

RESEARCH PAPER

Fostering Data Openness by Enabling Science: A Proposal for Micro-Funding

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In recent years, the promotion of data sharing has come with the recognition that not all scientists around the world are equally placed to partake in such activities. Notably, those within developing countries are sometimes regarded as experiencing hardware infrastructure challenges and data management skill shortages. Proposed remedies often focus on the provision of information and communication technology as well as enhanced data management training. Building on prior empirical social research undertaken in sub-Saharan Africa, this article provides a complementary but alternative proposal; namely, fostering data openness by enabling research. Towards this end, the underlying rationale is outlined for a 'bottom-up' system of research support that addresses the day-to-day demands in low-resourced environments. This approach draws on lessons from development financial assistance programs in recent decades. In doing so, this article provides an initial framework for science funding that call for holding together concerns for ensuring research can be undertaken in low-resourced laboratory environments with concerns about the data generated in such settings can be shared.

Keywords: Open Data; micro-funding; cash transfers; micro-credit; Africa

The 2015 publication *Open Data in a Big World: An International Accord* produced by the International Council for Science (ICSU), the InterAcademy Partnership (IAP), the World Academy of Sciences (TWAS) and the International Social Science Council (ISSC) offers a recent high level statement on the potential of making research data widely available. Against claims of a revolution in memory storage capacity and connectivity, the report sets out to identify the benefits of promoting data openness; this including facilitating the correction of results, enabling the replication of findings, detecting fraud, promoting international collaborations, and supporting evidence-based decision making.

And yet, *Open Data in a Big World* recognized that achieving openness was not straightforward. Merely making data accessible by putting it online, for instance, would not be sufficient. Other requirements included the need for data to be: readily discoverable; complemented with background information necessary to make it intelligible; combined with sufficient computational metadata; and supplemented with enough information to reveal the competences and financial interests of data producers. Further still, ethical, safety, security and other concerns were recognized in *Open Data in a Big World* as limiting what data *should* be shared. Despite the demands of and cautions with open data, when the revolutionizing benefits were considered against potential downsides, the conclusion reached by ICSU, IAP, TWAS and ISSC was clear: openness should be the default position for publicly funded research.

And yet, echoing conclusions reached elsewhere, *Open Data in a Big World* noted that researchers in least developed countries would struggle to partake in collecting, analysing, reusing, and sharing data (see as well CODATA, 2014). To enable their participation the report called for national schemes to incentivize openness, the development of organizational norms to support open data, and the funding of data storage, analysis, and broadband transmission infrastructures.

In this article too, I want to attend to what can be done to promote world-wide openness with data; with particular emphasis on those working in comparatively low-resourced research environments in Africa. The proposal is advanced that those funding and promoting science can help foster data sharing by empowering

scientists to identify and redress the day-to-day challenges that impede their research. Specifically, by making available easily securable but flexibly allocated small amounts of funds, science bodies could help overcome impediments to doing research and thereby put in place the conditions for greater openness. More than a mere practicality of funding mechanisms, however, the 'micro-funding for science' suggestion set out in this article raises basic questions about the purpose and direction for science funding, who decides these matters, and the assumptions behind efforts to promote open data.

Data Sharing in Africa: Empirical Findings

This section begins the justification for such micro-funding by summarizing the findings of research undertaken by the author and collaborators (Louise Bezuidenhout, Sabina Leonelli, and Ann Kelly) that points to the need for an alternative approach to promoting data sharing. Although scientists' reasoning for making their data available to peers and using others' data has been the topic of some social research (e.g., Edwards et al. 2011; Whyte et al. 2011; Acord and Harley 2012), much of this work has been confined to high-income settings. In contrast, through a Leverhulme Trust funded project, we set out to investigate the day-to-day experiences of those undertaking research in low-resourced environments. This investigation sought to address the questions such as: How does data availability compare with usability? Why do scientists disengage from attempts to promote openness and data sharing? How might openness be encouraged?

Our work consisted of initial extended visits (three to six weeks) by LB to four laboratories in sub-Saharan Africa. The selection of labs was taken on the following basis:

Continent: We focused on Africa because experiences from researchers from this part of the world are largely missing from international Open Data discussions even though it is often identified as one of the regions in the world that is most in need of assistance to enable the realization of Open Data.

