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PROMOTING INNOVATION IN DEVELOPING COUNTRIES: A CONCEPTUAL FRAMEWORK

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Preface

Increasing attention is being paid to the promotion of innovation in developing countries, including at the World Bank. Despite this, however, there is no solid conceptual framework from which appropriate policies can be developed.

This paper aims at providing such a framework. The intention is not to provide an exhaustive overview of innovation issues and policies in developing countries[1], but rather to offer a starting point for further refinement and enrichment by relevant communities both in the Bank and outside.

Selected examples are taken from different regions around the world to illustrate points and ideas developed in the paper. Some, elaborated in a more lengthy manner, are presented in boxes.

The paper is also complemented by more detailed documents prepared by other members of the K4D program: by Yevgeny Kuznetzov on national innovation strategies (in relation to section 4 of this paper), by Robert Whyte on enterprise innovation (section 5), and by Aisling Quirke on globalization-related issues (section 6 to which she contributed).

[1] By developing countries we mean low and medium income countries in the World Bank categorization.

1. Introduction

Back to the basics

The promotion of innovation, in particular technological innovation, in developing countries is becoming a fashionable subject. The growing interest in the subject stems from a recognition that it is necessary to go back to basics after experiencing the limits of traditional economic policies encapsulated in the "Washington consensus" approach. This set of privatization, liberalization, and deregulation policies have clearly demonstrated their limits for promoting sustainable growth in the developing world. Similarly, policies focusing on modernization, in the sense of building infrastructure and institutions with a more interventionist government, have not yielded the expected fruits. Thus, there has been a tendency to look into the black box of the engine of economic development, that is technology, its creation and diffusion.

Policies supporting technology development are known as "innovation policies". Although governments have a long such practice of promoting innovation by various measures of both a direct and indirect nature, the explicit formulation of innovation policies began about 40 years ago in the 1960s[2]. Since then such policies have been expanded and improved, while new analytical concepts, such as the concept of "national innovation system", have been elaborated.

It should be clear that the concept of "innovation" encompasses not only "technological innovation", i.e. the diffusion of new products and services of a technological nature into the economy, but equally it includes non-technological forms of innovation, such as "organization" innovations. The latter include the introduction of new management or marketing techniques, the adoption of new supply or logistic arrangements, and improved approaches to internal and external communications and positioning. Although this paper will argue for an embedment of technology promotion within broader actions aiming at upgrading enterprises, industries or regions, it will focus on technological innovation.

While there is considerable experience accumulated in the field of innovation policy in developed/OECD countries, much of this is not directly applicable to developing countries because of the nature of the challenges the latter are facing. In fact, developing countries face genuine obstacles to innovation and this is precisely why they remain underdeveloped. These obstacles derive from inappropriate business and governance climates and insufficient education. At the same time, there is no choice: innovation policies should cope with these difficult situations. Thus there is a need to think about innovative approaches adapted to the needs and possibilities of developing countries.

[2] This began with the so-called "Charpie Report"; prepared in US at the request of President Johnson in 1964, and entitled "Technological Innovation and its Environment". This remains a seminal document for the definition, understanding and coverage of innovation policy. It emphasizes, in particular, the need for innovation policy to touch and put in question many policy domains which affect more or less directly innovation capabilities of countries: research of course, but also education, trade, finance, industry, etc.

The situation is, however, rendered more complicated because the "developing world" presents very diverse situations in terms of levels of development, culture, etc. Consequently, innovation policy schemes have to be tailored to countries' specific characteristics in line with the recognized fact that "one size does not fit all", and the recognized need for working much more on national peculiarities in all walks of development economics and policies.

Global drivers for change

The overall context in which innovation in developing countries takes place is dominated by two global drivers. The first one is the intensification of the globalization process. Spurred by the revolution in telecommunications, this globalization manifests itself, among other things, by the importance of trade within the global economy. It has also reduced significantly time and distance throughout the world, linking the most remote to the most vibrant areas. The second global driver is the intensive ongoing technological change stimulated by tremendous scientific advances made in the foundations of life, matter, energy and time. As a consequence of both those changes, a new development era is gradually taking shape, replacing the industrial era[3].

This new era presents the developing world with both challenges and opportunities. These challenges are accentuated by the fact that the development process requires more knowledge and entrepreneurial spirit to compete in an environment of intensified global competition. The opportunities arise from the possibilities for modernization of traditional activities offered by new technologies.

Globalization entails also the risk of a functional specialization of economies throughout the world, based on the exploitation of their differentiated advantages within one single model of development. Such a trend would perpetuate inequalities and the status quo, while reducing opportunities for a diversified development. Another approach should and can be designed and put at work, guided by the idea of a gradual transformation of developing countries.

Building on countries' capabilities and specificities

The conceptual approach adopted in this paper is that the promotion of innovation should be considered in a gradual manner in building upon resources and capabilities available in countries at their level of development and in taking due account of their specificities including their conditions of governance. This approach is valid also for broader development policies.

[3] In the same way that the industrial era had replaced the agriculture era. The share of the manufacturing activities is declining in the economies, while the share of services is increasing. Knowledge and other intangible factors tend to replace capital and labor accumulation as source of growth. A new growth regime is taking place, materialized by a larger contribution of the total factor productivity.

This approach takes place within a broader current of thoughts characterized as the "new institutional economics". Rather than imposing a single, unique model for judging and promoting growth capabilities, this school of thought tends to take as a basis the existing institutions and to understand the minimal changes which can help generating progress and growth[4]. The transformation of actors' behaviors is seen as a long-term process, involving the formation and diffusion of new values following judicious adjustments in the broad regulatory framework[5].

