Institutions and Economies
Vol. 4, No. 2, July 2012, pp. 45-64

Governance of Science, Technology and Innovation Programmes for Development: Is Global Financing Getting it Right?

Ana Carolina Machado Arroio
Federation of Industries of Rio de Janeiro State and Redesist
Economics Institute
Federal University of Rio de Janeiro, Brazil
Email: aarroio@firjan.org.br

***Abstract*:** To address the gap between international financing and the promotion of local capabilities for Science, Technology and Innovation this study focuses on key governance dimensions of international cooperation in ST&I. Governance activities and processes including voting power in decision making processes, project selection and evaluation, research themes, regional focus and investment types are examined to enable an understanding of the link between governance structures and outcomes that are favourable to the development of local capabilities. The paper pools information and initiates analysis on global governance and international cooperation in ST&I. In so doing it attempts to bridge the gap between research on innovation systems and governance of access to and dissemination of knowledge, so far mostly executed in an ad hoc fashion or within uni-disciplinary frameworks.

***Keywords*:** development, financing, global governance, innovation, science and technology

JEL Classifications: F500, F550, O190, O300

1. Introduction

Governance of Science, Technology and Innovation (ST&I) is a relatively new research area that has been attracting considerable attention and promises to bring important benefits for developing countries. Research is spurred by the recognition of the vast gap between the potential and the realization of Science, Technology and Innovation for development (Salomon, *et al*., 1994; Casssiolato, *et al*., 2003; Mansell, 2009). The widening gap, allied with a significant expansion in the technology frontier in recent decades and increased scientific

complexity and global interdependence, has led to a growing body of literature on scientific and technological cooperation (Sagasti *et al*., 2005; Wagner, 2008; Desai, 2009), international networks (Slaughter, 2004; Woods and Martinez-Diaz, 2009), implications of the privatization of knowledge for science and development (Maskus and Reichman, 2004; Serfati, 2008) and governance of global public good technologies in specific sectors such as Security, Health and the Environment. This has led to proposals for the establishment of international foundations and other institutions to deal with the trans-frontier implications of inequalities in ST&I (Pogge, 2001; Buchanan *et al*., 2009).

This paper takes a step back from these analyses seeking to determine if the promotion of local capabilities for science, technology and innovation is effectively a priority for international organizations concerned with development issues. The analysis led to the conclusion that because agencies use different definitions of ST&I no cross-agency comparisons are valid. Instead it examines key governance dimensions of international donors to draw out and to assess global strategies for strengthening innovation systems. This approach looks at the link between governance structures and the promotion of local ST&I capabilities.

2. Discourse and Reality: Science, Technology, Innovation and Development

The literature on economic development and growth has long argued that technology is a major, if not the major, component of long-run economic growth – of increased productivity (Schumpeter, 1934; Solow, 1956; Freeman, 1992). Scholars have called for a "concerted effort in promoting technological research and the background sciences required to consolidate and develop research findings" (Furtado, 1970: 303).

A pioneering document to raise awareness of the role of international cooperation in ST&I for development was the *Science and Technology to Developing Countries during the Second Development Decade* report, or *The Sussex Manifesto*, published in 1968 as an annex in *Science and Technology for Development: Proposals for the Second United Nations Development Decade* (United Nations, 1968). The document advanced a series of proposals, including that developing countries build up local technological capabilities by increasing R&D expenditures accompanied by institutional reform and designing new policy making institutions. It advocated the reorientation of R&D in Developed Countries, directing scientists' attention to "science for development" and proposed that 5 per cent of total Overseas Development Assistance be used for direct support of science and technology in addition to the creation of an international technology transfer bank.

The Manifesto contested the assumption that developing countries can rely on technologies from governments and industries in Developed Countries. On this view, all that is needed is to clear the channels for the "transfer of technology". But this is not an alternative to the development of local science. It is difficult for a country without local ST&I capacity and particularly without the trained people required to know what useful technology exists elsewhere, to understand it, select it, absorb, adapt and operate, repair, and then, generate new knowledge. Studies on "Technology and Development", "Dependency theory" and more recently the "National Technology system Framework" and "National Systems of Innovation" approaches have shown that social and economic development, or "catching-up", is not simply a question of accelerating the pace of technological diffusion and increasing access to new technologies. Of particular relevance is the emphasis on the importance of accumulating capabilities and knowledge for sustainable competitiveness.

The decisive role of technology and of international cooperation for social and economic development has increasingly been incorporated into policy discourses and the international agenda. Policy documents, directives and mission statements of leading international cooperation Organizations, multilateral development institutions and Official Development Assistance agencies usually make reference to the role of ST&I in development and the promotion of capabilities for local innovations.

3. Methodology

The chief principle of this study is to provide consistent and comprehensive data on key governance dimensions in international ST&I funding and promotion efforts. It identifies and discusses the governance styles of the eight largest international ST&I funding agencies: three bilateral donors (the Canadian International Development Research Centre – IDRC, the UK's Department for International Development – DFID, and the Japan International Cooperation Agency – JICA); one regional S&T international cooperation funding agency, the European Commission's Framework Programme for Research and Technological Development – the EU-FP6, the EU's main instrument for research funding; the largest private ST&I donor, the Bill and Melinda Gates Foundation – BMGF; and three multilateral agencies (the United Nations Industrial Development Organisation – UNIDO, the United Nations Conference on Trade and Development – UNCTAD and the World Bank).

