Research Summary 2

Science, Technology, and Inequalities in the Global Knowledge Economy: Policy Dimensions

Preliminary Position Paper

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Contemporary knowledge production is subject to dynamics and constraints which pull towards increasing inequality. These constraints and dynamics may not, however, spring from inherent nature and immutable laws, but are as much the effect of knowledge production taking place within a politically constructed configuration of institutional structures and power relationships, which we may hope, may be amended and changed to help decrease rather than increase poverty and inequality. The task of Work Package 1 within ResIST, from which this preliminary paper comes, is to analyse these structures and relationships, and the policies they give rise to, in the expectation of being able to point to more socially and economically inclusive approaches – socially sustainable development.

The paper is divided into two main sections. The first explores the central concepts of the ResIST project and the intended ResIST contribution; the second section provides illustrations of the treatment of inequalities in S&T-related policies at three levels: national, European, and global.

The central concepts of the ResIST project, and the intended ResIST contribution

The first section details what is meant by the knowledge economy and inequalities in current thinking; the institutional arrangements that derive from and support current orthodoxies, and the policies that result. It sees these as embodying restricted notions of knowledge and of innovation leading to unbalanced, and ultimately unsustainable, global innovation system, overwhelmingly based on the single objective of increased competitiveness. The paper sets out some of the building blocks of a more systematic framework for thinking about the issues and their interconnectedness which ResIST offers; and which it hopes will contribute to the development of multi-objective, balanced set of policies for science, technology and innovation. This is the part of this section that we develop in this summary, below.

One initial assumption of the ResIST project is that this can be done by addressing, explicating and strengthening of interdependencies between what we have called the *structural, representational, and*

distributional aspects of science, technology and innovation systems. The *structural* aspect reflects the organization of resources and capacities, for example, the dominance of men in science and engineering careers and the high concentrations of science-based businesses in the global North (a particular concern of Work Package 2 – WP2). The *representational* aspect refers to political power and voice, and therefore to the processes of accountability (examined in WP 3). Examples are the greater levels of political participation, both formal and informal, among middle-income Americans as compared with low-income Americans. At a global level, the greater voice of the U.S. Treasury in the decisions of the World Bank and International Monetary Fund, institutionalized in their voting rules, serves as an example. The *distributional* aspect refers to who gets the benefits and who bears the costs of science and technology, as for example, the benefits to consumers from lower production costs through automated production processes, as compared to the costs to workers who are displaced from old jobs by automation but do not have the higher skills needed to get new ones (a focus of WP4).

None of the ResIST work packages directly examines the factors that allow science and technology to contribute to economic growth, although the issue stands in the background of all the studies. This is particularly true for WP2, which includes questions about national advantage and disadvantage in human resources and such development paradoxes as the presence in the US workforce of more trained African scientists and engineers than in the whole African workforce. Several of the work packages, however, examine inequality within countries. The participatory case studies of WP3 consider the dynamics of distribution within countries, by examining processes of choice involving local or national governments. Furthermore, the framework that WP4 is developing is intended to help policymakers understand how new technologies will interact with their local conditions to increase or decrease inequalities in both wealth and well-being dimensions within countries. The development community usually refers to the unequal distribution of incomes or wages as "vertical inequality," then uses the term "horizontal inequalities" to refer to differences by culturally-defined categories such as gender, ethnicity, religion, or region. Both vertical and horizontal inequalities will appear in the ResIST studies, characterizing a variety of contexts.

The global development community, however, most often addresses two measures of absolute poverty: people living on less than $1 per day, and those living on less than $2 per day. These are such low levels of cash income that we can assume that severe deprivations of others sorts follow, such as malnutrition and lack of access to clean water. Absolute poverty in this sense is very much a phenomenon of the developing world. Eliminating global poverty at these absolute levels is an important international goal. Cutting the number of people living in poverty by half is the first of the United Nations' Millennium Development Goals. It is easy to picture reducing or eliminating poverty as the main route to reducing world inequality; but the unequal distribution of either wealth or well-being can increase even while absolute poverty is decreasing, as the experience of China has shown. ResIST is of course considering poverty-reducing, or for short "pro-poor," S&T policies in some of its work packages, in particular WP4.

But the project also includes inequality itself in its scope and call attention to growing gaps in wealth, well-being, power, or capacity, where they appear in our analysis. Following Cozzens, Gatchair, and Thakur (ResIST, Working Paper 1, 2006), we will refer to policies that decrease vertical inequality as "equalizing" and those that decrease horizontal inequalities as "egalitarian." These join "pro-poor" policies in the set of policy options for reducing inequalities through S&T, a set we refer to as "re-distributional."