Structure of the document

The approach outlined above will be followed in different ways in this paper, after outlining the main issues characterizing innovation climates in developing countries (section 2). We will detail the forms taken by innovation in developing countries in understanding it in a broad perspective, including most modest local improvements brought into economies or societies (section 3). Then, we will discuss how to conceive national strategies in function of countries' technical and institutional capabilities. The key idea is to make change possible in promoting successfully most needed innovations (section 4). In this perspective we will present policy actions and instruments principally needed for supporting efficiently innovative projects in considering differentiated capabilities of enterprises, including those with very low technical and managerial capabilities (section 5). A key idea is to embed the promotion of innovation into an overall process of enterprise upgrading. In the next section we will discuss some issues related to the globalization process: foreign direct investment, research concentration in the North, patent asymmetry and brain drain, and we will outline possible policy responses by developing countries (section 6). Implications of cultural specificities on the design and management of innovation policies are then discussed (section 7). A section is finally devoted to the evaluation of innovation policies (section 8). In conclusion we summarize the main lessons derived from the analysis (section 9).

In the annex we suggest initiatives to be taken within the World Bank.

2. Innovation climates in developing countries

Major weaknesses in the overall environment

Innovation climates in developing countries are first hampered by weaknesses of other key elements of knowledge-based economies as defined in the WBI four pillar framework, namely levels of educational attainment, the business environment and the information infrastructure.

[4] See Dani Rodrick, Getting Institutions Right, Working Paper, Harvard, April 2004.
[5] See O.E. Williamson, The new Institutional Economics: Taking the Stock, Looking Ahead, Journal of Economic Literature, September 2000.

Educational levels are low in developing countries, and, this is a significant barrier to the development and diffusion of innovation in these countries[6]. In fact, one can establish a clear relation between educational needs and the different phases of industrialization. In the pre-industrial phase, educational needs demand only basic literacy. In the industrial phase, more professional and medium-level skills are required. In the post-industrial phase, there is a need for a significant share of a population with tertiary education, with the rest of the population having at least functional literacy[7].

The influence of the quality of the business environment, linked to governance conditions, on innovation performances is also clearly demonstrated. However, there is a need to approach with some caution the appreciation of business environment. The quality should be seen from the perspective of countries themselves with their own values and cultural specificities. A lack of financial transparency is not necessarily a problem in a number of cultures, as discussed later. On the other hand, a bureaucratic climate which forces an entrepreneur to obtain a hundred authorizations to establish his/her enterprise is a problem, whatever the culture in question. More generally, when judging the quality of a business environment it is of crucial importance to go beyond the formal appearance of laws and to examine how laws are applied in practice in taking due account of the more or less informal relations regulating transactions among economic agents.

Finally, there is the issue of a lack of infrastructure. Of primary importance is, of course, the telephone infrastructure. The telephone is the most important tool for (potential) entrepreneurs. Mobile phone technology has transformed the conditions of telecommunications in developing countries. Yet, the tele-density remains weak in a number of developing countries, inferior to what may be considered the minimal threshold for take-off (around 30 percent). Progress made with mobile phone technology can lead to rapid improvements in connectivity, however it does not solve the necessity for greater internet penetration – something which remains quite low in most developing countries. Infrastructural needs for innovation in developing countries are, however, not limited to telecommunications. Road and other transport infrastructure are of primary importance, as well as sanitation, water, and other systems.

Innovation systems

As a consequence of this overall problematic environment, innovation systems[8] in developing countries are poorly constructed and are very fragmented. On the enterprise side, generally a large number of micro-enterprises operate in the informal economy, and a more or less important number of foreign-based firms, which tend, however, to be disconnected from the rest of the economy.

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[6] For a convincing demonstration of the correlation between educational levels and innovation performances, see W. Maloney, presentation at the ECA KE forum Budapest, March 2004. Innovation performances are measured by patent deposited in international systems.

[7] On this notion of functional literacy – which means a capability to orient oneself in various walks of life – see OECD, and notably the Adult Education Surveys.

[8] The innovation system is defined as the set of organizations (firms, universities, public laboratories, etc.) and their linkages through which innovation processes develop. For an in-depth analysis of innovation systems in developed countries, see Managing Innovation Systems, OECD, Paris 2000.

On the knowledge side, there is generally a limited research community, operating usually in an ivory tower, and a university system poorly connected to local realities, particularly to labor market needs and opportunities. Particularly problematic are the lack of technological support services and infrastructure (metrology, quality control, standards, etc).

Public sector institutions tend to be numerous, including those supporting the promotion of enterprise development, export, foreign investment, etc. In this often over-crowded support system, it is not easy to establish new, efficient organizations for the promotion of innovation. Where this is possible, the organizations are rarely appropriate, lacking the flexibility and drive crucial for entrepreneurship.

These overall conditions keep innovation systems into a low equilibrium trap. They are characterized by low levels of R&D in the business sector, with the bulk of national R&D effort borne by the government, and with questionable relevance for the economy.

Due to a desire not to upset the status quo and the preference of key actors to continue benefiting from vested interests and protected situations rather than taking the risk of un-chartered waters, reform is usually difficult[9].

Innovation processes

The conditions evoked above make innovation processes particularly difficult. Success stories present generally the following features:

- Projects are borne by very motivated individuals or small groups of people who benefit from both a) the assistance of foreign partners who bring in some finance, technology, or market network, and b) the support of local politicians – who are well rooted in national power networks, and who help to overcome bureaucratic or institutional barriers.
- Projects tend to be concentrated in well defined localities, as in the developed world, where these people are able to find, exploit or create a differentiated advantage and then generate, by their examples, a process of emulation and replication among the surrounding communities. The initial differentiating advantage can be related to the presence of a strong university (e.g. Bangalore in India, or Campinas in Brazil) or a dynamic industrial community (Monterrey in Mexico), and may lead to undertakings of considerable significance. It can also be due to the presence of a strong agricultural community[10], or a rich cultural legacy, as illustrated by a number of cities of the Third World which have become very dynamic tourist destinations[11].

[9] In line with the ideas developed by Mancur Olson who identified income redistribution patterns as the main determinant of the political economy of change.