Two criteria were used for the selection of funding agencies to be studied. Firstly, the agency must have a publicly reported financial commitment to assist ST&I efforts in developing countries and, secondly it must have implemented an institutional structure to support this commitment, including the establishment of an international cooperation ST&I department, division or unit within the

organization staffed with qualified, dedicated professionals. The eight funding agencies discussed are amongst the largest technology financing agencies and, most importantly, they are key strategists and policy makers for the topics related to ST&I and social and economic development.

The definition of Science, Technology and Innovation used in this research is the one adopted by the donor or funding agency. These use differing conceptions thus making the data incomparable and a near impossible task to quantify the amount of ST&I support that the aggregate donor community provides to developing countries (Farley, 2005). This lack of a clear and coherent definition of ST&I funding makes objective assessments impossible to reach in a meaningful comparative way.

This paper argues that reflection and debate on the precise definitions and indicators used when discussing ST&I for development is important. The complex nature of most scientific and technological development work does not lend itself to easy categorization as highlighted by Godin (2001). His research shows that important controversies rage beneath the consensus of an international community as judgements employed in making estimates vary from agency to agency. To arrive at the standards adopted in the OECD publications, the Frascati Manual *(*2002) and The Oslo Manual (2005), for example, various alternatives have been proposed and adopted in different periods.

Forging a consensus on a shared terminology is a political and evolutionary process that may lead to an improved understanding of the dimensions involved in ST&I for development. Clear and coherent definitions that are commonly held by funding agencies and recipients are essential for the collation of quantifiable, compatible and comparable data, enabling a more accurate view of international cooperation and ST&I funding for development.

To date, no systematic effort has been made to link the stated priorities of the largest international donors and their disbursement for ST&I in developing countries. Publicly available data on ST&I funding is incomplete and not standardized. The OECD creditor reporting system provides information on the "Advanced Technical and Managerial Training" Aid activities of 23 member countries and several UN and multilateral agencies. However, this database does not contain information about the activities of key ST&I funding agencies and donors such as the Canadian International Development Research Centre – IDRC. In addition the data offers very limited possibilities for understanding international ST&I financing flows. Neither does UNESCO nor other OECD databases provide this information (OECD, 2008).

In order to provide consistent data, two core principles were followed. Firstly, only raw primary data reported by the funders themselves were included in the analysis. The only exception is data for the BMGF which

was complemented by a study by McCoy *et al*. (2009) that examines the Foundation's grant-making for the "Global Health Programme" and traces the geographical location of primary recipients. Foreign currencies were converted to US dollars based on the 2008 average annual exchange rate as reported by the International Monetary Fund. Given the poverty of existing figures and that comparisons are rendered meaningless by the lack of a standard definition, ST&I funding is examined only as a component of a specific organization's total resources and no attempt is made to undertake cross-agency disbursement comparisons.

The second principle was that in order to make the data as robust as possible, all information gathered from annual reports, budgets and policy briefs was collated in a database classified along six governance dimensions, described in Table 1. Initial collation of data was followed by a three-month period of intensive cleaning, cross-checking, and organizing of the complex dataset collected. When possible, in-depth semi-structured personal interviews were carried out with selected ST&I international cooperation specialists to triangulate the data.

Table 1: Key Governance Dimensions

Dimension	Focus
Representation	Developing country input and voting power in decision making processes
ST&I Programmes	Research themes or Programmes supported
Primary recipient of funds	End-user of international ST&I resource
Regional focus	Regional ST&I lending patterns
Investment type	Area of investment
Project selection and evaluation	Approval of thematic priorities and project review process

Source: Author

4. Discussion: Bilateral and Multilateral ST&I funding agencies – Key Dimensions

The stated priorities of the eight agencies examined in this paper include the critical words "science, technology, innovation and development". The International Cooperation Programme of the European Union FP6 and FP7 (European Commission, 2009) aims to "*contribute to the production of global public goods and help to close the gap between different countries in the world*". DFID's Research4Development strategy, states that "*the development of a science and technology base goes alongside economic growth: they contribute to each other*" (DFID, 2008). The World Bank (2008) links technology to

globalization and private enterprise and the 2009 Annual Letter from Bill Gates (Bill and Melinda Gates Foundation, 2009a) states that "*Our optimism about technology is a fundamental part of the foundation's approach ... we try to point scientific research toward the problems of the poor*." The discourse is similar across all donors and this is reflected in Mission statements, Annual Letters and other institutional policy directives.

4.1 Representation

The mind-set of an institution is inevitably the entity linked to which it is directly accountable. The specific mandate, *capacity* and decision-making mechanisms of each funding agency can affect priorities. In addition, voting rights matter and who has a seat at the table, even with limited voting rights, matters as it determines whose voices get heard. All funding agencies examined have procedures for developing-country input into decision making, but it is only the IDRC, UNIDO and UNCTAD that include formal and substantial developing country representation on decision making boards with equal voting power. The IDRC has a 21-member international Board of Governors that oversees the Centre's affairs. The IDRC Act stipulates that up to 10 Governors can be appointed from other countries and this composition "*helps to ensure that the Centre's Programmes and operations are effectively grounded in the realities and needs of the developing world*" (IDRC, 1971). Member state representatives constitute the highest decision-making body at UNCTAD and UNIDO. The chief policy-making organ at UNIDO is the General Conference, comprising representatives of all Member States, with meetings taking place every two years (UNIDO, 2009a). At UNCTAD, the highest decision-making body is the quadrennial conference. The organizations' mandates, work priorities and regular and operational budgets are decided in *fora* that include developing country members (UNCTAD, 2008).

