Innovation Policies as Social Policies

On Strategies for the Pursuit of Proactive Equality in Underdevelopment

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Abstract

Fostering innovation and increasing inequalities often come together, particularly in underdeveloped countries. Development strategies need to promote ways of diminishing inequality that are positively correlated with increasing collective capabilities for learning and innovation. The paper explores the conjecture that an advance in that direction can be made when innovation policies are directly connected with the attention of the most pressing social needs. Empirical evidence from bioinnovation will be presented to support the conjecture.

Key words: *Innovation, Inequality, Underdevelopment, Social policies*

I.- A main problem and a related conjecture

Diffusion of innovations more often than not favors social groups already favored (Rogers 1995). That trend towards higher inequality is probably stronger in a global knowledge-based and innovation-driven economy, where a generalized Matthew effect seems to hold: broadly speaking, people with greater capabilities, power and social capital are better situated to innovate, to take profit of innovations and to learn by innovating. That trend fosters economic growth in the North but not necessarily in the South, where moreover it can hamper social cohesion, thus posing a main problem for good governance.

More than half a century ago Latin American Development scholars studied the "structural heterogeneity" of underdeveloped economies, where a modern sector concentrated technical progress while a large part of the population was relegated to a backward sector. Such duality in South Africa at present is described by President Mbeki - as quoted by the GLOBELICS 2005 Call for Papers - when he speaks of the "First Economy", modern and integrated to the global economy, and the "Second Economy, or the Marginalised Economy". Innovation tends to be concentrated in the First Economy and thus widens the gap separating it from the Second Economy. Also with South Africa in mind it is said that "in highly unequal or dualist societies, business-science relations contribute at best to isolated pockets of excellence" (Lorentzen 2004: 10). As a consequence, often a social gap and even conflicts appear between, on the one hand, the small group of innovating firms, research groups connected with them and related decision makers, and on the other hand social movements and organizations fighting against marginalization.

Such frequent divorce between fostering innovation and searching for more equality is a crucial problem for many regions of the South. Development is not possible neither when extreme inequality is present, nor if accumulation of knowledge and innovation capabilities are not enhanced.

Coping with such problem requires strategies that promote *proactive equality*, characterized as those ways of diminishing inequality that are positively correlated with increasing collective capabilities for learning and innovation. Elaborating on previous work on such notion - particularly a paper presented at the previous GLOBELICS Conference (Arocena and Sutz 2004) - this paper will explore the conjecture that concrete and feasible ways of coping with stated problem are highlighted when innovation policies are directly connected with the attention of the most pressing social needs.

We are considering an issue of policies but also of politics: innovation policies need to be implemented effectively and with a systemic scope, but that is not enough; actual results depend also on the social legitimacy of innovation and its place in the political agenda as well as on the conflicts around its priorities and the possibilities of building coalitions oriented towards proactive equality. In the case of Latin America, after the disastrous social consequences of economic and institutional policies inspired by the recommendations of the "Washington Consensus", social policies enjoy high legitimacy nowadays, to such an extent that they seem to concentrate -in the view of the international financial community- the only really legitimate realm for public spending. Social policies could profit from local innovation to fulfill many of their aims, thus providing an adequate "policy umbrella" for stronger capability building efforts; perhaps the same holds in many other regions of the South.

The conjecture can thus be rephrased as follows: linking innovation closer to the demands that stem from social policies may help (i) to overcome pressing needs, thus (ii) making innovation more strongly valued in society at large and, moreover, (iii) enhancing knowledge and productive capabilities in a wide array of productive sectors located in the "Second Economy", so (iv) social cohesion and Human Development would be fostered.

In section II some empirical basis for the conjecture will be provided, mainly by referring to bioinnovation processes which (as suggested in the proposal of the authors of this paper to the "Catch-up Project" coordinated by Professor Richard Nelson) offer a wide array of potential examples for relating innovation and social policies. In section III, possibilities for connecting innovation policies with social policies will be considered in relation with the case of Uruguay, where a new government assigned maximum priority to a program for overcoming extreme poverty. In section IV, six "building blocks" for innovations policies in Underdevelopment will be briefly described from the point of view of their connections with social policies.

II.- Bioinnovation and inequalities

Innovation based on life sciences and related with biological problems (in brief, bioinnovation) shows an increasing relevance. It also illustrates the wide possibilities, strong conflicts and worrying gaps stemming from innovation processes.