[10] A well known example is the asparagus producers in Peru who have even created a university to consolidate their knowledge, and develop research and training.

[11] A case in point is Essaouira in Morocco. This example was documented by a film presented at the MNA Marseille II Forum in March 2004.

- Dynamic, nascent industries, and related business communities, are efficient entry points into innovation systems; they can bring about change and stimulate needed reforms or investments. In many countries, such entry points are often constituted by IT related industries and services which provide the bulk of technological newness[12].

It is with this background in mind that appropriate policies have to be designed. The first step is to have a clearer understanding of what innovation means in developing countries.

3. Innovation needs and opportunities in developing countries

Innovation should be understood as something new to a local context. This relativity to the context is important and particularly relevant for developing countries. In a global perspective three forms of innovation can be distinguished. The first one relates to local improvements based on the adoption of technologies which are more or less available worldwide or locally ("technology adoption" from a global perspective). The second type of innovation materializes in the building up of competitive activities with some adaptation made to existing technologies ("technology adaptation"). The third type of innovation is the design and production of technologies of a worldwide significance ("technology creation" from a global perspective).

Local improvements

Firstly there is a considerable need to improve welfare conditions in developing countries, notably with regard to health issues (one should remember that mortality rates have increased in a number of countries due to HIV/Aids). Agricultural productivity and performance can also benefit considerably from technological improvements, as illustrated by the green revolution in India. Similarly, the diffusion of technologies and best practices in defined segments of a given economy is the most efficient way to increase the performance of firms, and to generate wealth and jobs.

There is, however, a need to be realistic about what is possible and the challenges which remain to be addressed in certain contexts, even with apparently very simple technologies. A case in point is the diffusion of gas burning techniques in Africa, as described in the box below.

[12] Note that IT sectors are the source of more than 50 per cent of innovations in the developed countries. Their role reaches an even larger proportion in developing countries.

Box 1. Gas burning techniques in Africa

The diffusion of gas burning techniques to heat households in African villages in place of wood-based fires would have considerable impact on people's health, forest conservation, etc. However, the widespread introduction of such a technique requires establishing, from scratch, distribution systems of small gas tanks, creating maintenance shop networks by facilitating borrowing by potential entrepreneurs (possibly through micro-finance), establishing regulations to prevent the use of wood, and developing an efficient enforcement mechanism. All these simple issues are currently out of reach for a number of African countries.

Development of competitive industries

A second form of innovation is the development of competitive industries (including services) which take advantage of differentiated advantages, such as cheap labor, nice landscape or cultural legacies (for tourism purposes). This requires the adaptation of technologies which are locally or globally available. To a certain extent, the introduction to a country of an activity (manufacturing or services) by a foreign enterprise, to exploit cheap labor or other advantages (proximity of dynamic markets), can be considered as an innovation for the country in which this activity takes place, even if, in itself, there is nothing new in this activity.

To keep up with the competition and to gradually climb the value chain, improvements will be necessary in quality, marketing, organization, logistics, etc. and these can be considered as true innovative steps. It is even possible to develop innovations of worldwide significance in very competitive industries, in taking advantage of those assets imported by multinationals. For instance in the car industry, creative design in mono-space car was developed by Turkey for Fiat (Doplo model) and by Slovakia for WW (Touran).

One may, however, question the breadth of opportunities offered to the bulk of developing countries in the context of the increasing market shares being taken by a few large countries, such as China in the manufacturing sector, and India in IT services. In addition, with the development of telecommunications and transport, there is an increasing volatility of FDI, which is becoming increasingly sensitive to the size of the market and the quality of the business environment. This issue is discussed in the section on challenging global trends (6).

Note that a number of developing countries can, and should, exploit the unique differentiating advantages brought about by their climatic and geographical positions for tourism, as well as by their cultural legacies. This, however, requires sustained efforts for quality enhancement, the improvement of security, and infrastructure development.

Innovations of global significance

Opportunities for such innovations are less frequent in developing countries, and tend to be found more in medium-income than in low-income countries. Some countries have also gained unique, very advanced scientific or technological knowledge which can be

exploited for the introduction of radical new innovations. That is notably the case of Russia and a number of countries which benefited from significant R&D investment within the former Soviet bloc. The experience shows, however, that due to a poor entrepreneurial climate, these countries have not been able to take great advantage of these situations.

Another form of innovation is the development of technologies to fit the local conditions, the development of technologies which meet the specific features and challenges of developing countries. A typical example is technology which maintains the autonomy of local communities such as autonomous sources of energy and low cost efficient telecom infrastructure -- and thus prevents the destructuring of societies through urban concentration[13].

From foreign technologies to indigenous knowledge

It is clear that developing countries should tap into the tremendous knowledge and technology available worldwide by adapting these resources to their needs and capabilities. They should organize themselves in consequence with appropriate mechanisms for scouting, screening and transforming foreign technologies, including by reverse engineering. The past experience of Asian countries illustrates the advantages to be gained and progress which can be made by taping into Western knowledge and technology and using this as a source of competitiveness.

In addition, developing countries have a specific asset in the form of indigenous knowledge deriving from peoples' experience, accumulated and transmitted over generations. This knowledge concerns many walks of life and is a very valuable asset as a source of innovation, both technological and organizational[14]. See Box 2.

In fact innovation is often born out of the blending of indigenous knowledge with technological and organizational inputs from the developed world. The key is to facilitate the proper exploitation or integration of such indigenous knowledge and know-how in projects relevant to the countries concerned.

[13] There has been an abundant literature on appropriate technologies, notably following the seminal "Small is Beautiful" book by Schumacher. However the question is taking a very strong acuity today with the global climatic change as well as the destructive paths that developed countries' urban growth models have obviously represented for developing countries.

[14] For more details, see the IK program of the WB Africa region.

