres. Despite their proximity and influential position in the national research system, the staff face very different incentives regarding their individual performance, not to mention the administrative barriers to sharing funds or managing activities across dissimilar organizations.

4. Discussion

The previous sections reflected on the experience of Arabic-speaking countries to identify trends in public research funding toward adopting funding competitions and fostering international collaboration while largely ignoring careers incentives. This section examines how these trends persisted over time, and influence the organization of research efforts. These countries sought to rally research toward national priorities based on societal challenges, and privileged collaboration with distant science-leading countries rather than with neighbouring countries. Moving forward, countries need to consider how funding opportunities shape the size and organization of distinct research efforts, and which arrangements are best suited to making meaningful progress on different problems of societal and scientific interest.

4.1 Arrangements and barriers persist

Research funds in all six countries enjoyed a period of stability and implicit consensus on the policy direction. The common model was

to establish such funds as an administrative branch within the government bureaucracy. Even Morocco's CNRST is connected to the science ministry, while QNRF is part of the Qatar Foundation which is closely affiliated with the royal family. These research funds persisted and thrived over the past decade, despite their potential susceptibility to changes in official policy or organizational restructuring (at least compared to the model of autonomous research councils found in other jurisdictions). Yet this persistence and stability were partially an artefact of benign neglect, as governments were preoccupied with popular uprisings and satisfying citizen demands amidst shifting economic fortunes. To the extent that research and higher education attracted government attention or media coverage, it was to bemoan ongoing weaknesses in public education and lack of youth employment.

Research in Arabic-speaking countries remains more often than not a solitary activity, the product of an individual seeking to publish and contribute knowledge to scholarship in order to advance her or his career. This stands in dramatic contrast to the networked model of global science, emerging elsewhere, where scientists increasingly work collaboratively whether through loose coordination on common themes or more formal consortia of organizations to deliver joint work packages (UK Royal Society 2011). All six countries introduced more structured tenders and competitive calls, based on subjects or problems considered severe or important enough to be labelled as a national priority. Unsurprisingly these countries consolidated around similar short lists of priorities involving energy, water, ICTs, and health. Remarkably the identification of such priorities is not necessarily based on an analysis of the comparative strengths of the country's scientists or research infrastructure. These priorities fixate on the natural science and engineering dimensions involved, largely ignoring the rising need for integration across disciplines as well as the participation of the social sciences required to fully address contemporary societal challenges (Lyall et al. 2013). Additionally all six countries were reluctant to sponsor research that question or critique government policy or political leaders. Researchers who pursue such critical inquiry rely either on collaboration with peers abroad and support from outside their countries, or limit such work to the modest means at their disposal.

The popular uprisings beginning in 2010–11 voiced demand for social justice, including calls for greater accountability within university and government hierarchies, and for research outputs that contribute to reducing inequality among citizens. The political environment initially appeared ripe for novel research that addresses these demands, with a more substantial role for critical social sciences and humanities. While Egypt's 2014 constitution enshrined a promise to boost research funding, the trends observed above predate the uprisings and continued since. In general, Arabic-speaking countries view research as contributing indirectly toward national visions of becoming a knowledge economy, or more directly as an input for enhancing industrial production or academic ranking. More troubling, continued instability in the region prompted talented researchers to emigrate abroad to join the diaspora of highly-qualified personnel living overseas. Open warfare in Syria, Libya and Yemen severely disrupted and deliberated their research systems, and the threat of such chaos spilling over into other countries has quelled the demands for policy reform. Yet as support for science relies partly on alliances between researchers and specific groups (Waast 2010), the ongoing breakdown and renegotiation of these relationships might yet reshape the political economy surrounding research funding.

4.2 Funding influences structure

Morocco, Tunisia, and Qatar reveal how the eligibility and selection criteria of funding opportunities influence how research is organized. These countries emphasized scientific excellence via the proxy of potential for peer-reviewed publication. In interviews, Moroccan respondents felt that recipients were chosen to receive grants primarily based on their ability to publish in international journals, as a means toward improving the country's standing in international rankings or league tables. Researchers perceive that public funding is less encouraging of work destined for local publication, as well as potentially novel research that lies outside of established disciplines and approaches. In Tunisia, the four-year periods for funding units or laboratories provides an enviable level of stability for the teams selected, yet also requires researchers to structure their activities in ways that fit into one of these two levels. In other words, the two-level taxonomy of 'laboratories' and 'units' imposes a standardized structure that makes it possible for government to simplify and make sense of the scientific community.⁸ Meanwhile as Qatar embraced national priorities and societal challenges as the cornerstone of its funding programs, it sent a strong signal to researchers to redesign their proposals to align with these priorities.