The bilateral donors, JICA and DFID, and the EU regional ST&I funding Framework Programmes while accountable to national parliaments, and to the European Parliament in the latter case, have no provision for official developing country representation and accountability. For the EU, the ST&I International Cooperation Programme is regarded as a political instrument and is a "privileged tool for implementing cooperation between the EU and these countries" (European Commission, 2007). The World Bank is governed by an executive board in which all member states are formally but not equally represented, thus developing countries have limited voting rights. The BMGF, a private initiative, has four co-chairs who oversee operations and retain overall decision-making power, but the executive committee does not include developing country representation.

Although policy documents state that international cooperation activities in ST&I aim to "target developing countries particular needs" (European Commission, 2007), in a majority of the agencies examined there is no formal institutional procedure to capture what these needs are. With few exceptions, developing countries are not represented in priority setting and decision-making *fora*. In most cases, the partners with the financial resources and technical capacity establish funding priorities.

4.2 ST&I Programmes

International research agenda setting is crucial in many ways. It determines not only priorities for funding but what fields are seen as significant for the future and consequently what research is deemed (note) worthy. As highlighted in Tables 2 and 3, the issue areas selected by funding agencies are remarkably similar and prioritize research on Health, the Environment, Information and Communication Technologies.

Table 2 - Key dimensions of major bilateral / regional ST&I funding agencies, 2008

	JICA	DFID	IDRC	EU – FP6
Representation	Japanese Government	UK Parliament	21-member Board of Governors / 10 Governors from other countries	European Commission, European Parliament, Council of Ministers
ST&I Programs	Planning & Administration, Public Works & Utilities, Agriculture, Forestry & Fisheries, Mining & Industry, Energy, Business & Tourism, Health, Welfare	Sustainable Agriculture, Climate Change, Health, Governance in Challenging Environments	Environment & Natural Resource Management, Social and Economic Policy, ICT for Development, Innovation, Policy & Science	Health, Food, Agriculture & Fisheries, Biotechnology, ICT, Nanosciences, Energy, Environment, Transport, Socio-economic Sciences & Humanities, Space, Security
Primary recipient	Government, local government, NGO, private enterprise and citizens	Governments, charities, businesses, international bodies, universities	Individuals, research groups, universities, development agencies, NGO, think tanks	Research groups at universities or research institutes
Regional focus	Asia, 43%, Africa 22%, Middle-East 12%, North & Latin America 17%, Oceania 4%	Africa 46%, Asia 31%, Americas 2 %, Europe 1% Pacific 1% Multiregional & global 19%	Africa and Middle-East 31%, Asia 17%, Latin America & Caribbean 11%, Multiregional & global 40%	Developing Countries 53%, Industrialized Countries 20%

Investment type (ST&I) Project selection and evaluation	Technical Cooperation Internal Project & Programme Evaluation	Science (research) Specialist contracted advisers	Science (research) Internal Selection / External evaluation	Science (research) Panel of Experts

Source: Consolidated from Annual Reports and Agencies' Publications.

Table 3: Key Dimensions of Major Multilateral and Private ST&I Funding Agencies, 2008

	UNIDO	UNCTAD	World Bank	BMGF
Representation	UN General Conference / Industrial Development Board	UN General Assembly / UNCTAD quadrennial conferences	Executive board – proportional voting power	Co-chairs (Bill, Melinda, and William Gates)
ST&I Programs	University Chairs on Innovation, Technology Parks	Technology and Logistics, S&T for Development Network, Capacity-Building	Comprehensive S&T Development, Human Resource Development, Technology Development, Health, Environment	Global Health, Global Development, United States
Primary recipient	governments, academia and the business community	international & regional agencies, academia, business community, NGO	Government, private enterprise	NGO, global health partnerships, university, public sector, business
Regional focus	Africa 30%, Asia & Pacific 20%, Arab Region 12%, Europe & NIS 12%, Latin America & Caribbean 10%, Interregional & Global 16%	Africa 20%, Asia & Pacific 20%, Latin America & Caribbean 8%, Europe 3%, Interregional 49%	East Asia 40%, Latin America 20%, other 40% (ST&I loans 1980 to 2004)	USA 82%, Europe & other high-income countries 13%, low & middle-income countries 5%*
Investment type (ST&I)	Technology Promotion	Technology Development / Technical Cooperation	ST&I	R&D
Project selection and evaluation	Internal Selection / External evaluation		Internal Project & Programme Selection & Evaluation	

Source: Consolidated from Annual Reports and Agencies' Publications.

While it is important to carefully unpack these broad categories, little evidence was found to support the idea that programme selection was based on a systematic and horizontal determination of what developing countries judge to be their own priority needs in research and technological development. Many initiatives appear to be asymmetric, promoting one-way knowledge and capacity flows from development partners to developing country clients who are striving to augment their ST&I capacity. This is not only because most project selection and decision-making is carried out in formal and informal spheres that do not include developing country representation but is also often due to the perception that recipient countries have insufficient knowledge to negotiate.