The paper goes on to examine in depth the four main types of science and technology policies: innovation, research, human resource, and regulatory. Although in practice, these four perspectives are often intermingled in the same program or policy instrument, and of course their results interact strongly it is argued that it is possible to put most S&T policies and programs into one dominant type.

Illustrations of different policy approaches at National, European and Global levels

These types of S&T policies can be utilized by bodies at various levels of the political system, from sub-national to multi-national. In this section of the paper, we give examples of distributional issues that arise in S&T policies at three of the most important decision-making levels: national, European, and global. The section illustrates both the complexity of the issues and the variety of possible responses.

National level policies

In Portugal a 'Technological Plan' focuses mainly on exploiting S&T for competitiveness, but also includes several actions which relate to combating *structural inequality*, especially through human resource policies and programs, and *distributional inequality* through access to the 'information society'. Notably the appropriation of ICTs are seen as important not only in an economic context but for a wider range of social actors. Another aspect of inclusiveness are public understanding of science programmes, but rather than focusing here on issues of *representational inequality*, there is a focus on a deficit model (*structural inequality*) and, eventually, on the relevance of greater understanding of science for day-to-day activities (some *distributional* impact).

Britain is seen as a clear example where concerns with the impacts of science and technology on inequality are essentially expected to filter down from primary concerns with excellence and economic impact of science. Like other leading research countries, there are few concerns with structural inequality although there are emerging concerns with regional imbalances. There are also concerns with with "women and other low participatory groups". Rather than being explicitly concerned with the potential *distributional* impact of these asymmetries, the concern is mostly with the functioning of the system, of guaranteeing participation (and in that sense, *structural*), rather than with the outcomes of such structure. Otherwise issues of *distributional inequality* appear to be mostly ascribed to the role of science and research across government, rather that to science and research itself. *Representational inequality* is an emerging concern. The lay public is treated increasingly at *a par* with scientists, with 'public understanding' giving place to 'public engagement', 'public confidence'. Nevertheless, the locus of this concern is somehow tilted towards the protection of those already traditionally represented ("improve the promotion of science in society", "improve public confidence in the Government's use of science"), rather than otherwise (e.g. improving the participation of society in science, or providing new mechanisms of accountability on the Government's use of science).

Brazil . The Brazilian case is clearly at an opposite extreme of the British case. The Strategic Plan for S&T in Brazil identifies as an horizontal axis of action the strengthening the national system of research and innovation and identifies three additional vertical axes. These include one on promoting innovation following the Industrial, Technological and Foreign Trade Policy, one on developing strategic programmes central to the country's sovereignty and one explicitly dedicated to 'Science, Technology and Innovation for Social Development and Inclusion'. The areas of activity of this strategic objective include actions directly oriented towards addressing inequality (in general terms) through S&T, such as through actions on 'social technologies', 'assistive technologies', 'popular cooperative incubators', or more traditional initiatives on 'local productive arrangements', 'technological vocational centres' or 'digital inclusion'. The concern with distributional impacts is also explicit on including as priorities within this objective 'research on basic sanitation', as well as 'research on health, food nutrition and food safety', or 'S&T in the Northeast and Semi-Arid', reflecting some local primary concerns of the population, and not simply an international research agenda. Specific actions are also directed at specific under privileged groups of the population.

Mozambique. The first paragraphs of the 'Science and Technology Policy' document from Mozambique illustrate well that S&T do not have a fully dominant position within knowledge systems as in some of the other countries analysed here. The identification of science as one among other forms of knowledge, in the national S&T policy, is both a recognition of a weaker S&T base in world terms as well as the recognition of the importance of other knowledge systems in local society. At the same time, this document makes clear that, at the global level, S&T has emerged not only as the dominant knowledge system, but also as central to an increasingly interlinked global economic system. The implicit acknowledgement of *structural inequalities* as well as of *representational inequalities* is therefore made clear. It is not only the fact that there are less S&T resources in the country, but also that other strong knowledge systems are weakly represented in the global system.

Within this background, the challenge for Mozambique's S&T policy is clearly intertwined with inequalities. While it includes actions directed towards the strengthening of the existing research institutions, of the relationship of the research system with civil society and the productive sector, of the advanced education system, or of technological innovations, it also includes explicit actions directed to different forms of inequality. These include:

- promoting the expansion of research institutions throughout the territory;
- promoting the participation of women and youth in research;
- promoting research and the use of local knowledges;
- promoting the integration of local knowledges in the formal system of education;
- promoting innovation in the production and use of local knowledges;
- creating conditions for the diffusion in the media of local knowledges.