Box 2. Indigenous Knowledge

Indigenous knowledge in developing countries relates to the know-how, techniques and innovation often non-documented and held by local communities. This knowledge is vast and mostly concerns: a) a considerable potential in biodiversity and treatment of illnesses, and b) rural knowledge and traditional farming techniques adapted to local agricultural needs.

Despite the abundance of Western medicine, traditional healers remain central to the health system in African developing countries. Over the African continent, it is estimated that traditional healers take care of approximately 70 percent of all illnesses. Such treatments have proven to be very successful to the surprise of many skeptics who blamed traditional healers of charlatanism. Traditional healers have already helped world medicine with their knowledge of herbal treatments, which could potentially play a critical role in defining vaccines and advancing world medical knowledge.

4. Appropriate strategies at the national level

Innovation ambitions and policies have to be adapted to levels of development and educational bases[15]. Differences in institutional capabilities (strong, limited, weak) need also to be taken in consideration. It is possible to outline a specific policy agenda for different types of configurations, as summarized in Table 1 below.

Support should be initially focused on most promising regions and industries in order to build a climate of self confidence through success stories, and then facilitate a broader reform process[16].

[15] This was made clearly explicit within the World Bank in the LAC flagship report: "From resource-based to knowledge based economies", World Bank 2002

[16] Note that the development of "competitive platforms" promoted by the World Bank Africa Region are directly inspired by these considerations. The objective of these platforms is to provide a "package" of support services relating to communications, technical services (quality control, testing), training, custom clearance, etc.

Table 1. Innovation systems and policy agendas (Y. Kuznetzov)

<table>
<tr><td>Level of institutional and human capital capabilities</td><td>Strong institutions
(litmus test: business R&D dominate R&D budget)

Decision-making horizon: long-term</td><td>Limited institutional capabilities

(litmus test: large stock of export-driven FDI exists yet national innovation system is virtually irrelevant for business)
Decision-making horizon: medium-term</td><td>Weak or fragile institutions

(little state activism is possible/ desirable)
(litmus test: investment climate is poor and volatile)
Decision-making horizon: short-term; survival</td></tr>
<tr><td>Low ST capabilities

Technology adoption</td><td>‘</td><td>Exports as a springboard’ agenda:

Developing non-traditional exports as entry point for institutional and technology development

Central America (with the exception of Costa Rica)
Traditional urban and rural economies in India and China

Korea in the 60’s
Mexico in the 70’s
Vietnam,
Mauritius</td><td>Technology basics agenda:

Creation of demonstration effect to show that innovation does matter, in particular in health, education, agriculture and crafts

Most of Sub-Saharan Africa

Most Central Asian states</td></tr>
<tr><td rowspan="2">Medium ST capabilities
Technology adaptation</td><td colspan="2">‘Turning point’ agenda:
a need for transition from global sourcing to proprietary technology</td><td rowspan="2"></td></tr>
<tr><td>Increase in R&D investments

Korea, Ireland in the 90’s
Malaysia
India (IT clusters)</td><td>Increase in business R&D through recombination of S&T capabilities

EU accession countries

Chile
China, Mexico, Brazil
Turkey, South Africa

Korea in the 70’s and 80’s</td></tr>
<tr><td>High ST capabilities
Technology creation</td><td>Innovation leaders agenda:
Development of proprietary technology through promotion of innovation clusters

Korea, Singapore, Taiwan
Finland, Israel</td><td>‘Turning point’ agenda:
Increase in business R&D through recombination of S&T capabilities

No country currently fits
Russia in the future?</td><td>‘Embedded autonomy’ agenda:
Creating a diversity of autonomous business-led innovation organizations (Foundation Chile agenda)

Argentina, Russia, Ukraine, Belarus, Armenia

Chile in the 70’s</td></tr>
</table>

Low-income countries

- In low-income countries, where the institutional capabilities are limited, policies should focus on basic investment in technology infrastructure and demonstration operations of "basic" innovations which can contribute to improvements in welfare, education, and agriculture. This is important for establishing a dynamic technology sector and for promoting technology-led development which goes beyond meeting the need to survive. An example is provided by Uganda which began with a good investment promotion agency, used specific advantages at a low technology level (e.g. with cultivating flowers and exporting them in European markets), made appropriate reforms in the education system at all levels, and benefited from coherent support from donors. Thus Uganda has gradually been able to build a sustainable path toward development.
- Where institutional capabilities are relatively strong, there is the possibility for a more comprehensive, dynamic and structured policy. An example is provided by Vietnam. A strongly articulated policy was put in place to develop new cultures taking advantages of the climatic features of the countries: coffee, cotton, etc. in providing the necessary technical support, organizing transport and logistics for exports. On the high tech front, vigorous actions were taken for developing a competitive software industry in selected niches, in building on State owned enterprises and making good use of government procurement. Meanwhile other reforms were gradually implemented in many other key areas such as education, finance or trade, creating a broader environment more conducive to innovation.

Medium-income countries

- For medium-income countries with no S&T capability but with some institutional capacity, policies can focus on fostering the development of brand new activities – services and IT oriented – of world class. A good example is provided by Dubai which, by attracting both foreign investors and an educated labor force (notably from the Arab countries and from India), has been able to establish from scratch a set of internet and media cities. Key for this was the vision and drive provided by the leadership and the establishment of powerful agencies able to act on all necessary fronts[17].
- For medium-income countries with a relatively strong S&T work force but low institutional capability (Russia, Argentina), the road ahead seems to be through the development of autonomous innovation promotion institutions, managed as private sector organizations, and focused on establishing sustainable clusters of innovative firms (along the lines of the Fundacion Chile as described later). A major problem faced by such countries is resistance to reforms, and difficulties in transforming existing RD organizations and revitalizing the entire RD system which is in decay. Thus, there is a need for marshalling entrepreneurial capabilities around existing technological and scientific assets, and drawing on the support provided by bodies which are agile and not caught in the government machinery.

[17] For a summary description of the Dubai experience, see "Knowledge Economies in the Middle East and North Africa, Towards New Development Strategies", Chapter 8, the World Bank, 2003.