Possibilities

The potential contributions of biotechnologies for achieving the Millennium Development Goals (MDG) are impressive (UNDP, 2005a). The report of the Genomics Working Group of the University of Toronto Joint Center for Bioethics on Genomics and Global Health describes carefully the kind of problems where the search for solutions can profit from biotechnology approaches. That report insists that bioinnovation is not a magical recipe to redress, for instance, the millions of children that die before five years per year, one among the many pressing health and nutrition problems affecting developing countries. What the report does is identifying how bioinnovation can be a tool, among others, in the fight against such an extreme form of inequality. It identifies ten biotechnologies with specially strong possibilities to address this type of problems; five of them are listed and very briefly explained in Table 1.

Table 1.- Five of the ten biotechnologies identified to help achieving the MDGs

Molecular diagnosis	"…once disease strikes, diagnosis and treatment methods are essential. Molecular diagnostics are simple to use, give quick results and can be relatively cheap" (Joint Centre for Bioethics, 2004: 16) Example: African sleeping sickness; Nicaraguan multiple test for *Leishmania*
Recombinant vaccines	"…may prove to be cheaper than traditional vaccines because of innovative production methods and, in some cases, because improved storage characteristics may not require them to be refrigerated." (ibid: 20) This field is more a promise than real fact up to now, but progress in clinical trials is being made in malaria and tuberculosis. Cuba is working with these techniques in dengue and cholera. The promise has been fulfilled in the case of hepatitis B. In India, where 1% of all adults deaths are due to hepatitis B and more than 40 million people are carriers of the disease, a locally developed recombinant vaccine was available at 50 cents, while previous imported vaccines had a cost of $16 per dose. (Thorsteinnsdóttir et al, 2004a: 19; Kumar, et al, 2004: 34)
Vaccine & drug delivery	"…logistic of vaccine delivery are prohibitively expensive. The 'cold chain' is a major expense in all vaccine programs. Unsanitary drug and vaccine injections are associated with blood-borne diseases. Injection-free and controlled-release delivery can help to solve many of this problems." (Joint Centre for Bioethics, 2004: 22) Examples (in developmental stage): Inhalable, skin patch and powdered vaccines.
Bioremediation	"Bioremediation is the use of bacteria or plants to clean up the environment" (ibid: 23) An Uruguayan example (ongoing): Children living in some poor neighborhoods in Montevideo are affected by heavy lead contamination, with consequences for their intellectual abilities. Contamination is concentrated in the soil and a strategy of bioremediation through specific plants to remove the lead is being followed at the Faculty of Sciences. A massive water arsenic poisoning process in Bangladesh can be addressed by means of this technique, using a bacteria discovered in Australia, currently under research and trial.
Recombinant therapeutic proteins	"Therapeutic proteins, such insulin, are used to treat many non-communicable diseases." Current trends suggest that these diseases will account for over 70% of deaths in developing countries by 2020. "Affordable and sustainable sources of therapeutic proteins for treating these diseases are therefore critical." (ibid: 33) Recombinant insulin is up to now the great achievement of this technique: its importance derives from the illness it helps to control, diabetes, that affects 33 million people in South America, 30 million in India and is expected to rise at world level up to 300 million in 2025. Brazil in the late 1990s and India in 2003 patented their own recombinant insulin, after sustained R&D and commercial efforts.

The case of insulin, mentioned in the last column, is particularly telling in terms of how endogenous bioinnovation efforts can redress the problem of no-access to technical solutions due to no-affordability. In the case of Egypt, where around 10% of the population is affected by diabetes "…before the start of local production, over 90% of the country's total insulin needs were imported from one multinational company at a cost of US$ 35 millions annually to the government. Today, local firms have the ability to manufacture by recombinant means sufficient quantities of affordable insulin" (Abdelgafar et al, 2004: 25). Other techniques mentioned by the report and connected with the achievement of the MDGs are bioinformatics and combinatorial chemistry. These are techniques than can greatly accelerate the discovery of useful drugs. In South Africa, for instance, a bioinformatics spinoff company from the University of Western Cape "…makes software for processing and analyzing mRNA and expressed sequence tag data, and this platform has already been exploited, for example, in drug target discovery in trypanosomes" (Motari et al, 2004: 19). Combinatorial chemistry is so important that Médecins sans Frontières rely on it for its Drugs for Neglected Diseases Initiative, aimed at creating portfolios of new drugs for some of such diseases. (Joint Centre for Bioethics 2004: 36)

Conflicts and alternatives

Bioinnovation also provides relevant examples that even non-military innovation is not necessarily a good thing for everybody and that innovation processes may be increasingly conflictive, so the issue is not only one of policies but also of politics.