Competitive calls influence how researchers to organize themselves, providing implicit minimum and maximum limits to the scale of research effort eligible for consideration. Invariably the scale of proposals sought under a competitive call suits some researchers and disciplines better than others. Looking at the six countries, the size of research grant appears to be driven more by the budget funding agencies can obtain rather than any assessment of the critical mass of personnel and resources required to address particular problems or establish competency in a particular field. Consequently, individual grants tend to be modest, providing just enough resources to permit a handful of researchers to collaborate on original work, train some graduate students and produce a few publications, and perhaps connecting with select scientists elsewhere or attend a couple of conferences or meetings abroad. Consequently such calls are less suited to more ambitious efforts involving more extensive data gathering or more tightly networked efforts involving numerous personnel and organizations in multiple countries.

Increasing the size and ambition of grants is forcing the scale of research to shift from individual to collective pursuit. Researchers in Arabic-speaking countries have often struggled to carry out their work based on their own curiosity and interests with limited means. Access to greater funding for projects, units, and consortia provide expanded means to go beyond theoretical desktop research and work with existing data, in order to gather original data, conduct experiments, or design and test real-world prototypes or pilots. Yet such greater means comes at the implicit price of less autonomy for individual researchers, as funding opportunities prescribe the focus of research efforts and require coordinated activities across organizations and borders. In short, the experience of Arabic-speaking countries lends weight to the implications of increasing the size of research grants (Bloch and Sørensen 2015), namely enabling research that would not otherwise be possible yet also adding administrative burdens in coordinating complex research activity.

Arabic-speaking countries are pushing researchers to participate in global science. All six countries sought to facilitate international collaboration as a means to encourage the production of more and higher-quality research outputs. Programs emphasize links with scientifically proficient partners in Europe, North America, and Asia. Yet this push to connect with 'best-in-world' ignores opportunities for regional collaboration, despite similarities in climate, geography, history, resource scarcity, and socioeconomic problems. It also marks a notably pivot away from unique regional institutions championed under the Arab League and OIC. Beyond bilateral cooperation with individual countries and the EU, Arabic-speaking countries are exploring opportunities to join multinational initiatives such as Future Earth and the Global Research Council, albeit underpinned by the principle of *juste retour* limiting their obligations to covering the costs of their nationals participating in such programs. Yet funding competitions often pale in comparison to the career incentives within the home organizations that hire and reward researchers.

4.3 Fit for purpose

The response to funding competitions depends on the practices and incentives within hiring organizations. Governments intend to stimulate their scientific communities to produce more and reach higher-quality international journals, and attempt to rally attention and effort to solving societal challenges. Yet the practices within hiring organizations greatly influence researchers, shaping which activities are rewarded and which forms of output are encouraged. Some organizations do encourage researchers to seek external grants and/or engage with real-world stakeholders in using the knowledge they generate, but these remain far from common. More prevalent are the expectations to 'publish or perish' for promotion purposes or to simply burden staff with teaching and training duties. Scientific personnel in Arabic-speaking countries have precious little opportunity to engage in research, and tend to do so as a solitary activity for career advancement relying on meager intramural funds or consultancies. As researchers respond to various opportunities to advance their interests, the grants offered by domestic funding opportunities in Arabic-speaking countries are often been insufficient to attract their attention. Larger and different funding opportunities are needed to encourage more team-based, interdisciplinary, and solution-oriented work.

Policy also needs to better understand how funding opportunities influence research practice and content. There are relationships among the structure of funding opportunities, the organization of research activities, and the outcomes researchers are expected to

produce. The authors agree with Bloch and Sørensen (2015) that we need to know more about which types of funding, operating contexts for researchers, and organizational arrangements are most conducive to novel research. Grant competitions codify a particular level of ambition in their eligibility criteria, requiring proposals to fit within parameters of team size and permissible budget. Exceeding or underwhelming this level of ambition is grounds for disqualification. Governments worldwide have experimented with different approaches, such as research chairs for senior personnel to train younger researchers, and consortia or networks connecting organizations to share resources and work collaboratively to address a common research problem. Such approaches introduce some diversity into the array of funding opportunities available to researchers. Yet there is little evidence as to which approaches are most suitable for a given context or problems, and how the expected results vary under different approaches.

As Arabic-speaking countries embraced national priorities and societal challenges, these more often than not simply translated into a thematic focus for grant competitions. There is little consideration of what forms of organizing research efforts are best suited to achieve desired outcomes. What is required is greater reflection on how the size and organization of distinct research efforts—whether project teams, established labs, research chairs, consortia, or networks—affect performance and the ability to make meaningful progress on different problems. When competitions offer larger levels of funding, there is an implicit expectation that such grants will ‘do more’, whether attracting more senior personnel, larger teams, or facilitating real-world application in industry or society. Yet the design of funding opportunities is often indifferent to the nature of the problem to be solved. The rhetoric of societal challenges raises the political stakes and promises that research might provide ‘useful’ technologies or solutions. Yet the budget and structure of funding opportunities are often based on what governments or foundations can afford, rather than what scientific community needs. Dressing a meager level of resources in the language of societal challenges does little to alter the day-to-day expectations surrounding researchers.