It is not clear what opportunities there are for influencing the ST&I Programmes of these agencies, however, given the principles of ownership by developing country leadership, and of alignment with developing country national development and poverty reduction strategies, as identified in the Paris Declaration on Aid Effectiveness, there is scope for a more dynamic bottom up approach to enable recipient countries to identify the ST&I inputs needed to meet their development goals.

4.3 Primary Recipient of Funds

International cooperation in ST&I is mainly carried out by means of grants (technical cooperation or research grants), with the exception of the World Bank, that operates through loans. Most ODA agencies and multilateral organizations work primarily through national governments, while the IDRC, the EU-Framework Programmes and BMGF finance individual researchers within developing and developed countries. True to the broad based nature of innovation advance, secondary recipients across all donors comprise an ample spectrum, including individuals, research groups, private enterprise, development agencies, NGOs and think tanks.

Research leading to innovation requires long-term support and a key step to ensure technology promotes local development is empowering local actors, particularly those committed to innovation. This includes a wide-range of economic, political and social agents: not only scientists and firms (producers of final goods and services, suppliers of inputs and equipment, service providers, etc.) and their various forms of representation and associations, but also other public and private institutions and organizations specializing in educating and training human resources, R&D, engineering, promotion, financing, etc. National Systems of Innovation research shows that it is crucial that support to individual scientists feed into local systems of innovation, however incipient, and to the overall strengthening of local capabilities.

4.4 Regional Focus

When looking at the overall distribution of the participation of ST&I lending patterns by geographical region the data confirm that domestic capabilities matter. The World Bank, for example, has provided loans mainly to a handful of large, middle-income, scientifically advanced countries. More than 50 per cent of the major S&T loans went to only seven countries, notably South Korea, China, India, Indonesia, Brazil, Chile and Mexico (Crawford *et al*., 2006). Of a total of 69 major nonagricultural projects, East Asia received about 40 per cent of all S&T loans during the review period (29 projects) and Latin America took out about 20 per cent of the loans (15 projects).

This is confirmed by data from the EU Framework Programmes. Although in absolute terms developing countries have the highest number of participations (53 per cent), as shown in Table 3, complementary data show that proposals involving industrialized countries have in general a higher success ratio, 22 per cent in the case of the US and 29 per cent for Australia, while emerging economies vary between, for example, Brazil with 9 per cent, China and the Russian Federation with 14 per cent and 16 per cent respectively, and South Africa with 24 per cent (European Commission, 2009). In addition, emerging economies and industrialized countries are increasing their participation shares, while the shares of developing countries are decreasing. This tendency might be exacerbated in the FP7 Programme covering the period 2007-2013 because unlike preceding Framework Programmes, developing countries do not have to apply through the "International Cooperation" category, but rather can be candidates for funding in any research topic heading. In one sense, this may allow broader participation, but it is likely that resources will go to third countries that are more capable of competing for these resources, including industrialized countries and emerging economies. This provides confirmation to the perspective that efforts aimed at creating an indigenous research and technological capabilities base must co-exist alongside improved technological diffusion.

The most heavily skewed support in terms of the geographical location of primary recipients is the BMGF. McCoy *et al*. (2009) examined all "Global Health" grants awarded between January 1998 and December 2007 looking at a total of 1094 grants in the value of US$8.95 billion. They found that 40 per cent (US$3.62 billion) of all funding was awarded to supranational entities such as Global Health partnerships and intergovernmental organizations. Of the remaining amount, recipients based in the USA received 82 per cent (US$4.39 billion), recipients in Europe and other high-income countries were awarded 13 per cent (US$0.70 billion) and those in low and middle-income countries received 5 per cent (US$0.24 billion). In other words, 95 per cent of total R&D resources went to recipients based in technologically advanced

countries. In addition, considering a total of 231 grants to universities, only 12 were awarded to research centres in developing countries. This is particularly relevant given the role of universities and research laboratories in developing the local scientific and technological base. The Foundation's generous funding of organizations, primarily in the USA and UK, may accentuate existing research and other disparities between developed and developing countries.

UNIDO and UNCTAD appear to have a strong focus on Africa and the Asia and Pacific region. However, this does not necessarily signify that local research or innovation is being funded in these regions, more detailed information is needed. In contrast, in the case of the IDRC the relatively strong bias toward Africa and the Middle-East (31 per cent of total grants) and Asia (17 per cent) is effectively tied in with funding of local scientific research. Only the EU Framework Programmes, the World Bank, IDRC, and BMGF provide specific data on regional recipients of ST&I project resources. Data for the other donors comprise a general overview of funding patterns, not focused on funding for research and innovation.

4.5 Investment Type

Reflecting the lack of an informed and coherent perspective on concepts, terminology and indicators, policy making in international funding does not appear to take into account the complex spectrum of processes involved in science, technology and innovation initiatives for development. There are many dimensions to be considered, both for donors and for national governments seeking to strengthen domestic capabilities. Designing ST&I policies is complex and research on National Systems of Innovation shows that the promotion of innovation, investment priorities and strategies should be closely tied to domestic industrial and educational policies. In addition, government support for innovation requires delicately balanced incentives and agility to respond to rapidly changing circumstances. Innovation is dynamic, risky and as discussed previously, includes a wide-range of economic, political and social agents. Selecting national investment priorities and priorities for international funding of ST&I is not an easy task.