Country: South Africa and Kenya were chosen because they have comparatively vigorous national research activities within Africa.

Laboratory: We sought examples of labs successfully undertaking 'homegrown' research; meaning that while the labs visited were conducting and publishing research recognized internationally, as well as securing funding from sources beyond their national borders, none of them were part of formal research consortia sponsored by international funding agencies (for instance, KEMRI or MalariaGEN).

Specialization: To reduce differences related to areas of study, all four laboratories conducted chemistry/biochemistry research and worked in the area of medicinal chemistry.

This study employed a qualitative approach, involving interviews and observations to gain an in-depth understanding of key issues that influence scientists' interaction with online data. Semi-structured interviews were undertaken with staff and post-graduate students (n. 56) along with laboratory observations and participation in departmental activities. The interview focused on researchers' data generation, storage, curation, dissemination and re-use activities. Follow-on visitations were made in order to feedback our preliminary findings.¹

Detailed analysis of the fieldwork has been given elsewhere (Rappert and Bezuidenhout 2017; Bezuidenhout et al. 2017; Bezuidenhout et al. 2016). In setting a background for later sections, in the reminder of this one

¹ To expand, initial data collection was carried out in Kenya and South Africa over a period of five months between November 2014 and March 2015. Fifty-six interviews (23 at two South African sites and 33 at two Kenyan sites) were conducted amongst postgraduate students and staff members. Participation in the interviews was voluntary and interviewees were recruited through departmental emails and personal communication. The interviews explored themes including the use of online data, the barriers experienced to accessing online data, contribution of data, and opinions about Open Science, Open Access and Open Data. The issues raised in these interviews – particularly the perceived barriers to data usage and contribution – were further informed by observations of the laboratories and the working practices of staff within these facilities. All interviews took place in English and were audio-recorded by the researcher (LB). The interviews were then transcribed and analysed using a thematic approach. Some of these codes related to experiences of financial costs data access, and were collated into the category "unexpected financial barriers". All recordings, transcripts and other collected data have been securely stored in a password protected online storage facility. Identifiers have been removed from the transcripts and any information linking institutions or participants to the data is accessible only to the researcher. Written consent was obtained from all interviewees. All participants and institutions were assured that confidentiality would be respected. The anonymized datasets were released on completion of the project into the University of Exeter Open Access repository as well as Figshare (https://figshare.com/articles/Beyond_the_Digital_Divide_Sharing_Research_Data_across_Developing_and_Developed_Countries/3203809). Follow-on visits to each site were made in late 2015 by the Louise Bezuidenhout and the author to solicit feedback on our analysis.

I want to recount one of the central recurring themes of the interviews: namely the day-to-day difficulties of doing research that shaped what science could be done; frustrated interviewees' ability to collect, analyse, publish, assess and reuse data; and downgraded the self-relevance they perceived in calls for data openness. These day-to-day demands included (Bezuidenhout et al. 2017: 4):

- Personnel Skills
 - Data management and curation skills: Interviewees reported the absence of training in data management and curation.
 - Technical servicing: All sites were characterized by a lack of skilled technicians to service and repair laboratory equipment, and the absence of functioning relevant equipment.
- Communal
 - Mentorship: Mentors with ICT skills and knowledge on data engagement activities were widely perceived as missing for both staff and research students.
 - Endorsement: Support for data sharing from peers and supervisors was regarded as not present.
 - ICT sharing: Some researchers reported a need to share existing computers which curtailed the time each individual could spend online.
 - Ownership: Absence of clear intellectual property rights policy led to reported data hoarding in some cases.
- Organizational
 - Policies: Dearth of institutional policies such as data sharing guidelines.
 - Procurement: Complicated and restrictive procedures for procuring and reimbursing ICTs (e.g., paying for software).
 - Discretion: Because of the reliance on project based funding, researchers had a limited flexibility in how to spend research income.
 - Workplace demands: The extent of teaching loads reduced the time available to do research.
- Infrastructural
 - Remote access: The absence of proxy servers lessened researchers' ability to make use of university resources when off-site.
 - Basic provisions: Irregular power supply caused breaks in down/uploads as well as limited functional time with ICTs.
 - Transfers: Border controls slowed down data generation and analysis.
- Epistemic
 - Research continuity: High graduate student turnover resulted in data loss, inefficiencies and a diminished ability to set cohesive research streams.
 - Dependency: The lack of equipment availability and technical support meant that standard forms of analysis elsewhere were outsourced or not possible; leading to lowered self-perceptions of peers' assessment of the quality of science undertaken in these labs.
 - Lack of standards: Diversity in data formats and labels made it difficult for researchers to assess the compatibility and significance of data classified and formatted by others, and thus to reuse them.
- Economic
 - Access payments: Especially for graduate students, the need to purchase personal data bundles proved prohibitively expensive.
 - Personal provisions: The self-funded purchasing of computers and software lead to the use of older machines with dated software.