Conflicts connected with bio-innovation often oppose grass-root activists with actual innovation processes (Parayil, 2003). Such movements often have a good cause. Due to them Monsanto gave up the commercialization of "terminator" seeds. If more evidence is needed to show how bioinnovation is related to politics, the discussions around who is entitled -and based on what knowledge- to make decisions on issues involving in a way or another the manipulation of life provide good supplementary elements. In the case of Germany's conflict over biotechnology in the mid 1990s, it is said that:

> Civil servants and scientists tends to follow a traditional approach, claiming that their actions are based only on the law and putatively objective knowledge. They presume that there is only one correct interpretation of the law and one 'rational' solution. Hence, they can respond to objection only by blaming the objectors for 'irrationality'… When objectors are labeled as irrational, they react angrily. As a normal counter-reaction, administrative and industrial experts make their safety claims even more precise and restrict the public discussion to technical issues. The more precise the claims, however, the more easily they can be rejected by counter-expertise, or even contradicted by factual events… Other objectors are cognitively excluded and emotionally frustrated by the narrowing battle over expertise…Thus the dominant legitimation style in Germany perpetuates the original conflicts, as the GMO issue illustrates. The problem is not that there is a conflict but that there are no compromises, nor even meaningful dialogues" (Gill, 1996: 179).

Ten years later, political problems derived from "styles of legitimation" like the one just described can be seen everywhere. In Uruguay, for instance, there is nowadays a hot debate about the installation of a Finish and a Spanish cellulose plant that some actors in the civil society claim is going to pollute the big Uruguay river beyond all acceptable standards and other actors, particularly in government, claim that not and that all the monitoring measures will be in place. The issue has trespassed national borders, with Argentina fighting against these installations in international financial and juridical forums, and Uruguay fighting back, because the volume of investment involved is huge indeed. However, little information has been released to make possible independent judgments.

Now, are they other possible styles of legitimation or the complexity of modern knowledge and the importance of the economic related issues make the proposal of broadening participation merely rhetorical? In Finland, for instance, it is recognized that early TA (technology assessment) exercises "were largely seen as 'speaking truth to the power' exercises", while more recent TA studies "have increasingly encompassed objectives as 'generating dialogues' and 'mobilizing common learning processes'". (Salo and Kuusi, 2001: 460). In the case of environmental issues in Denmark "most proposals from the authorities are submitted to various interested groups, such as industry and NGOs, thus providing opportunities for them to influence decisions at an early stage" (Toft, 1996: 174). As many other issues, this one is related in a fairly direct way to social cohesion, that is, to social mutual trust.

Contrastingly, in Latin America biotechnologies are often introduced in agriculture as an imposition to local producers; in such cases, they serve the expansion of big capital in agriculture and at the same time foster inequality as well as social conflicts.

Better results are obtained when local knowledge and opinions are taken into account, that being a striking illustration of the notion of proactive equality and showing the way for shaping innovation policies as social policies. Bunders developed a methodology to achieve what she calls "the interactive bottom-up approach" that aims precisely to overcome the lack of interaction and exchange of information that hamper effective decision-making on biotechnology directed to improve small and poor farmers conditions. Many studies on the often disappointing results of bioinnovation for such actors have been made and all type of inadequacies have been identified. "The most critical obstacle to success in the generation and adoption of new technologies would appear to be the absence of communication and cooperation between the various groups and types of people whose contributions are essential: farmers, scientists, policy makers, extensionists, and others such as the private sector" (Bunders, 1994: 154). Particularly difficult is to recognize and to take into account what end-users already know: "it is necessary to pay more and systematic attention to the method of identifying problems of small-scale farmers, of the interests and the political power of the different groups involved, and of assessing the appropriateness, feasibility and sustainability of the perceived biotechnological solution. The 'interactive bottom-up approach' is designed to meet these criteria; to avoid technology-push and to include the opinions and organize the support of not only scientists but also that of end-users and the organization that represent/and/or work with them." (Ibid: 163) Research is only one step in the complex process of wedding knowledge to development, but a very important one. However, research is a concept that convey various meanings and imply different attitudes, many of which are not appropriate to deliver useful results for development processes. Bunders proposes a beautiful and challenging phrasing: "Research has to be the handmaiden of development" (Ibid: 158).

Some aspects of the STI & I gap

Bioinnovation plays a main role in the actual gap, at a world level, between on the one hand increased scientific, technological and innovations capabilities and, on the other hand, increasing inequalities. We may call it the *STI & I gap*. Several aspects of such gap were highlighted in a Workshop on "Science, Technology, and Inequalities: Effective Policies and Programs", organized in February 2005 by the American Association for the Advancement of Science (Cozzens and Nelson, forthcoming). Two of those aspects will be briefly mentioned here.