- Lastly, in medium-income countries with a strong S&T capability and a relatively good institutional capability (Chile, Poland), there is a need to improve the science base. Public investment can be recommended as a means to this end, providing that the business environment is good enough for private sector to invest significantly in RD. The way to make the ST and educational structures more responsive to innovation needs of the surrounding business communities lies in the change of funding mechanisms (see below section 6).

High-income countries

High-income countries are, in many ways, confronted by issues similar to those of medium-income countries. These countries have to climb to a higher level of indigenous innovation performance. Ireland and Korea have been confronted, each in their own way, by this challenge. Ireland, which built its innovation system largely on FDI attracted by strong incentives and a high quality educational infrastructure, is addressing this challenge by seeking to strengthen its research base through massive investment, notably through a recently established Irish Science Foundation. Korea, which had rooted its economic growth and industrial development in large conglomerates (Chaebols), is seeking to enlarge its science base and diversify its economic structures through a vigorous innovation-led regional policy approach.

Multi-level situations

Problems become even more complex when considering large countries which encompass different levels of development. Typical examples include China, India, Brazil and Mexico. Here, the key is to exploit dynamic regions of different levels of development and with differentiated comparative advantages[18].

5. Efficient support for innovators

Stimulating and supporting enterprise innovation

Creating a climate conducive to innovation in developing countries requires first the recognition of the very special nature and composition of the enterprise sector. A large part of the sector is made of micro enterprises which are operating in the informal economy and which have a very low technology competency, if any. A less important segment is composed of SMEs with minimal technological capabilities. An even smaller segment is constituted of technology competent enterprises. Finally, there is small number of R&D rich enterprises.

What is important is to have: 1) schemes adapted to the different types of enterprises, 2) schemes tackling the various needs: technical, commercial, legal, etc. 3) schemes embedded in broader actions aimed at upgrading the overall management of enterprises. The attached table (Table 2) summarizes policy instruments responding to these different requirements.

[18] This is notably the strategy proposed to Mexico in the KE report prepared by the K4D program (C. Dahlman and Y. Kuznetzov), June 2004.

As far as financial support is concerned, this takes various forms and is generally provided in the form of subsidies for the primary steps of innovation projects. Then, for more costly phases of development and commercialization, and when there is a smaller risk of failure, funding normally takes the form of reimbursable subsidies or grants. In more sophisticated conditions, there are also schemes, often fiscal, to attract venture capital. The use of tax incentives is, however, not particularly recommended for most developing countries, notably in low-income countries, due to the fact that there is a large informal sector and a poorly equipped tax administration.

Flexible and autonomous agencies

A key factor for providing efficient support is that it is delivered in an integrated and coherent way with a maximum degree of flexibility. This therefore requires organizations with matching characteristics. A particularly good example is provided by the Fundacion Chile, a public agency, but with an independent, business oriented approach, which has consequently been able to play a dynamic and decisive role in the development of resource-based industries such as the wine and salmon industries, by using different instruments, scouting appropriate technologies worldwide, creating new businesses, etc [19].

[19] Efficient international programs helping innovators in Third World countries are also characterized by their flexibility and capability to offer appropriate packages of support. An example in point is the US-based Aid to Artisans organization, a private NGO which offers to artisans in several dozens of developing countries access to international fairs, technical advice, design assistance, management training, and some form of financial help, and presents a remarkable record of success.

Table 2: Policy Frameworks Appropriate to Enterprise Innovation capability (R. Whyte)

Low technology SMEs and micro enterprises	**Policy Objectives** **Business**: To **s**tabilizing business and build competitive capabilities. **Innovation:** Building awareness of scope and benefits of innovation	**Policy Instruments** ➢ Business advisory and support services – SME and micro-enterprise support agencies ➢ Finance (including micro-finance) ➢ Management and skills development ➢ Innovation awareness and understanding ➢ Productivity enhancement services ➢ Innovation identification and matchmaking ➢ Cluster-based approaches to stimulating innovation
Minimal technology SMEs	**Business:** To develop competitiveness. **Innovation:** To introduce basic innovation skills. To encourage adoption and application of new ideas	➢ Support for business development, diversifying customer base ➢ Product diversification and quality improvement ➢ Management and skills development ➢ Internet-based information services ➢ Technology awareness and marketing ➢ Support for technology adoption and adaptation projects ➢ Graduate intern and placement programs ➢ Consultancy and technical assistance support
Technologically competent enterprises	**Business:** To support market development, internationalization of business. **Innovation:** To build in-house innovation capabilities	➢ Business development, exports market support ➢ Internet-based information services ➢ Innovation and technology support ➢ Technology transfer support ➢ Incubators and techparks ➢ Linkages with academic researchers ➢ Innovation Relay Centers – matchmaking services ➢ Laboratory services and metrology ➢ Graduate intern and placements ➢ Consultancy and technical assistance support – e.g. on commercialization, IPR, licensing, patenting, etc. ➢ Technology joint ventures
RD rich enterprises	**Business:** To develop international markets, entry to global supply chains **Innovation:** To encourage R & D, engagement with international innovation networks, technology transfer and diffusion	➢ Exports support ➢ Technology support ➢ Support for participation in international R & D networks, e.g. EU 6th Framework Program ➢ Technology and other innovation-based spin-offs ➢ University-industry collaboration ➢ Support for commercialization

Box 3. Fundacion Chile

One of the most successful attempts in the Latin American region to establish national agencies for new technologies is Fundacion Chile, created in 1976 originally as a joint effort between the Chilean government and the U.S. firm ITT, but now largely autonomous. Fundacion Chile uses four main techniques in its technology transfer and dissemination work: (1) it creates innovative enterprises, almost always in association with companies or individuals; (2) it develops, adapts, and sells technologies to clients in the productive and public sectors, both in the country and abroad; (3) it fosters institutional innovations and incorporates new transfer mechanisms; (4) it captures and disseminates technologies to multiple users though seminars, specialized magazines, project assistance, and so on.