An additional layer of complexity is added when the full spectrum of activities involved in ST&I, comprising a wide-array of non-linear processes, including basic and applied scientific research, engineering and technological development, prototyping, scale-up and commercialization of technology is considered (Mytelka and Ohiorhenuan, 1998). It is also essential that policies consider non-R&D aspects (Oldham, quoted in Ogodo, 2009) such as: design and computer programming; management; business, administrative and production activities; teaching and other activities needed to innovate.

DFID, along with JICA and the EU, have not traditionally provided funding for the local capabilities to innovate. They have focused on technical cooperation and technology acquisition, the aim being mainly to facilitate technology transfer and diffusion rather than the capabilities required to develop local solutions. In the same vein, the Bill and Melinda Gates Foundation has a mandate to provide technological solutions but they promote research capacity mainly in advanced countries. For the EU, disbursement is tied to cooperation in basic and applied science development Programmes. This does not include support to firms and the final stages of the innovation process.

A different investment strategy is adopted by the IDRC, UNCTAD and UNIDO focusing on capacity-building activities and private sector development. According to the IDRC (2009), "the aim is to strengthen local research capacity in developing countries and to support research that influences public policy". UNCTAD (2009), the United Nations agency for issues on trade and development, states that the "main goal is to enhance the endogenous capacity of beneficiary countries to face challenges and benefit from opportunities and to set and implement their own development strategies, as well as to emphasize the development of human, institutional, productive and export capacities of beneficiary countries". It also focuses on interrelated issues in the areas of finance, technology, investment and sustainable development.

UNIDO provides support for ST&I through the Global UNIDO Network and Technology Parks Programmes. UNIDO is one of the few funding agencies to provide support to this vital component in the innovation system. However, it is not immediately clear that the initiative works in tandem with other decisive aspects, such as support to the design of industrial, economic and technological policies that prioritize and support local innovation initiatives. Although local industrial development is the stated aim, it is curious to note that the first phase of the "Global UNIDO Network of University Chairs on Innovation", called "Taking care of the future of Innovation in Africa" is chaired by three European universities. Universities in industrialized countries are encouraged to participate as this may "improve links with industry, academia and governments in relevant future markets" (UNIDO, 2009b). This, of course, begs the question of whether "the future of innovation" also includes African countries' access to relevant markets in industrialized countries.

In the 1970s and 1980s, the World Bank provided financing for the full range of ST&I activities, including linking the supply and demand for S&T services, fostering university and industry cooperation, restructuring public R&D institutes to make them more responsive to industry needs, projects to enhance technology development in industry, and projects focused on Metrology, Standards, Testing, and Quality (MSTQ) systems, among others. Although the benefits of an approach that targets the broader innovation system

are significant, since the 1990s the Banks' overall approach has become less focused on the capabilities to build systems of innovation and more strongly focused on private sector and infra-structure development. In addition, its support to ST&I has had limited geographical reach.

While not all funding agencies can provide support to all aspects of the innovation process the investments discussed suggest that most disbursements do not target initiatives to strengthen capabilities at the local level. In order to bring to light clear policy choices to enable increased effectiveness of resource allocation it is vital to clearly understand the links between science, technology and innovation and the various dimensions and actors involved in creative production processes. This understanding can only emerge from a clear typology reflecting the complex spectrum of processes comprised in building local ST&I capabilities.

4.6 Project Selection and Evaluation

As regards the project selection process and approval of thematic priorities, only the Europeans (DFID and EU-Framework Programmes) rely on external evaluations, hiring Expert Panels or specialist contracted advisors. Other funding agencies do not have systematic selection procedures based on independent and technical peer review processes. Grant making by the Gates Foundation is largely managed through an informal system of personal networks and relationships and the process by which individual proposals for projects are solicited, adjudicated, and funded is unclear (McCoy, 2009).

Project evaluation, monitoring and accountability are key elements of good governance and funding efficiency and this is a crucial "black box" of international cooperation in ST&I. Ostrom *et al.* (2002), use a collective action framework to examine the incentives that underpin aid effectiveness and sustainability, highlighting the importance of institutions and the incentives they produce. Project ownership is deemed crucial for effectiveness and they recommend that owners not only contribute to project design and implementation, but also that they be allowed full participation in project evaluations.

Local appropriation is a necessary step for effective projects to develop systems of innovation and local capabilities. Going a bit further however, the operational, on-going and *ex-post* evaluation of projects is a crucial governance dimension that also suffers from the lack of a typology as an instrument to pry open the various categories of ST&I investment. In order to monitor the effectiveness of innovation funding it is necessary to draw out and make explicit the categories that are being financed and the full-range of expected benefits of such funding. It is relatively simple, for example, to assess expenditure on R&D for immediate technological solutions for development and this is the

basis of the idea of "results-based philanthropy" sponsored by the Bill and Melinda Gates Foundation.