One such aspect is the *research agenda component* of the STI & I gap, that is, the biases of the world R&D agenda. It concerns the big problems which are not the object of active and well founded research because there is no market pull for them. Its relevance is forcefully stressed by the so-called "neglected" or "under-researched" diseases. An estimation due to Médecins sans Frontières shows that from 1975 to 1999 "only 15 new drugs were developed for tropical diseases, while 179 new drugs were developed for cardiovascular diseases in the same period" (Thorsteinsdóttir et al, 2004b: 4). It is also estimated that 50% of the world expenditure in health related research is done by the United States, while the developing world without China accounts for 6% of such expenditure (Michael Free, 2005, oral presentation at the Seminar "Innovation Systems Theory. Application to diseases of the poor"). Thus, there is a "scientific failure" concerning many problems affecting deprived populations, of which health problems acquire special pre-eminence. As already said, this scientific failure has its roots in market considerations: when after extensive consultation with African health officials a Meningitis Vaccine Project was defined to get an affordable meningitis conjugate vaccine at a price not higher than one dollar the dose, no multinational manufacturers where interested in participating. (Morel et al, 2005: 8) A PPP (public-private partnership) between WHO and PATH (Program for Appropriate Technology in Health) with a innovative manufacturer of a developing country did the job (ibid).

The issue of under-researched diseases belongs to a category of problems that Mahmoud Fathalla, from the WHO denominates "*diseases of the poor*": these problems provides an example of the *research agenda component* of the STI & I gap. He categorizes another type of health-related problems, labeled "*diseases and the poor*", derived from the impossibility to rely on existing technical solutions because they are too expensive, because the existent infrastructure cannot assure its proper conservation, use and distribution and even due to cultural factors. The latter is an example of another aspect of the STI & I gap: its *access component*. It concerns problems for which solutions exist, but are out of reach for the deprived populations, mainly for cost reasons.

These problems too can be seen as deriving from a scientific and technological failure or, more accurately, from an innovation failure. This way of understanding the second component of the gap is not trivial: if the gap is conceptualized only as an access failure and not as an innovation failure, the search for solutions can be reasonably directed to finding ways of providing financial assistance to developing countries so they can buy the existing drugs, treatments, medical equipment and the like. If the gap is seen as an innovation challenge, national and international financial resources can be channeled to innovative approaches leading to different heuristics in the strategies for problem-solving.

Narrowing the gap

Bioinnovation is not only related with fundamental problems of people in development countries but also its cognitive support is relatively stronger in the South than what happens in other disciplines. Several indication of the latter can be given for Latin America:

i) Health sciences concentrate a majority of research groups there where such groups has been studied: Brazil (41,5% of all groups), Colombia (30,1%) and Uruguay (40,7%). (CNPq, Relevamiento de Grupos de Pesquisa 2002, Colciencias, 2002 and Unidad Académica de CSIC, 2003);

ii) 60% of all basic research done in the region is in the realm of biology (Cetto and Vessuri, 1998);

iii) In the promotional schemes for researchers implemented in the region, biologists rank very high, for instance, Uruguay 63% and Venezuela 72% in 2001;

iv) Biology is the best represented discipline in terms of its contribution to world science measured by publications in Argentina and Mexico, and ranks very high also in Brazil. Two other countries where this situation appears are Australia and Canada. (Fapesp, 2002, p. 6-6)

v) Life sciences are also the more internationally recognized of Latin American research achievements, as the three Argentinean Nobel Prizes in chemistry and medicine –the only Nobel Prizes in sciences in the region- show[1]. An impressive Brazilian achievement -to be the first country to decode the genome of a plant pathogen (attacking citrus fruits) in 2000- is another example of the international impact of the regional capabilities in life sciences.

So bioinnovation is also a great opportunity for development purposes. A striking example of the application of an innovation potential to social problems is the Cuban vaccine against *Haemophilus influenzae* type b. It shows how one aspect of the STI & I gap can be narrowed by opening to poor people health opportunities previously reserved to rich people.