The creation of "demonstration" companies by Fundacion Chile has undergone successes and failures, but overall has proved effective as a method for disseminating new technologies. The companies are transferred to the private sector once the technologies have been proven in practice and their economic profitability has been established. One of the most successful cases, which exhibits many elements of the successful development of a knowledge cluster, is that of the salmon industry, which in a period of 10 years grew to become a dynamic export sector. Recent focus areas include forestry genetics and DNA vaccines for aquaculture.

Fundación Chile has been quite successful in incubating new ventures through entrepreneurship and technological innovation. By 1999, it had launched thirty-six such ventures. Seventeen have been sold. The six leading companies have generated more revenues than the total cost of the Fundación during its existence.

Success Factors are**:** an entrepreneurial, highly paid and highly professional management team (which takes years to establish); arms-lengths relationships with the government; operates as a business, not as a public sector organization; private shareholders which do not expect an immediate return and tolerate risks ("oligarchs with a strategic agenda").

Mobilizing local communities

As discussed earlier, experience shows that innovation flourishes in well defined regions where there is a concentration of talent, energy, and vision. It is also crucial that support be delivered as close as possible to enterprises, as they are dispersed on the territory. For this it is important to mobilize local communities to create a strong ownership. There are various ways to do this. In developed countries, the mechanisms most often employed include: the establishment of antennas of central agencies which enjoy enough autonomy for project selection and funding, and matching funds by which local authorities are stimulated to spend resources on infrastructure and other innovation programs. These approaches should work in developing countries too, as long as they are implemented with simple methods and means in a certain transparency.

As previously in developed countries, the establishment of technological parks or special industrial zones is a favored model in a number of developing countries. The experience has shown that success is far from being guaranteed and policy makers should in fact proceed very cautiously and gradually. A right approach is to build such techno-parks close to universities and associate dynamic business communities to their development. It is important also to avoid the use of financial, notably tax incentives, which would offer to enterprises and their personnel working in such techno-parks excessive advantages which would be perceived as undue and unfair by the other parts of the business or academic communities.

Research and technology infrastructure

It is clear from the discussion of innovation opportunities and needs conducted in section 2 that there are few basic functions that have to be fulfilled for this.

The first one concerns the diffusion of technology and knowledge. This is done by a number of key activities including: metrology, standards and quality control, extension services (for manufacturing and agriculture), information and training programs, demonstration and pilot projects. Key for the efficiency of such schemes is the proximity to the local entrepreneurs, intending innovators and populations in general. Note the importance of all these services which do fulfill functions of public services and thus should be funded appropriately. This applies particularly to organizations for standards and norms which should not be privatized.

A second function is the building of appropriate research structures. Research activities, from basic to more applied, need to be adapted to local needs and capabilities. In fact, a major problem in a number of developing countries is the lack of interfaces between research bodies and local communities. Improving linkages depends primarily on the conditions of financing of such research bodies. A key rule of thumb, illustrated by the experiences of the developed countries, is the provision of a definite share of guaranteed resources (core funding), ranging from 50 to 70 percent to the total available budget, and 30 to 50 percent of more volatile resources (contracts). Some developing countries have been able to transform large sections of their research structures along these lines. India is a case in point as illustrated below (Box 4).

Box 4. Reforms of Research Structures in India

In the India of the 1980s, there was a significant pool of good scientists, many well equipped institutes which turned out some good basic research and a number of spin-offs, but which were held back by projects with little commercial value, a protectionist lobby which sought to further its own interests, and an antagonism towards industry.

An Abid Hussein Commission, created in 1986, put forth strong recommendations in an attempt to push for reform of India's research system. In particular, it recommended the promotion of better research-industry collaboration, the increase in contract revenues, and by offering them a share of the consulting and R&D revenues, the provision of incentives to staff working on a particular project.

Through top level commitment, the provision of incentives (interest free loans) to institutes demonstrating leadership and capability, the introduction of business plans and by emphasizing common interests and objectives of industry and researchers, India succeeded in turning around its research institutes, and, thus, in upgrading a vital player in the innovation network.

The legal and regulatory environment

Many of the major obstacles to innovations in developing countries are related to the institutional environment: government authorizations of various types, government procurement, technical norms and standards, competition, customs, industry-university relations, finance and banking, intellectual and other property rights, … without counting those obstacles of a more informal nature. Such obstacles are not

fundamentally different from those to be encountered in the developed world, but they are much more difficult to address, notably because of the absence of an efficient judiciary system.

There are several possible ways which can be considered to improve this situation:

- Firstly, the strengthening of relevant established institutions to give them the necessary independence, legal and financial resources to accomplish correctly the functions they are supposed to fulfill. For instance, a number of countries have competition laws, but there are no mechanisms and appropriate organizations to ensure their enforcement.
- Secondly, the establishment of efficient counter powers, made notably of users of the public services, including entrepreneurs, to get those services better functioning, less sensitive to corruption, etc. Such initiatives have notably been implemented in the education sector to ensure an appropriate use of public funding[20] and could usefully be extended to other sectors, such as public procurement to ensure more transparency in funding allocations and selections of providers.
- Thirdly, the implementation of institutional audits, focusing on innovation-related obstacles. Such audits could be built, or grafted, on those broader surveys implemented by the World Bank to evaluate the business environment[21] or governance conditions[22]. Such audits – to be implemented by high level, independent bodies - should not be conceived as one shot events, but should be designed as processes, through which recommendations made by the relevant bodies would be followed-up and monitored in their applications and effects. Note that these audits could also be implemented by international instances, modeled on the peer review mechanisms put in place in Africa within the NEPAD for governance and democracy issues[23].