So, while all the researchers interviewed had access to a computer, internet and other ICTs, when discussing data engagement it became apparent that factors existed within their working environment that significantly shaped their research activities and contributed to a state of sustained lowered ability to engage with data – online or otherwise.

It was hardly surprising then that those interviewed consistently voiced a stark distinction: while acknowledging the *theoretical value* of data openness for science as a whole, when asked to assess its *practical value*

to them as individuals they found little merit in making their result freely available beyond known and trusted peers (see Rappert and Bezuidenhout 2017 for a detailed discussion). Interviewees accounted for their lack of involvement in sharing data by citing various considerations related to the day-to-day demands noted above. The majority of these involved time – the lack of time to conduct research, the time needed to upload data in infrastructure-challenged environments, the time taken to produce data and the need to control it, and the difficulties of sharing data in environments with no support structures. Researchers pointed to these considerations as justifying fears that they would be ‘scooped’ by their more well-resourced peers if they made their data openly available. Openness then might be laudable in the abstract, but within highly stratified global fields of science, those we interviewed repeatedly spoke of its perils to their existing projects as well as their long term research careers.

Although in-depth, since our fieldwork was only conducted in four sites, the generalizability of its findings is clearly a matter for caution. Yet, as the factors limiting engagement with data openness stem from relative deprivation in research environments, it seems reasonable to assume they are likely to be germane in many in low-resourced research settings. Certainly the fear that those in developing countries might have their data scooped by their better supported peers elsewhere has been frequently voiced in relation to the comparatively well examined areas of clinical and public health research (Pisani and Abou-Zahr 2010; Tindana 2014; Bull et al. 2015).

Macro Discourses and Micro Practices

Against these findings pointing to the importance of laboratory environments and national research systems, it can be noted that much of the policy discussion about Open Data today is universalistic in outlook. For instance, as part of its *Science as an Open Enterprise* report, the British Royal Society (2012: 7) maintained that:

Open inquiry is at the heart of the scientific enterprise. Publication of scientific theories – and of the experimental and observational data on which they are based – permits others to identify errors, to support, reject or refine theories and to reuse data for further understanding and knowledge. Science’s powerful capacity for self-correction comes from this openness to scrutiny and challenge.

Such expressions are noteworthy because they present a unified image of what science is and how it progresses. It follows on from this way of thinking that the imperative for openness applies everywhere. It also follows that the relevance of research can extend far beyond national borders. *Science as an Open Enterprise* offered various statements in this vein that are commonplace elsewhere in Open Data discussions, such as:

It is important to recognise that science published openly online is inevitably international. Researchers and members of the public in one country are able to test, refute, reinforce or build on the results and conclusions of researchers in another. New knowledge published openly is rapidly diffused internationally, with the result that the knowledge and skills embedded in a national science base are not merely those paid for by the taxpayers of that state but also those absorbed from the wider international effort, of which it is a part (ibid. 17).

Here as elsewhere (e.g., Arzberger et al. 2004) – at least when it comes to publicly funded research – science is understood as a public good produced for public benefit. The implication is that data should be available to the maximum extent possible; an imperative that applies to researchers irrespective of their geographic location (see as well the 2014 *Data Sharing Principles in Developing Countries*).