The anecdote surrounding the Cuban initiative to develop an affordable vaccine against the bacteria of *Haemophilus influenzae* type b (Hib) is as follows: once, during the 1980s, the President of the Council of Ministries of Cuba visit Canada; being a pediatrician professionally, he asked to visit Centers for Intensive Pediatric Care. He was surprised by the fact that such centers were really big, being clearly underutilized. The reason for the size of the centers was Hib, a illness that hits specially small children under five years; it exhibits high mortality and often severe sequels in case of survival. The reason why such centers were underutilized was that a vaccine against Hib had been recently developed in the US, dropping dramatically the incidence of the illness. The cost of the vaccine, produced by biological methods, that is, by fermentation, was unaffordable to any public health campaign in a poor country; it was for sure unaffordable for Cuba. However, Cuba had reasons to believe that the cognitive base of the country was strong enough to embark on the adventure of looking for a different heuristic to get a efficient and cheap vaccine. After all, the meningitis B Cuban vaccine, developed by means of endogenous R&D in the eighties, was the first of the world of its kind. Fifteen years of research, development and clinical trials took the development of the first synthetic vaccine ever developed: its efficiency was proved, a million Cuban children around two months of life were immunized in 2004 and the scientific breakthrough was published in Science in the same year. The abstract of the paper is quoted below:

> Glycoconjugate vaccines provide effective prophylaxis against bacterial infections. To date, however, no commercial vaccine has been available in which the key carbohydrate antigens are produced synthetically. We describe the large-scale synthesis, pharmaceutical development, and clinical evaluation of a conjugate vaccine composed of a synthetic capsular polysaccharide antigen of *Haemophilus influenzae* type b (Hib). The vaccine was evaluated in clinical trials in Cuba and showed long-term protective antibody titers that compared favorably to licensed products prepared with the Hib polysaccharide extracted from bacteria. This demonstrates that access to synthetic complex carbohydrate–based vaccines is feasible and provides a basis for further development of similar approaches for other human pathogens. (Vérez -Bencomo et al, 2004)

The practical importance of this breakthrough is the low production cost of the vaccine, given the synthetic procedure to “build” the antigen. It is expected that this synthetic

[1] Bernardo Houssay got his Nobel Prize in Medicine and Physiology in 1947; his research was triggered by the discovery of insulin and relates to the pituitary gland. Luis Federico Leloir got his Nobel Prize in Chemistry in 1970; his work was associated to the metabolism of sugar related compounds. César Milstein got his Nobel Prize in Medicine and Physiology in 1984, a shared prize for his contributions to the development of monoclonal antibodies.

vaccine will help to redress the gap between 600.000 children dying from Hib in developing countries while no children are hit by the illness in rich countries (Kayser, 2004).

This is an outstanding example of narrowing the STI&I gap, but by no means an isolated one. The study of *trypanosome cruzi*, the agent responsible for the Chagas illness -a important death factor for poor people in the countryside- is intensively researched in outstanding institutes in Brazil and Argentina, FioCruz in Rio de Janeiro and Campomar Foundation and the Institute of Genetic Engineering and Biotechnology in Buenos Aires. Such researches have greatly contributed to the understanding and prevention of the illness. The Brazilian Butantan Institute, with it wealth of serums and vaccines against different illnesses, including tetanus and diphtheria, has made a great contribution to public health in its country.

Uruguay also provides an example of technological learning and production capabilities accumulation with impact in public health services: electronic pacemakers. In 1960 the first world successful under the skin pacemaker implantation was performed in Uruguay, where the demand for pacemakers was important given the incidence of cardiovascular illnesses. At that time pacemakers were produced in very small batches; most devices were imported and high costs, as in many other cases, severely limited its use. In 1969 the cardiologist that performed the first implantation established a firm to design and produce pacemakers at low cost to overcome the problem, a difficult issue given that pacemakers are life support devices and so technical tests are specially complex and rigorous. The commercial survival of the firm in its initial stage relates to a public health policy of warranting a pacemaker to everybody in need of it irrespective of his/her capacity to pay for it, establishing for that aim a special public fund. This policy instrument did not act as a technology governmental procurement, because medical doctors could buy or recommend any pacemaker, locally manufactured or imported. But the good quality and significantly lower price of local pacemakers allow the firm to hold a fair share of the internal market. Learning processes and knowledge and capabilities accumulation lead the way to exports to almost every country in Latin America and the Caribbean and to Iran, Hungary, Greece and Italy. By now, Uruguay is the only developing country producing pacemakers with own design.