6. Challenging global trends and policy responses

Globalization and technological change represent both opportunity and challenge for developing countries, and so the question of how developing countries can harness the globalization process to turn potentially adverse spillovers into windows of opportunity, how they can tap into what is an increasingly rich pool of global knowledge. This section looks at how to turn FDI volatility, the north's research concentration, patent asymmetry and brain drain into potential sources of new knowledge for the developing world.

FDI volatility

Foreign direct investment can be crucial in stimulating change and innovation, and in bringing new technology and knowledge to a country, as illustrated by the examples of China and Malaysia. Equally, it is an important driving force behind improvement of a country's business climate and governance conditions.

[20] E.g. in Uganda, increasing by more than 50 per cent the use of funds received from the donors – which used to be lost because of corruption practices.
[21] See Doing Business, World Bank, 2003.
[22] As designed and implemented by the WBI Governance program.
[23] Which begin to work, a number of countries having offered to be reviewed.

However, FDI remains a volatile source of new knowledge, and positive spillover effects should not be assumed. Its impact is linked not only to the local context (i.e. political and business environment, incentives offered to MNCs etc.), but equally to the global context and the emergence of new "hotbeds" of investment, as demonstrated by the current shifting of investments by European companies away from Eastern Europe to Asia, and China in particular. Nevertheless, much of China's FDI is still directed towards short-term, labor intensive manufacturing, while investment in high-tech activities, particularly in service sectors, lags behind.

This question of how to move higher up the value chain and attract knowledge-intensive industries to developing countries – whose spillover effects are potentially far greater than those of low-tech investments – is an issue for all developing countries, and will partly determine the speed at which a country shifts from the technology adoption, to the technology adaptation, to the technology creation stage – and the type of investment it attracts.

Evidence has shown that in general, investors are primarily concerned about:

- The overall regulatory framework of a country, more than by the incentives (e.g. fiscal, financial) it offers, and they prefer to locate investments, especially large, long-term ones, in countries with predictable policy regimes. This underlines therefore the primary importance of government support and good governance to foster FDI and innovation in developing countries.
- The absorption capacity of an economy and, in particular, the availability of a skilled labor force, with up-to-date skills and the flexibility to adapt to new technologies and new management styles. Where firms and countries reach a level of absorptive capacity that will allow them to attract and retain foreign enterprises, FDI can be a powerful source of technology transfer and trade expansion.

This latter point is particularly crucial for climbing and maintaining one's position in the innovation value chain, as illustrated below by the cases of Ireland and Poland (Box 5).

Box 5. Ireland, FDI and value chains

Over the past three years, the attractively low wages found in China, India, and Eastern Europe have eclipsed Ireland's financial advantages, spurring many global companies to scale back or cancel their plans for Irish operations**.** Ireland has had to fight hard to reclaim its status as a major outsourcing destination, and has done so by emphasizing its work force's brainpower, productivity and flexibility, in short, its success at becoming a fully fledged knowledge-based economy.

The fruits of this explicitly new and differentiated marketing strategy are already showing signs of reward, with a number of large MNCs having already returned, re-located, or planning to relocate to Ireland in the near future. Companies such as Dell, which employs about 4,000 people in Ireland but which has also begun outsourcing to India and elsewhere, are now experiencing great difficulty in that quality isn't always what they had hoped the quality might be. Thus, countries like Ireland, who in parallel do strong marketing campaigns, have strengthened their knowledge base through concerted investments in R&D and education, have seen large multinationals returning and more importantly, returning to turn out products and services higher on the value chain. Today, investment is going into higher-level jobs in pharmaceuticals, biotechnology and digital media.

Interesting to note is that countries like Poland on the other hand, not so long ago an attractive location for foreign investment, are beginning to lose their share of FDI due to the fact that, according to some sources[24], their marketing capacities are weak and they are failing to "sell" their sources of competitive advantage.

Note that medium technology industries (such as automotive) are often more demanding in terms of required technical skills than high tech industries (such as electronics), because a large part of the components have to be produced locally, while high tech elements, of a lighter weight, can be more easily supplied from abroad. In this connection, it is generally the industries supplying materials and components which benefit, on the domestic front, most from technology transfer and skill upgrading from FDI.

The practice of licensing is another way in which countries can effectively access technology and foreign knowledge. Many developing countries are lagging in such use of innovation through licensing, despite the fact that it often provides technology in a more accessible manner than FDI.

Research concentration

Global disparities in terms of S&T capacity, in terms of both input and output, are startling: R&D spending by the 29 countries of the OECD in 1998 was greater than the total economic output of the world's 61 poorest countries.

It is clear that developing countries need to boost indigenous R&D capacity, however, this is easier said than done without increased financial and human resources, as well as the fundamentally important existence of demand for R&D results. International R&D cooperation activities can, however, serve as important

[24] McKinsey, May 2004.

means to upgrade the research systems in developing countries. Such cooperation activities include:

1/ Bilateral and multinational R&D schemes:
- Potentially most cost-effective alternative to attempting to mount large R&D infrastructures in the countries concerned. North-South schemes offer developing countries the opportunity to tap into the research systems of the industrialized world, where most of the world's research is concentrated. There are already many examples of North-South cooperation, in particular between ex-colonial powers (UK, France, Netherlands, Portugal) and their former colonies.
- The nature of cooperation activities takes many forms: financial support of research projects in the developing countries, the exchange of researchers between North and South, opportunities for students from developing countries to study in northern universities or for professors from developed countries to take up research chairs in developing countries, the participation of universities, research institutes in multinational schemes to promote international R&D, such as World Bank's CGAR program to promote international research in the field of agriculture, or the European Union's Framework Programs for Research and Development.
- The focus of the international research is, however, very often dominated by the agenda of the participating developed countries, and not always in the interest of developing countries (HIV/AIDS research).

2/ The development of research centers of excellence in the developing countries which attract top international expertise. Centers of excellence are founded with the intention of attracting top international research expertise, which then feeds into the local knowledge base (World Bank funded Millennium Research Centre, Chile).