Establishing accountability and defining indicators to monitor projects that adopt an innovation system perspective, from cooperation in R&D projects to the financing of ST&I infrastructure and production related expenditures, such as links with industry and the development of technical skills and capabilities, is a more complex challenge. And this discussion, of the link between ST&I financing and evaluation, is not surprisingly, usually absent from donor Annual Reports and websites. IDRC's approach and methodologies to map outcomes of funding for research on innovation and development can be singled out but most agencies focus mainly on evaluation and monitoring of their poverty-reducing Programmes and the impact of interventions on the poor. This is different from assessing the results of strategies to develop technological capabilities and innovation outcomes.

4.7 Disbursement

The main focus of this paper is on the governance dimensions that define which ST&I Programmes are selected and financed. It is interesting however, to take a step back and examine the allocation of financial resources for international cooperation in ST&I by the main donor agencies. Keeping in mind that donors use different reporting periods, varying definitions for ST&I disbursements and that in many cases resources disbursed go to research that is carried out in developed countries (an important variable given the tacit and localized nature of the innovation process) it is only possible to draw a very broad picture of individual allocations. Due to the poverty of existing data, the aim is not to provide cross-agency comparisons or generalizations on global flows of ST&I financing, but rather to provide insights into the financial commitments of individual efforts to support ST&I in developing countries.

In absolute terms, JICA at US$2.6 billion provided the largest funding for Technical Cooperation in 2008 (JICA, 2008). In 2008, completing a three-year reorganization of Japan's overall Official Development Assistance, JICA merged with the development assistance section of the Japan Bank for International Cooperation to form the world's largest bilateral development aid agency. JICA focuses mainly on Technical Collaboration, providing funding for the underlying scientific infra-structure, research support and technical expertise for the transfer of Japanese technology.

The United Nations agencies, UNCTAD and UNIDO, disbursed US$124 million and US$31 million respectively to support Technology Promotion, Development and Cooperation Programmes. UNIDO (2009b) recognizes that "the flows of investment and technology to developing countries have not

materialized to the extent expected". From the 1960s, UNCTAD has linked trade and development to S&T. It has helped elaborate Science, Technology and Innovation Policy Reviews (STIPs), to "assist developing countries identify and adjust their policies and institutions in order to support the technological transformation, capacity-building and innovation of their enterprises". Despite good intentions, budgetary allocation to Technology Development and Cooperation is low, at US$31 million. UNCTAD, along with other funding agencies, is increasingly seeking partnerships with multilateral and private donors to enable additional resources for ST&I projects.

Keeping in mind the non-comparability of the data, Annual Reports show that DFID (2009) disbursed US$592 million under the category "Science" in 2008 and in the same year the Canadian IDRC allocated almost its entire budget of US$140 million to support scientific research and innovation. Between 1980 and 2004, the World Bank lent US$8.6 billion dollars to directly support S&T activities through 647 projects. Annually, average lending for science and technology totaled $343 million and these projects represented 11 per cent of all Bank projects (6059) for the period (Crawford *et al*., 2006). The Bill and Melinda Gates Foundation (2009b) disbursed US$8.95 billion in a ten year period (1998 to 2007), of which 3.2 billion (36.5 per cent) were allocated to R&D. Funding was directed at technology development and innovation for vaccine and anti-microbial development and research was carried out mainly in universities in the USA and Europe.

As regards the European Union's Sixth Framework Programme, "International Collaboration" category, the four year budget outlay, from 2002 to 2006, reached US$509 million. This represents slightly less than 2 per cent of total FP-6 allocations and highlights the fact that third-country participation in European Union sponsored S&T projects is very low. Developing countries represented 47 per cent participation in FP-6, a decrease from 53 per cent participation in FP5. There has been a marked decrease of developing country participation from FP5 to FP6, and this is a tendency that might be exacerbated in the new FP7 Programme.

Although it is not possible to arrive at any valid cross-agency comparison and it is also not possible to paint an accurate picture of global ST&I financing, the data suggests that there is a relatively low level of financial commitment for the development of local capabilities in ST&I. This is increasingly leading to the establishment of "global partnerships" to enable additional resources for specific projects. These findings underscore the need for a common framework and a typology to discuss and finance ST&I for development. This is essential to build efficient governance designs to structure decisions regarding the allocation of scarce resources.

5. Concluding Remarks

The analysis has shown that the eight international ST&I funding agencies vary in their governance styles by regional focus, investment in science, technology and innovation, support of government, research institutes and private enterprise, project selection and evaluation procedures and developing country input and representation in decision making instances. The study has pointed to the gaps between bilateral and multilateral funding agencies' rhetorical commitments to supporting ST&I in the interests of development, and the lack of substantial evidence that this commitment is reflected in lending policies and disbursements. It has also shown that each donor emphasizes a slightly different facet of innovation and that they have operated in isolation as regards ST&I governance styles and funding policies.

The paper has argued that while not all funding agencies can provide support to all aspects of the innovation process and that the pluralism of international cooperation institutions makes a move toward a unified and centrally coordinated global funding system highly unlikely, international governance of ST&I would be greatly facilitated by a common understanding and a shared language for this very complex theme. As highlighted in this study, the definition of Science, Technology and Innovation adopted by the major funding agencies is inconsistent and unclear. This has implications for project accountability and governance mainly because independent project evaluations should be based on conceptual coherence, common standards and empirically measurable indicators. A common terminology, based on a coherent and transparent typology of ST&I and development, would improve harmonization and donor coordination, one of the guiding principles of the Paris Declaration, in addition to paving the way for the best exploitation of potential synergies from "global partnerships" to fund ST&I projects.