With much of the promotion of Open Data originating from Western nations, policy deliberation regarding the conditions experienced in low-resourced environments has been uneven. When they are considered, one response has been to acknowledge grounds for unease associated with data openness stemming from who benefits from science (Royal Society 2012: 18). As in the case of *Open Data in a Big World*, another response has been to devise recommendations about what needs to be done to overcome the skills, infrastructure, and normative belief deficiencies delimiting effective data engagement.

Taking data openness as the object of concern, national government, professional associations, funders and international bodies are asking what needs to be done policy-wise to ensure data sharing. For instance, the National Research Foundation (2015) in South Africa currently requires grant holders to submit the data underpinning supported publications to be deposited in an accredited Open Access repository.

The fieldwork summarized in the previous section provides some reasons for caution about the general direction and tone of current Open Data discussions. Initiatives that either implore the benefits of Open Data or require adherence to mandatory rules are in danger of being perceived as at odds with the conditions of those in low-resourced environments. When faced with the difficulties associated with merely doing research in such settings, for instance, the additional demands of making data open can breed cynicism, alienation, or token participation. Even if such data openness is supported with training and other forms of data management training, requirements for openness might well be regarded by bench researchers as designed around priorities derived from elsewhere and requiring underlying support (infra)structures in place elsewhere.

The remainder of this article considers a complementary, but also contrasting, strategy to promote sharing. It begins by taking a step back from data openness itself. Recognizing the variety of day-to-day factors that impede research in low-resourced environments, this article asks how addressing those factors could provide a basis for enabling openness. In other words, I want to elaborate an approach that offers an alternative bargain for those in low-resourced environments. Instead of Open Data being promoted as a good in its own right and in a context-blind fashion, I want to inter-link expectations for greater openness with the imperative of enabling research. The kernel of the proposal below is that in light of the prevalence of relatively lost cost hindrances to doing research, through making available easily securable but flexibly spent small amounts of funds, science funders could help researchers in low-resourced research environments to overcome impediments to their work and thereby put in place the preconditions for greater openness.

Systems of Financial Support

By way fleshing out what such support systems might look like, this section provides an overview of two prominent forms of financial development assistance: micro-credit and cash transfers.

Micro-credit

In recent decades, micro-credit schemes have been heralded as bringing about a re-negotiation of the relations between individuals, financial services and development agencies; in particular by promoting development in a manner that is more inclusive and participatory than traditional 'top-down' programs of aid (Bayulgen 2008). Typically traced to the pioneering research of Muhammad Yunus and the establishment of the Grameen Bank in Bangladesh, micro-credit has been attributed with improving the skill, income, productivity and quality of life for economically deprived groups across the globe (Manos et al. 2013).

In its most elemental form, micro-credit consists of making small loans readily available to those that would struggle or simply not be able to access credit from conventional financial institutions. That might be because they lack collateral or because their income is too low. The typically small size of the loans made (starting from roughly \$5) is matched with the expectation of a comparatively short repayment period (varying in duration, but often within 6 to 18 months). Many schemes compel borrowers to save so as to ensure eventual repayment.

Micro-credit, then, supplies small sums of money to support small scale activities without the application procedures and guarantees associated with traditional loaning. In enabling economic activities to take place that would otherwise not due to a lack of financial wherewithal, micro-credit has been embraced by aid donor countries, non-government organizations, national development agencies, and others.

Today, as micro-credit programs have become established not only within developing nations but in Europe and North America. Important distinctions in the diversity of the programs include:

Individual or group lending: While micro-credit can take an appearance very similar to conventional individual-to-bank loans, other forms are designed for groups. Those can be pre-existing groups within a community or individuals that agree to join together. With group lending, an advantage is that the need for sufficient personal collateral from individual borrowers can be bypassed. Too, the peer pressure that groups assert on individuals is a low-cost mechanism for ensuring repayment, as the failure of any one person to repay can condition the prospects for other members of the group to receive support (Yunus 2003).

Types of group lending: Group lending can be alternatively structured such that individual borrowers (guaranteed by the group) receive funds directly from the lender, or the group itself can become an intermediary that independently manages funds.