At a more broader scale, it is stated that “60% of UNICEF’s vaccine requirements for the Expanded Program of Immunization (EPI) are produced in just four countries: India, Indonesia, Cuba and Brazil. Thailand obtains 90% of its antiretroviral (ARV) ingredients from India, while the three South Africans producers of ARV obtain 100% of their raw materials from India” (Morel et al, 2005: 7). Many more examples of biotechnological prowess with high impact in the quality of life of poor people can be found in a special issue of Nature Biotechnology, December 2004, containing the results of a three years research project on health biotechnology innovation in several developing countries. The lessons learned during this project are worth quoting:

Table 2. Lessons learned from case studies

Brazil	▪ Focus on developing strong science capacity ▪ Promote linkages and exploit existing strengths in disparate fields ▪ Exploit biodiversity for health ▪ Gain access to key actors
China	▪ Provide long-term government support ▪ Attract expatriate professionals ▪ Ensure that biotechnology development goes hand-in-hand with regulations ▪ Leverage large population base
Cuba	▪ Ensure long-term government vision and policy coherence ▪ Promote domestic integration to spur innovation ▪ Capitalize on internal linkages ▪ Tap into national pride
Egypt	▪ Focus on health needs ▪ Gain access to key actors ▪ Take advantage of international linkages
India	▪ Leverage strengths when cultivating linkages ▪ Meet international standards ▪ Use competitive advantage ▪ Pay attention to the regulatory environment
South Africa	▪ Focus government policy on public health needs ▪ Exploit both indigenous knowledge and science-based innovations ▪ Develop local R&D infrastructure for self-reliance
South Korea	▪ Create a mix of small and large firms ▪ Exploit existing competitive advantages ▪ Go global

Source: Thorsteindóttir et al, 2004c: 50.

III.- Social emergence and innovation in Uruguay

Uruguay is a good case study for “testing” the conjecture stated at the beginning: the frequent divorce between fostering innovation and searching for more equality can find concrete and feasible ways of redressing it when innovation policies are directly connected with the attention of the most pressing social needs. The country is also a good case for relating such conjecture to bioinnovation. Uruguay has developed quite strong research and innovative capabilities related to or used for life sciences that can be of direct application to social aims. A new progressive government took office this year; its main project is the PANES, Programa Nacional de Atención a la Emergencia Social or National Program for the Attention of Social Emergency. (In Spanish, PANES is the plural of PAN, which means BREAD.) It is worth noting that Uruguay belongs to the countries with high human development index according to UNDP reports: during the 1990s the place it occupied varied from 34 to 40, falling to place 46 in 2002 (UNDP, 2005b: 41). However, the economic crisis suffered in 2002 has aggravated the trend towards increasing levels of poverty, that reached 40,8% of the population in 2004. Uruguayan trend has been characterized as “infant poverty” because children constitute the most deprived sector in terms of income: in 2004, 65,1% of children between 0-5 years and 62,9% of children between 6-12 years were below the poverty line, while 18% of people aged 65 and more were in such situation. (Ibid: 101)

At the same time, the government is committed to backing science, technology and innovation, that have been officially neglected up to now. A connection between social and S,T&I aims at policy level seems to be emerging, even if it is too early to provide any evidence in that direction. Some connections of this type exist, though, since long before, but given the weak structure of the Uruguayan innovation system the solutions that were obtained often remained encapsulated and its diffusion processes truncated. The hope is that the renewed and serious attention that people in social critical conditions are receiving, on the one hand, and the commitment to a “Innovative Uruguay” as part of a long term development project, on the other hand, can help these two realms of action to cross its paths, reaching in that way new and higher levels of synergies. In what follows five examples of such crossing paths will be presented.

i) Nutrition. Malnutrition, even if not of the extreme type that can be found in other underdeveloped countries, affect children that in a high proportion live in homes under the poverty line. To such an extent that some studies associate the extension of pre-scholar attendance to a betterment in children’s size due to the fact that the only place where these children eat is at school. So, providing public schools with a simple and cheap “nutrition unit”, like a cookie, that can be eaten two times a day and provide all the basic nutrients needed to a healthy growth is of paramount importance. A team of biochemists have reached a good solution at laboratory stage; from this point onwards social policy can take the lead to organize field trials, leading the way to the production phase.

ii) Health. Poor children usually live in neighborhoods and in houses with bad sanitary infrastructure and with high exposure to soil. In such conditions a illness associated with intestinal parasite worms (Geohelmintiasis) frequently develops, causing diarrhea, growth difficulties, low level of attention and, if not properly treated, even death. However, if early detected, the illness can be cured and further propagation through interpersonal contact can be lowered. A project funded in 2003 by a university program aimed at connecting academic research to problems derived from social emergency gathered a joint team of medical doctors and earth specialists to detect the conditions of humidity, temperature and shadow that make probable the apparition of parasite worms. The project developed afterwards a system of early alert so parents and, moreover, teachers, can put in place special surveillance measures when probabilities of upsurges are high.