Finally, and most importantly, the collation of quantifiable, compatible and comparable data, enabling a commonly shared terminology and a more accurate view of the ST&I support that the aggregate donor community provides would empower developing countries, providing them with important indicators to participate more knowledgeably in debates and negotiations in multilateral *fora* that set "the rules of the game" on ST&I issues in development and also enabling recipient countries to make better choices in the identification, selection, negotiation and adaptation of the ST&I inputs needed to meet their development goals. Adoption of a common conceptual framework for international cooperation in ST&I could have a significant impact on how ST&I for development is conceptualized, designed, funded and evaluated, opening new opportunities for developing country participation and enhanced coherence and coordination by donor agencies.

References

Bill and Melinda Gates Foundation (2009a) "2009 Annual Letter from Bill Gates", downloaded from http://www.gatesfoundation.org/annual-letter/Pages/2009-bill-gates-annual-letter.aspx in February 2009.

Bill and Melinda Gates Foundation (2009b) "Grants", downloaded from http://www.gatesfoundation.org/Pages/home.aspx in May 2009.

Buchanan, A., Cole, T. and Keohane, R. (2009) "Justice in the Diffusion of Innovation", *Journal of Political Philosophy*, 19(3): 306-332, downloaded from http://philpapers.org/rec/BUCJIT.

Cassiolato, J.E., Lastres, H. and Maciel, M.L. (eds), (2003) *Systems of Innovation and Development, Evidence from Brazil*, London: Elgar.

Crawford, M., Yammal, C., Yang, H. and Brezenoff, R. (2006) "Review of World Bank Lending for Science and Technology, 1980-2004", Science, Technology and Innovation Discussion Paper Series, Education Department, Human Development Network, World Bank, downloaded from http://siteresources.worldbank.org/EDUCATION/Resources/278200-1099079877269/547664-1099079975330/Review_WB_lending_ST_80-04.pdf in May, 2009.

Desai, P. (2009) "Globalization of Innovations: Changing Nature of India's Science and Technology Cooperation Policy", *International Journal of Institutions and Economies*, 1(1): 53-78.

Department for International Development, UK (DFID) (2008) "Eliminating World Poverty: Making Globalisation Work for the Poor", White Paper on International Development, Presented to Parliament by the Secretary of State for International Development, downloaded from http://www.dfid.gov.uk/Documents/publications/whitepaper2000.pdf in April 2009.

Department for International Development, UK (DFID) (2009) "DFID Annual Report, 2008", downloaded from http://www.dfid.gov.uk/About-DFID/Finance-and-performance/Annual-report/Annual-Report-2008/ in April 2009.

European Commission (2007) "European Commission Seventh Framework Programme for Research and Technological Development - FP7 in Brief", downloaded from http://ec.europa.eu/dgs/research/organisation.cfm?lang=en#D in May 2009.

European Commission (2009) "A More Research-intensive and Integrated European Research Area – Science, Technology and Competitiveness Key Figures Report 2008/2009", European Commission, Directorate-General for Research, Brussels.

European Commission (2007) "European Commission Seventh Framework Programme for Research and Technological Development - FP7 in Brief", downloaded from http://ec.europa.eu/research/fp7/pdf/fp7-inbrief_en.pdf in May 2009 and July 2012.

Farley, S. (2005) "Support to Science, Technology, and Knowledge for Development: A Snapshop of the Global Landscape (Summary Report)", Paper prepared for The Africa–Canada–UK Exploration: Building Science and Technology Capacity with African Partners, 30 January – 1 February 2005, London, UK.

Freeman, C. (1992) *The Economics of Hope: Essays on Technical Change, Economic Growth and the Environment*, London/New York: Pinter.

Furtado, C. (1970), *Economic Development of Latin America, Historical Background and Contemporary Problems*, Cambridge: Cambridge University Press.

Godin, B. (2001) "Tradition and Innovation: The Historical Contingency of R&D Statistical Classifications", Project on the History and Sociology of S&T Statistics, Working Paper No. 11, downloaded from http://www.csiic.ca/PDF/Godin_11.pdf in April 2009.

International Development Research Centre (IDRC) (1971) "International Development Research Centre Act and General-Bylaw", downloaded from http://web.idrc.ca/pan_americas/ev-58004-201-1-DO_TOPIC.html, in May 2009 and July 2012

International Development Research Centre (IDRC) (2009) "International Development Research Centre Annual Report 2007–2008", downloaded from http://www.idrc.ca/EN/AboutUs/Accountability/AnnualReports/Annual%20Report%202007-2008.pdf. in May, 2009 and July 2012.

Japan International Cooperation Agency (JICA) (2009) "2008 JICA Annual Report", downloaded from http://www.jica.go.jp/english/publications/jbic_archive/annual/2008/pdf/05.pdf in April, 2009.

Mansell, R. (2009) "The Information Society and ICT Policy: A Critique of the Mainstream Vision and an Alternative Research Framework", LSE Research Online, downloaded from http://eprints.lse.ac.uk/24990/ in August 2009.