Sustainability: Micro-credit programs differ in their requirements for financial sustainability between, on one end, international aid programs aimed at poverty reduction that can run at a loss, to those that are expected to be financially self-sufficient, to finally more recently launch fully fledged for-profit financial schemes.

Supplementary services: Some forms of micro-credit include educational and training programs for borrowers that are intended to enhance their future income generation prospects.

While micro-credit loans have been widely praised, by no means have they only been praised. The value of these types of loans depends on the specifics of how they are delivered. As such they are not universally appropriate. As critics have argued, group lending, for instance, can result in the weakening of pre-existing social groups or the reinforcement of oppressive ones (e.g., Fernando 1997). When micro-credit is positioned as part of neo-liberal development discourse, it can reinforce overall agendas questionable for the world's poor (Geleta 2015).

For some commentators, what is notable about micro-credit schemes over recent decades is the poor quality of evaluation evidence about their consequences; this despite the praise that has been showered on them (Banerjee 2013). In an effort to assemble rigorous evidence, authors to a 2015 special issue of *American Economic Journal: Applied Economics* brought together randomized evaluations of specific micro-credit schemes undertaken in Bosnia, Ethiopia, India, Mexico, Morocco, and Mongolia between 2003 and 2012 (see Banerjee et al. 2015). As a whole, the studies found little (positive or negative) transformative effects of these micro-credit programs with regard to poverty levels or living standards, but these schemes had improved lenders' abilities to make choices about their occupation and enhanced their ability to be self-reliant.

Cash Transfers

Other ways of alleviating poverty that start from the basic premise that those without should be able to decide for themselves what they need have been established in recent years. Cash transfer programs – schemes in which selected individuals or households are given sums of money without the need for repayment – are one such model. These have been used particularly in response to disasters or to support specific social objectives (e.g., improving well-being), including by organization such as the World Bank (Garcia and Moore 2012). Cash transfers can be conditional (meaning the receipt of money requires fulfilling certain forms of behaviour, e.g., attending health check-ups) or unconditional (Baird et al. 2011).

As with micro-credit, it is the flexibility in choice enabled by money as a form of assistance that has been identified as making cash transfers effective (Blattman and Niehaus 2014). As with micro-credit too, these schemes are presented as having a number of beneficial effects, far beyond the immediate purchasing power enabled. This includes the middle to long term development benefits of enhancing social capital. And as another similarity, the benefits of cash transfer critically depend on the specifics of how such programs are implemented. Conditional and unconditional cash transfer schemes have been evaluated and compared in relation to goals such as increasing school attendance and consumption levels, though the extent of systematic evaluations of cash transfer programs is also patchy (Baird et al. 2012; Baird et al. 2013).

Micro-funding for Research

Taking the previous three sections together then, the fieldwork recounted from South Africa and Kenya suggests that research environments can play a delimiting role in what science gets conducted and the perceived relevance of calls for openness. The day-to-day challenges of conducting research due to the aggregation of minor considerations (in monetary terms) represent one set of reasons why openness is limited. In outlining different methods of financial support, the previous section proposed relevant parallels – experience has suggested that small sums of money can enable individuals to redress what they identify as holding back their commercial entrepreneurial activity as well as their social development.

Thus in relation to science funding, one relatively low-cost intervention could be providing small scale funding to enable researchers to redress what they define as their most pressing research inhibitors. Providing easily accessible small amounts of funds that can be used in ways researchers determine for themselves could be one way then of both helping advance science and thereby enabling data openness. The basic orientation that informs this proposal is that scientists in low-resourced environments are not second rate researchers, rather that they are operating in challenging conditions; conditions which can and should be improved in order to allow research to flourish.

This section fleshes out possibilities for a ‘micro-funding’ related system for research. The ‘micro-’ designation is used to signal how the support is intended to address small, but cumulatively consequential, day-to-day issues in laboratories. This section elaborates the possibilities for support through examining similarities and dissimilarities between the domains of finance/international development and science.