iii) Environment. Uruguay has many polluting industries with health consequences for workers and for poor people. The latter relates to the geography of urban poverty: the poorest of the poor live near to small rivers where industrial pollution accumulates; the people who live near garbage dumps are also poor. Some twenty years ago research groups of Chemical Engineering began to study ways to reverse industrial environmental damage. The main concern then was to reduce chromium levels in tanning factories' sewage, as this was well known to affect tanning workers' health. After achieving success in this project, the group evolve towards bioremediation, establishing collaboration with hydraulic engineers and microbiologists to address the water pollution problems of the textile and the meat sectors. The technical approach used in these projects is being adapted to the environmental problems of urban garbage, a significant proportion of which is buried, thus increasing the danger of underground water contamination in addition to atmospheric pollution. For the people living in poverty conditions and for their many children, the diffusion of the developed solutions has great potential for the improvement of their quality of life.

iv) Efficient health system information. More than 40% of the capital city population and more than 60% of the population in the countryside attend different sorts of public health services, including hospitals, the Ministry of Public Health dispensaries and dispensaries from the Municipalities. Until recently, the clinical histories of patients were scattered between these different health entities, making necessary to wander from one to another to get all the information needed. This is not only time consuming, but very costly: the cheapest bus ticket is equivalent to one and half litre of milk. A team of software people undertook the project of unifying all the clinical information of public health patients in Montevideo, putting them in computer data bases and providing the whole individual clinical histories to every public health entity in the city. This seems a project without major technical difficulties, which can be true regarding the past. But making available the clinical histories actualisations to all health entities is another story, particularly because the computer network relying these entities is outdated, slow and weak. Substituting such network for a modern one was unaffordable; the software solution to avoid changing hardware was truly innovative. Perhaps it will be soon posible to extend this strategy to the whole country.

v) Affordable hospital equipment. Uruguay has a long tradition of dialogues between medical doctors and engineers, stemming from pioneer work aimed at measuring and controlling uterus contraction just before birth: as a result devises were developed to strictly monitoring foetus suffering, helping to lower the rate of children mortality. From this tradition evolved a common chair between the Medicine School and the Engineering School in Biomedical Engineering to train "hybrid" engineers and the creation of the Biomedical Engineering Group, a formal R&D group devoted mainly to the design of intensive therapy devices. Through both institutional arrangements tenths of prototypes of medical devices were developed; once tested, they usually were incorporated in public hospitals' intensive care facilities. Some of them were cheaper substitutes for well-known instruments; some were totally new; some were older designs which incorporated new features to suit them to local conditions. All this helps to bridge the sharp divide between rich and poor around the access to high-tech medical care.

IV.- On Policies

In Underdevelopment capabilities for innovation are often hidden and wasted, while *infant capabilities* need specific support in order to be able to grow. A fundamental task for innovation policies in Underdevelopment is to detect such capabilities and foster a high-level demand for them, thus providing opportunities for the expansion-by-use of capabilities.

Elsewhere (Arocena and Sutz, 2005) we have described six “building blocks” of such policies and several examples of specific policy instruments corresponding to each block. Here we summarize that approach, stressing its connections with social policies, and indicating the estimated costs of some instruments.

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(1) Strengthening learning capabilities

This “block” aims to improve the quality of education in general and to find ways towards the generalization of different types of permanent advanced education, closely connected with knowledge demanding working activities.

A concrete instrument related with proactive social policies is the betterment of scientific and technological general education. It can be implemented by the cooperation of researchers with primary and secondary level teachers.

Other aspects deserve attention. For example, a project to support the local development of some didactic tools for the experimental teaching of science and technology can have the double effect of providing what is needed at a low cost and fostering the emergence of a small specialized industry. In Uruguay, the cost of a pilot project of that sort has been estimated to be a little more than U$S 200.000.

(2) *Enhancing knowledge demand*

People that posses knowledge - basic knowledge, science based technological knowledge, practical technological knowledge, skills in general -, must be able to apply what they know to problem solving activities. In the Scandinavian countries highly successful technological innovations have been related with welfare state activities (Gregersen, 1988).

A fundamental instrument in this case is to include the science, technology and innovation dimension in programs addressing social urgencies. Two aspects must be covered at an initial stage:

(i) Detecting the scientific and technological demand stemming from such programs; if for example three teams of well trained people work during six months in connection with those charged with the implementation of the emergency plan in housing, nutrition and health, the estimated cost in Uruguay would be U$S 60.000.