The experience of Arabic-speaking countries suggests that the incentives provided by hiring organizations and connectivity to peers dominate in shaping how researchers decide how to organize their time and effort, and toward what ends. Different funding programs might be more suitable for particular goals, such as generating knowledge, building capacity, or solving challenges. One dimension is the degree to which funding programs can codify the desired outputs within a tender or terms of reference. At one extreme, funding opportunities can specify success criteria in terms of engineering and design characteristics to be met, such as those used by the X-Prize competitions or advance market commitments. At another extreme, funding opportunities can remain open-ended, highlighting in broad terms the challenges of interest to society and seeking the creativity of the scientific community to propose novel means to solve them.

The emergence and growth of research funds in Arabic-speaking countries over the past two decades represents a move to invest in, and exercise sovereignty over, their own research systems. While these funds evolved in a somewhat ad-hoc and iterative manner, they are beginning to demonstrate greater intentionality, encouraging particular forms of performance perceived as contributing toward policy goals. Funds sought to foster publications and collaborations that enhance a country’s standing in international rankings of academic quality. Moving forward, there is an appetite for research that helps identify and solve problems facing society, placing science at the service of national development plans. Yet

achieving such requires a better understanding of how different funding opportunities enhance the ‘fit’ among the challenges being addressed, the demand for knowledge, and the desirable attributes and outputs from the research system.

Rather than replicating competitive calls for all situations, funders can foster distinct research efforts—including project teams, established labs, research chairs, consortia or networks—to make meaningful progress on different problems of societal and scientific interest. The design of funding opportunities can influence how research activities are structured or organized. They can encourage different ways of organizing research and facilitate distinct ways of working, which vary in their suitability to addressing different problems and pursuing different results. Global response to Ebola or Zika outbreaks relied on international networks reporting in real-time in order to identify and track the spread of contagions and develop treatments. Such multinational cooperation remains limited due to the high transaction costs involved, and differing notions of merit and performance (OECD 2012), yet Arabic-speaking countries are clearly interested in being part of such arrangements.

5. Conclusion

Morocco, Tunisia, Egypt, Lebanon, Jordan, and Qatar created or expanded public research funds over the past two decades. A common trend among these funds was the use of competitive calls which required researchers to prepare and submit proposals for individual work, team-based projects, or four-year grants for a research unit and laboratory. The impact of such calls were mitigated by the often modest amounts of money available, as well as by the incentives within hiring organization that shape how researchers allocate their time and effort. Selection and evaluation criteria privileged international publications over domestic ones, and collaboration with Europe, United States and Asia over working within the region. Domestic funders also embraced societal challenges or national priorities, seeking to rally research toward the problems facing society and the economy. This created a synergy with multinational funding opportunities, yet Arabic-speaking countries directed their monies to benefit their nationals rather than pooling funds available to other nationalities.

Domestic research funds have persisted despite social and political turmoil over the past decade. Policy favoured domestic research capacity and its contribution to global science. Eligibility and selection criteria of funding opportunities requires researchers to organize themselves in particular ways, whether as projects, units, laboratories, networks, or consortia. Increases in the size of grants over time encouraged greater ambition in outcomes and expanded the range of activities researchers can pursue. Moving forward, governments need to consider how the size and organization of distinct research efforts affect performance, and which arrangements are best suited to making meaningful progress on different problems of societal and scientific interest. Funders can be more intentional, linking the design of funding opportunities to the characteristics of research community as well as the outputs and performance sought.

Notes

1. This selection was inspired by earlier ministerial-level discussions towards a Euro-Mediterranean research area after 1995 (Hanafi and Arvanitis 2016), and interest in understanding the extent that Arabic-speaking countries support research intended to address the needs of poor and vulnerable populations within the region (Currie-Alder 2015).

- Israel, Iran, and Turkey invest significant resources in research, and are geographically close to the region, yet were excluded from our analysis due to their distinct languages and institutional arrangements.
- The authors deliberately eschew the labels of Middle East and North Africa (MENA), or Arab states, as these countries encompass multiple ethnicities and are home to many non-Arab peoples. These countries include a rich diversity in culture, history and wealth, as well as disruptions due to conflict in Iraq, Syria, and Libya.
 - Such as those used by X-Prize, Defence Advanced Research Projects Agency (DARPA), and IDEO.org to select funding recipients
 - Data on the number of publications by country must be interpreted cautiously, as worldwide the number of publications indexed by Scopus nearly doubled between 2003 and 2014, both through new indexing of existing publications as well as new publications via expansion in the variety and frequency of publications (OECD and SCImago Research Group 2016).
 - CNRST data on *Programmes d'Appui à la Recherche Scientifique* (PARS & PROTARS). Funds operate in local currency, Moroccan dirhams (MAD). Authors' calculations use 0.11 USD/MAD before 2007 and 0.12 USD/MAD afterward.
 - Fond national de soutien à la recherche scientifique et au développement technologique* (FNSRSDT)
 - As determined analyzing data from Scopus on scientific publications in between 1996 and 2010.
 - This simplification of the scientific community is analogous to Scott (1998) critique of simplifying forests and fisheries in order to facilitate their inventory and control by government bureaucracies.

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