Masksus, K. and Reichman, J. (2004) "The Globalisation of Private Knowledge Goods and Privatization of the Global Public Goods", *Journal of International Economic Law*, 7(2): 279-320.

McCoy, D., Kembhavi, G., Patel, J. and Luintel, A. (2009) "The Bill and Melinda Gates Foundation's Grant-making Programme for Global Health", *The Lancet*, 373(9): 1645–1653.

Mytelka, L. and Ohiorhenuan, J. (1998) "Knowledge-based Industrial Development and South-South Cooperation", *The Cooperation South Journal*, No. 2, UNDP, Special Unit for Technical Cooperation Among Developing Countries, New York.

Oldham, G. in Ogodo, O. (2009) ""Poor Countries Spending More on Science", downloaded from http://www.scidev.net/en/news/poor-countries-spending-more-on-science-.html on 9 October 2009.

Organization for Economic Co-operation and Development (OECD) (2002) *Frascati Manual for the Measurement of Scientific and Technological Activities: Proposed Standard Practice for Surveys on Research and Experimental Development* (6th ed.), downloaded from http://www.oecd.org/document/6/0,3746,en_2649_34273_33828550_1_1_1_1,00.html in May 2009.

Organization for Economic Co-operation and Development (OECD) (2005) *The Oslo Manual Guidelines for Collecting and Interpreting Innovation Data* (3rd ed.), downloaded from http://www.oecd.org/document/33/0,3746,en_2649_34273_35595607_1_1_1_1,00.html in May 2009.

Organization for Economic Co-operation and Development (OECD) (2008) *Main Science and Technology Indicators Publication* (2nd ed.), downloaded from http://www.oecd.org/document/26/0,3343,en_2649_33703_1901082_1_1_1_1,00.html in May 2009.

Ostrom, E., Gibson, C., Shivakumar, S. and Andersson, K. (2002) "Aid, Incentives and Sustainability: an Institutional Analysis of Development Cooperation", SIDA Studies in Evaluation 02/01, Stockholm,

Ostrom, E., Gibson, C., Shivakumar, S. and Andersson, K. (2002) "Aid, Incentives and Sustainability: an Institutional Analysis of Development Cooperation", SIDA Studies in Evaluation 02/01, Stockholm, downloaded from http://sd-cite.iisd.org/cgi-bin/koha/opac-detail.pl?biblionumber=22713, in May 2009 and July 2012.

Pogge, T. (ed.), (2001) *Global Justice*, Oxford: Blackwell Publishing.

Sagasti, F., Bezanson, K. and Prada, F. (2005) *The Future of Development Financing: Challenges and Strategic Choices*, London: Pelgrave-MacMillan.

Salomon, J.-J., Sagasti, F. and Sachs-Jeantet, C. (eds), (1994) *The Uncertain Quest: Science, Technology and Development*, Tokyo and New York: United Nations University Press.

Schumpeter, J. (1934) *The Theory of Economic Development*, Cambridge, Mass: Harvard University Press.

Serfati, C. (2008) "Financial Dimensions of Transnational Corporations, Global Value Chain and Technological Innovation", *Journal of Innovation Economics*, 2(2): 35-61.

Slaughter, A.M. (2004) *A New World Order*, New Jersey: Princeton University Press.

Solow, R. (1956) "A Contribution to the Theory of Economic Growth", *Quarterly Journal of Economics*, 70(1): 65-94.

United Nations (UN) (1968) "The Sussex Manifesto: Science and Technology to Developing Countries during the Second Development Decade", in *Science and Technology for Development: Proposals for the Second United Nations Development Decade*, Annex II, New York: UN.

United Nations Conference on Trade and Development (UNCTAD) (2008) "Review of the Technical Cooperation Activities of UNCTAD and Their Financing", Report by the Secretary-General of UNCTAD, Annex II: Statistical Tables, Trade and Development Board, Working Party on the Medium-term Plan and the Programme Budget, Fifty-first session, Geneva, September, downloaded from http://www.unctad.org/en/docs/wpd202a2_en.pdf in May 2009.

United Nations Conference on Trade and Development (UNCTAD) (2009) "Science and Technology", downloaded from http://www.unctad.org/Templates/Page.asp?intItemID=1964&lang=1 on 07 May 2009.

United Nations Industrial Development Organization (UNIDO) (2009a) "UNIDO Annual Report 2008", Industrial Development Board, Thirty-sixth Session, Programme and Budget Committee, Vienna, downloaded from
http://www.unido.org/fileadmin/user_media/About_UNIDO/English.pdf in May 2009.

United Nations Industrial Development Organization (UNIDO) (2009b) "Global UNIDO Network of University Chairs on Innovation", downloaded from http://www.unido.org/index.php?id=o66410 in October 2009.

Wagner, C. (2008) *The New Invisible College: Science for Development*, Washington DC: Brookings Institution Press.

Woods, N. and Martinez-Diaz, L. (eds), (2009) *Networks of Influence? Developing Countries in a Networked Global Order*, New York: Oxford University Press.

World Bank (2008) "The Growth Report. Strategies for Sustained Growth", downloaded from http://www.growthcommission.org/index.php?option=com_content&task=view&id=96&Itemid=169 in May 2009.