South Africa. The South African research system underwent significant changes following the demise of the apartheid era. While specific sectors, such as the nuclear and defense industries, were targeted, there were wider impacts in the research system. After an initial phase when innovation took central ground, recently five key technology missions were identified. These are information technology, biotechnology, manufacturing technology, technologies to add value to natural resources and technologies to impact upon poverty reduction.

Also here distributional inequalities are of central concern within the national S&T policy. In particular, the strategic mission of impact upon poverty reduction has been identified as having "achieved some notable successes, particularly in the area of essential oil production, and new programmes in aquaculture show[ing] great promise" Nevertheless, the application of 'social technologies' has had some drawbacks, partly resulting from higher expectations.

An additional feature worth highlighting in this analysis is also the concern with local knowledges (here framed as 'indigenous knowledges'). The development of an Indigenous Knowledge Systems (IKS) policy was led precisely by the Ministry of Science and Technology and adopted in November 2004. Besides the relevance of an inclusive approach to knowledge from the Ministry of Science and Technology, this policy is also particularly relevant as it links IKS directly with the S&T system. It does not limit itself to stating the need for the recognition of IKS. It includes a broad perspective on IKS in almost full parallel with general S&T policy concerns. For example it includes discussions of the IKS in the National System of Innovation of South Africa, a discussion of the role of research institutions within IKS, IPR issues, as well as an IKS information and research infrastructure. Furthermore, it clearly considers that "IKS development is a unique opportunity to recognise and redress inequities created by past policies in South Africa."

Regional policies: the European Union

The goal of the ERA is to make Europe more internationally competitive in research by reinforcing the highest standards. Among the ERA's goals are several re-distributive elements. The ERA seeks to give more prominence to the place and role of women in research. It also seeks greater European cohesion in research based on the best experiences of knowledge transfer at regional and local levels, and to bring together the scientific communities, companies, and researchers of Western and Eastern Europe. All these elements address horizontal inequalities within the European Union. Conspicuously missing in documents on the ERA is any mention of reducing the horizontal inequalities of Europe's growing disadvantaged ethnic minorities; this set of issues has not yet appeared prominently in STI policy discussions.

Initial structural inequalities create some of the challenges of reinforcing social cohesion through STI policies. The EU member states invest in research and development at very different rates, and while some established members are rapidly increasing their investments, some are experiencing declines (OECD Eurostat 2003-04). The top 15 research-intensive regions appear in five Northern European countries, and the EU's clustering policy is likely to reinforce the concentration of resources further.

The concentration of resources in turn has implications for where highly-educated scientists and engineers want to work. The distribution of R&D workers in the ERA is already heavily skewed; in 2003 54% of R&D personnel in the EU-25 were concentrated in Germany, France and the UK.

The paper sees a fundamental and pervasive tension in the European Research Area strategy between the pursuit of two different dimensions of equality, namely individual equity (and the individual human right not to be discriminated against on grounds of nationality) and sustainable development within the European Union (sometimes referred to as 'balanced growth'). Although they are often not expressed as such, concerns around 'brain drain' within the ERA – and policy responses to it - need to be understood as facets of this wider debate. Does EU enlargement and the logic of individual freedom (to physically move in response to scientific and other opportunities) necessarily imply a relatively permanent loss of knowledge to the sending country? Equally, does limited out-migration, imply retention and efficient use of capacity in those regions?

In terms of the EU's relationship between the EU and non-EU countries, the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers explicitly recognizes these inherent policy tensions both in terms of researchers coming into the ERA from third countries and imbalances within the ERA: The development of a consistent career and mobility policy for researchers to and from the EU should be considered with regard to the situation in developing countries and regions within and outside Europe, so that building capacities within the EU does not occur at the expense of less developed countries or regions.

Global institutions and issues

IPR and Trade. Issues of IPR protection issues have within a time-span of just a couple of decades been transformed from a specialist, arcane issue of industry policy and law, into a highly contentious and strongly debated issue of innovation, industry and global trade policy. As knowledge has become an immediate economic resource, it has become a pressing issue to create effective and appropriate political and legal conditions for dealing with knowledge as such an immediate economic entity. Developments within the IPR domain have generally gone in the direction of stronger protection of the rights of "owners" of knowledge, thus contributing to a general shift towards the commodification of knowledge, as a prerequisite for ensuring the stronger private appropriability of knowledge qua economic resource. Thus, we have seen a fast change in IPR regimes, where a large number of separate changes in various domains have converged towards what James Boyle has called a "maximalist" rights regime . All major changes have contributed to the general extension and strengthening of the interests of right holders. These changes include the emergence of relaxed standards of patentability, in particular as concerns the criteria of inventive step and industrial use. The domain of patentable subject matter has been extended to include living entities, software programs, business methods and research tools.