Evaluation measures: While profitability and repayment rates are common parameters for the evaluation of financial micro-credit and specific social outcomes are typically used for cash transfers, in the case of science alternative criteria would be needed. One short to medium term way of judging would be through standard measures of research performance: outputs and productivity (e.g., as measured by improved bibliometric results). Micro-support might well have additional benefits such as bolstering scientists’ confidence and their engagement with funding schemes.

Another possibility in line with the overall importance identified in enabling researchers to define what is important for themselves would be to enable them to shape or propose criteria for judging the contributions made through micro-funding support. The possible benefits from support might well go beyond significant but narrow concerns about increased research performance. This could include, for instance, alleviating the perceptions of professional isolation and promoting networking. Such diverse benefits would be in-line with what is often claimed for micro-credit finance, particularly group forms of lending (Bayulgen 2008). Micro-credit has been identified as promoting ‘social capital’ – a notion varying defined but one that points to the importance of social relations, trust, and shared values in promoting community building and group reciprocity. By fostering interactions, including the exchange of information and the creation of peer reputations, group lending has been identified as a means of building networks of trust (Mayoux 1999) and even political empowerment (Barry 2012).

For micro-funding then, in line with Bayulgen (2008), for instance, evaluation indicators could include:

- * Growing self-efficacy and enhanced social capital on the part of recipients;
- * Increased participation in disciplinary and science governance discussions and activities (this due in part to scientists’ growing self-efficacy as well as the enhanced social capital);
- * Self-perceptions of the quality of research conditions and ease of undertaking research;
- * In the case of group loans whether networks, trust and standards of behaviour are enhanced within-groups and between lenders and groups.

Conditionality: As mentioned above, financial support systems differ regarding whether or not they compel certain behaviours in borrowers (for instance, compulsory savings or enrolment in skills training). Along these lines, micro-funding in science could either stipulate openness as a *requirement* for funding (or possibly sharing could be an overall evaluation criterion) or more modestly simply aim to *promote* conditions that would enable researchers consider data openness in circumstances more on a par with researchers in well-resourced settings.

For what: A basic tenet of both cash transfer and micro-credit programs is that the recipients are best placed to determine how funds can support their needs. In relation to science, such a flexible approach could support a wide range of products and services. Candidates suggested by previous research include equipment maintenance and calibration, professional membership fees, data storage fees, IT hardware and software purchases and updates, facility repairs, and data bundles (see Bezuidenhout et al. 2016).

For whom: As noted above, micro-credit loans are often intended for those who are deemed ‘unbankable’ or, at least, those that would otherwise struggle to receive a loan. And yet, despite this, lenders need to be reassured that borrowers have a reasonable prospect of repayment. Thus, those granted loans must have some means of income generation or existing capital in order to qualify for loans. The success of cash transfer too critically depends on who receives the support.

The selection process for micro-funding in science would likely be pivotal to its success. As with finance, while such resources would need to be directed towards those otherwise deprived, this would also need to go hand in hand with the prospect for the funds to be able to be effective. Many of the active research staff in South Africa and Kenya we interviewed fit this ‘marginal’ profile: while struggling to undertake research they were nonetheless able to publish in reputable journals and partake in international collaborations – they just were not operating on a level playing field compared to many of their international peers.

By what criteria: One dimension along which questions would likely to be asked about the selection of those supported is in the relative importance of 'scientific excellence' versus 'promoting participation' in allocation decisions. In this regard, a long standing tension within science funding is to what extent allocations should only be made on 'scientific merit' grounds. Doing so can lead to the reproduction of existing disparities. In contrast, to compensate for pre-existing variances in capacities, funding can be purposefully spread. Both such approaches have been justified through appeals to the (long term) advancement of knowledge.

Given the challenges associated with conducting research in resource constrained environments, the past opportunities and constraints of funding applicants would likely need to be taken in account in evaluating (i) applicants against each other, (ii) the merits of micro- support against other funding possibilities, (iii) the distributive equality effects in national research systems when support is given to some researchers.