(ii) Elaboration and financing of proposals able to achieve the goals posed by the detected demand; in Uruguay, based on past experiences, it could be expected that around 50 projects per year will be elaborated combining scientific and technological excellence, social relevance and fair possibilities of implementing the results obtained. The total cost for a period of five years - including a thorough ex-ante and ex-post evaluation - would be in the order of U$S 6.500.000 for the ensemble of projects.

(3) *Promoting linkages*

A relevant example of linkages is given by *innovative circuits*, which are started when an actor with a problem meets another actor with knowledge that can help in finding the solution to that problem; the solution can be found if the circuit works, that is, if both actors are able to communicate and combine what each knows. One example of this type of circuits can be found in the realm of alternative and effective energy, linking a top engineering group in fluid mechanics and a group of countryside women producing high quality cooking herbs, who need cheap and reliable sources of energy in the remote places where they live. In words of the engineer in charge of the project, it is the extraordinary capacity of these women to express what they want to obtain what explains the success achieved. Another example comes from the Biomedical Engineering Group above mentioned: the innovative circuit in this case has been established with the firm that manufactures pacemakers around the design of a semi-custom chip with specific features allowing to miniaturize the size of the devise.

Promoting linkages implies promoting the idea that technology can be useful, accessible and affordable. A good instrument for that is to provide systematic technical advice to very small firms, cooperatives, trade unions, local movements and other collective actors that usually lack the knowledge needed to be active partners (agents, not patients, as Sen would say) in innovative circuits and linkages. A “Technological Advice Office” with such aim could be useful both in itself and as a signal or flag for socially oriented innovation policies. Costs would obviously depend on the investments governments are willing and able to do in this area. In Uruguay it has been estimated that some positive results could be achieved with only U$S 30.000 a year.

(4) *Fostering specialization*

This “block” is related with promoting studies, agreements and actions that shape an efficient long term productive profile in selected areas. As already stressed, bioinnovation offers important possibilities. For example, wood has growing importance in Uruguay; it is exported with little value added of knowledge. An upgraded specialization pattern should combine genetics, ecology, preservation of natural vegetation, differentiation of production, advanced engineering, furniture design, etc. Examples concerning medical devices have already been mentioned; a good instrument could be a special program to foster bioinnovation related with them; the case of pacemakers in Uruguay suggests that in this way endogenous innovative capabilities and attention to social priorities can strengthen each other.

(5) *Anticipation, the prospective dimension*

The aim is to prepare today ways to cope with fundamental issues of tomorrow. The lack of prospective culture usually leads to not preparing the ground for what will come to be mandatory technologies. Related signals stem from different sources, including some that anticipate future social needs, as for example demographic trends. Prospective exercises should be systematic and involve several actors, including politicians, public officials, entrepreneurs, educators, researchers, journalists, representatives of trade unions, cooperatives and NGOs. Thus, prospective activities may help promoting linkages and proactive collective attitudes.

(6) *Citizenship, fostering involvements and consensus on innovation issues*

This is a key aspect of proactive equality. Public perception of science, technology and innovation is related to social cohesion; people may have pro-active or reactive attitudes towards them depending on whether their preferences are taken on board when related decisions are made. If that is the case and people know that such is the way things happen, we may expect that innovation will be more socially driven and that the citizenry will be better inclined to back investment in the expansion of innovative capabilities. Moreover, to be aware of the issues at stake, people also need to know about possibilities and national capabilities.

A concrete instrument in this case is to study public perceptions of science and technology, in order to allow decision makers to take into account people's priorities, hopes and fears regarding new knowledge and the use made of it. It would be useful to make, once each five years, a national survey and a focused study on such issues. In Uruguay that would cost around U$S 50.000.

Promoting citizen's participation in decisions concerning innovation priorities and conflicts is not at all easy. Different international experiences can be inspiring, but no attempt to import them should be made. Experimentation will be needed to devise concrete ways adapted to the specific cultural and political context. Journalists could greatly help. A necessary condition is that decision-makers and researchers are willing to foster public participation in what is often seen as a matter concerning only experts.

Concluding remarks

Summing up, it is suggested that social policies can act as "incubators" for a wide arrange of innovative products and services, conceived, manufactured and provided by means of interactions in National or Local Innovation Systems. The idea is that under this policy umbrella a sort of "demonstration effect" can be achieved, in such a way that endogenous innovation capabilities will expand by gaining the wider political legitimacy that comes with high social valuation. Now, that can only happen if innovative efforts help to achieve the aims of social policies. And the last is what matters first. Overcoming pressing needs should be the first target for innovation policies.

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