The TRIPS agreement marks the end of a process initiated by the US by which issues of IPR protection had become more strongly connected to trade agreements. The immediate effect of TRIPS for developing countries was the eventual removal of an important basis for previous industry policies in important industries, particularly in the pharmaceutical industry, where Brazil and India had built up an extensive production of generics based upon national patent laws which exclude the patentability of pharma-ceuticals. Given that acquiring technological capacity through copying, imitation and reverse engineering is an essential part of catching up strategies, TRIPS would place limitations, including higher licensing costs, on the use of that strategy.

Thus, TRIPS may be seen to offer few advantages to developing countries in terms of IPR; it was a trade-off where overall loss in IPR would be traded in for gains in trade, in particular export of agricultural products. It was also seen as an advantage that negotiations over intellectual property would be moved from bilateral to multilateral trade negotiations. However, TRIPS has not led to the removal of IPR from bilateral and regional trade agreements. These bilateral agreements have been retained as a channel to enforce higher, "TRIPS Plus" standards of IPR protection, alongside and over those of the TRIPS itself.

Key IPR issues in the Doha Round have pertained to the relationship between the Biodioversity Convention and TRIPS. This concerns issues of "biopiracy", by which the "piracy" and "theft" discourse discourse that have been extensively used to drive the maximalist agenda have been turned around to apply to the IP right holders of developed countries. Issues concerning the compatibility between the TRIPS and the Biodiversity

Convention, which regulates conditions of "access and benefit-sharing" between patent holders and providers, have been part of the Doha Round as a number of large, developing countries, including India, Brazil and China have pushed for a change in TRIPS to make it mandatory to include closure of origin of genetic resources in patent application. The Biodiversity Convention states the principle of national sovereignty of genetic resources, and the rights of origin countries to s fair share of the benefits of inventions based on biological resources. A closely related issue is work on the role of traditional knowledge in relation to IPR issues.

It seems, however, that multilateral IPR issues are now shifting back to the WIPO. Here, the WIPO 'patent agenda' is the basis for taking new steps beyond TRIPs towards the world-wide harmonisation of both substantive and procedural IPR regulation. This is, according to some, a process for developing harmonised TRIPS Plus standards, and even indicate the – still distant – possibility of the universal 'world patent'. At the same time, pressure has mounted for WIPO's adoption of an explicit "development agenda", by which the WIPO would, as a UN agency, become more committed to development goals.

International financial institutions. The role of international financial institutions in S&T for development and the rationales for their policies and programmes have undergone significant changes in recent years due to a number of factors, relating to shifts in policy thinking, the introduction of more strategic policy approaches as well as new understandings and partnerships. Policy learning in the form of open, healthy criticism, self-review and evaluation processes are also generating significant policy impacts. A major shift has occurred in their focus of activity from initial sole focus on economic development to also address more directly poverty alleviation and reduction in recognition of the fact that prior investments in infrastructure and physical assets, macro-economic and financial frameworks and foreign exchange resources need to be complemented by more human-oriented and community-based development. These approaches were recently enshrined in the Millennium Development Goals and their primary emphasis on human and social dimensions.

The shift from R&D to Innovation policy approaches outlined earlier in this paper has impacted on the changing rationales of S&T for development reflected in the currently emerging role of international financial institutions and their S&T aid programme design. This has been complemented by the gradual replacement of old linear approaches by more systemic, integrated approaches to innovation. In the case of the World Bank, in particular, this policy transition process has been in response to various criticisms over the years of its one-size-fits-all policy approach based primarily on experiences garnered from developed country, without giving due attention to the particular policy context of the country in question. The assumption that S&T would inevitably provide the means for developing countries to break out of the vicious cycle of debt and poverty, highlights the fact that S&T for development challenges relate not only to limited resources but also to wrong approaches projecting S&T as "instant cures for deep-rooted economic and social problems" (Bezanson and Oldham,47). Key concern remains the limited exploration of alternative, more knowledge-based and sustainable approaches working in synergy with local culture, values, socio-economic patterns and ways of life.

S&T continues to occupy only a small part of the agenda of international institutions largely as a result of a legacy of past fragmented approaches, lack of strategic vision and limited investments. This is evident in the World Bank's lack of a consistent S&T capacity-building strategy except in the area of agricultural research and the fact that only 1 in 50 projects focused on improving S&T or had a significant S&T capacity-building component (Review 48 of World Bank Lending for Science and Technology (1980-2004)). However, more recently there is evidence of a growing, enhanced role for S&T, with growing investments in S&T as a development objective per se as commitments to scientific understanding are perceived as critical to sustainable development.