Delivered by who: As noted above, in finance, intermediary organizations can play a role in holding and managing money from a funder. Such organizations vary considerably in their formality and the extent they are subject to regulation and oversight; from families to self-help groups to non-profit NGOs to credit associations to cooperatives to formal microfinance dedicated banks. In science a variety of organizations could play intermediary roles too, including national academies, professional associations, research networks, licencing bodies, etc.

Peer enforcement: Choices about which organization should play what role are likely, in part, to turn on how they are able to affect the behaviour of their members. In the case of group lending, peer monitoring is one of the mechanisms to ensure that individual micro-credit borrowers do not default on their loans or delay in re-paying. While much of the potential for monitoring stems from its coercive features (for instance, shaming defaulters), groups can also positively support individuals that have trouble repaying.

In science, peer scrutiny has been relied on to survey and enforce standards for conduct. Individual scientists must manage their reputation within their institutions and within their wider professional relations. As a result, peer awareness of failures or successes of micro-funding support could be one way of trying to ensure funds are well utilized.

Sustainability: In relation to micro-credit finance, much turns on the need or not for profitability, which in turn speaks to wider matters about the missions served by financial assistance measures and how they can be achieved. 'Welfarists' see micro-credit as a means of poverty reduction that can be legitimately subsidized. 'Institutionalists' by contrast identify financial self-sufficiency as a requirement to achieving poverty reduction and therefore are more prone to promote 'market efficiencies' and eschew 'subsidies' (see Nzongang and Nishimikijimana 2013). Thus even if commentators agree on the primary aim of micro-credit (e.g., poverty alleviation), they can disagree about its appropriate form.

In relation to science funding, as research is generally regarded as producing public goods that require some level of public or charitable funding, the general principle of subsidizing support for universities and other public organizations is not likely to provoke the same level of debate as in finance. In this sense, science funding is highly aligned with cash transfer support.

A New Bargain for Open Data

In response to the growing interest in data sharing but the often stated contention that more must be done to promote it, this article has advanced a 'micro-funding' scheme to put international Open Data discussions on a more positive and productive footing.

A central pillar of this proposal has been a call for a shift in the underlying philosophy associated with Open Data. Instead of basing calls for greater data sharing for those in low-resourced environments on appeals to the universal values of science or the requirements of research funding, I have sought to hold together concerns for ensuring research can be undertaken with concerns about data sharing. An understanding that informs the overall proposal of this article is that the amount and quality of science being produced in low-resourced environments and the extent of sharing of underlying data are not the result of the individual professional deficiencies of researchers. Instead, concerns about the extent of and sharing of science derive from the working circumstances under which researchers labour. This article has tied the remedying of those circumstances to the promotion of data openness.

By way of fleshing out how the new bargain could work, previous sections highlighted some of the choices and potentials associated with a micro-funding system. While the proposals outlined here have stemmed

from social research in African labs that struggle for funding, similar support mechanisms could be relevant for researchers in many parts of the world (including in Europe and North America) when they are comparatively low-resourced compared to their peers.

And yet, it is worth pointing out some cautions too with the specifics of the proposals given. One, micro-funding is not without its risk; both at the level of the individual initiatives funded as well as the wider contexts in which research gets conducted. As envisioned in this article, micro-funding would supplement other forms of support for research. Its success thus depends on the regulatory and fiscal policies that are set by local, national, and international agencies. Without adequate overall policies and procedures for supporting science and scientists, the gains achieved will likely be modest. Too, the efficacy of micro-funding will depend on how disparities in power in science across the global develop. Micro-funding can help redress inequalities, but only to a point. Other types of reforms will be needed.

In this spirit of learning, one way forward would be to pilot a micro-funding program. While being based on fieldwork and related experience, the proposal outlined in this paper stems from a limited amount of empirical data collected about particular areas of laboratory-based science. The wider relevance the proposal formulated offered is thus an open question. As mentioned above, a likely highly appropriate recipient group of micro-funding are researchers in low-resourced settings who, while struggling to conduct their science, are nonetheless still able to publish and collaborate. With relatively small amounts of flexible additional funding, such individuals might well be able to overcome many inhibitors. Starting from such a core group and then examining other categories of researchers would be one of gauging the relevance of micro-support into the future.

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Competing Interests

The author has no competing interests to declare.

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