3/ The establishment of the research facilities of multinational firms in the developing countries. Where this is achieved (India, China), the possibilities for positive spillover effects from the foreign to domestic firms and the upgrading of the indigenous R&D system are significantly increased[25].

In light of these trends, the questions are:

- Firstly, how developing countries can better leverage existing research cooperation schemes for their benefit, how they can improve their involvement;
- Secondly, what complementary measures could be introduced to stimulate R&D in the countries concerned. How increased publicly funded research should be directed requires careful consideration: it should not act as a form of subsidy to the existing industries in developed countries, e.g. the pharmaceutical industry, even if the industries have an important role to play, but should maximize the opportunity to build the capacity of the developing countries themselves to undertake R&D, e.g. in the case of the pharmaceutical industry, on treatments for those diseases which particularly affect them.

[25] General Electric, for example, has established its second largest R&D center in the world in India, employing about 100 PhDs, and 27 other global firms set up in R&D centers in India between 1997 and 1999.

***Patent asymmetry*[26]**

Proponents of IPRs recall that without industrial applicability and retribution there is little incentive for individuals and companies to pursue research and development activities, while weak protection deters investors in high R&D sectors. Critics of IPRs argue that intellectual property rights prevent the diffusion of new technologies, increase the cost of R&D, thus adversely impacting on R&D and productivity.

The crucial issue in respect of IP is therefore to what extent it promotes or hinders access to technologies that are required for their development, and how the current patent system can be exploited to accommodate the needs and interests of developing countries. It has been concluded that in most low income countries, with a weak scientific and technological infrastructure, IP protection at the levels mandated by TRIPS is not a significant determinant of growth. On the contrary, rapid growth is more often associated with weaker IP protection. In technologically advanced developing countries, there is some evidence that IP protection becomes important at a certain stage of development, but that stage is not until a country is well into the category of upper middle income developing countries.

The question is how can developing countries adapt their needs to exploit to their advantage the current patent system? One possibility is a greater exploitation of utility models / petty patents for innovations coming from developing countries: they offer a lower level of protection than standard patents, but are more easily obtained and target a lower level of inventiveness. Evidence (Japan, Brazil, Philippines) has suggested that utility models are more important than patents in stimulating productivity growth. Nevertheless, there are indications that interest amongst companies in the utility model is rather low.

In developing countries, one of the most important sources of innovation is local or indigenous knowledge. However, the difficulty is to locate, document and protect local and traditional knowledge. Also, without proof or written record of ownership, which in developing countries is often difficult to ascertain, it is impossible to place a patent claim on knowledge. A functioning legal framework, which goes beyond TRIPS and is adapted to the protection of indigenous, local and traditional knowledge in developing countries, is lacking.

IPRs are not adapted to the needs of protection required by indigenous knowledge, but such protection is vital for developing countries. Patents provide intellectual property protection for the invention of the company enabling investors to regain funds they risked for R&D, if and when a product is commercialized. Companies or investors will not risk capital to discover or develop a drug unless their investment is protected from competing companies by a patent. The same applies to local communities. In the absence of protection, few farmers or traditional healers would run the risk of losing retribution for their knowledge. As a consequence traditional knowledge and innovation in developing countries have been surrounded by much secrecy further impeding the enlargement of the knowledge base.

[26] This section is largely based on the UK CIPR report (UK Commission on Intellectual Property Rights): Integrating Intellectual Property Rights and Development Policy 2002.

Certain aspects of IPRs which provide excessive protection to technologies designed in the advanced world, which are of crucial importance to the developing world, may have also to be adapted to better serve the needs of the latter. A case in point is the patent protections on pharmaceuticals which can be produced as "generics", but which are extended to 20 years and more. For a number of developing countries – and even advanced countries, notably Asian ones with strong mass production capabilities, – this constitutes a particularly problematic situation[27].

Brain drain

Up to one-third of R&D professionals from the developing world reside in the OECD area. This brain drain represents a significant challenge for developing countries seeking to upgrade their knowledge bases. However, the migration of skills can be slowed through the return of expatriates to their country of origin, as demonstrated by the examples of Israel, Greater China, and more recently India and Mexico, whose diaspora communities have been mobilized to transfer, teach, and upgrade the vital technical and managerial skills needed in their countries.

There are essentially four main ways in which diaspora can nurture the knowledge base in their home countries:

1) By returning home with new knowledge gained elsewhere (e.g. Taiwan). This rarely happens on a large scale without professional and financial incentives provided by the government. The home country must be able to provide the infrastructure and career opportunities necessary to meet the aspirations workers may have developed during their stay abroad.
2) Through foreign direct investment (e.g. Chinese diaspora).
3) By acting as mediators between foreign and local partners (e.g. India). Indian expatriates have maneuvered as brokers between Indian companies and US partners intending to invest in India, and have provided valuable links with foreign markets notably helping US buyers to find suppliers in India, hence boosting outsourcing potential in India.
4) Through sending back money to their home country, i.e. remittances. Remittances from foreign workers, both permanent and temporary, are the second-largest source of external funding for developing countries, after foreign direct investment[28].

7. Cultural specificities and innovation policies

Development processes, and innovation climates in particular, are considerably affected by socio-cultural patterns proper to each civilization, country and even to each region within a country. This has been obvious from developed countries and is

[27] So far only drugs related to HIVs/Aids have benefited of reduced patent protection.

[28] In 2001, workers' remittances to developing countries abroad stood at $72.3 billion, considerably higher than total official development assistance and private non-FDI flows, and 42 percent of total FDI flows to developing countries that year. For most of the 1990s, remittance receipts exceeded official development assistance. In nominal terms, the top recipients of remittances included several large developing economies – India, Mexico, and the Philippines – although a share of GDP, remittances were larger in other low-income countries in 2001. Source: Global Economic Prospects, World Bank, 2003.

illustrated, among other things, by the different paths followed by them in terms of scientific versus technological orientation, openness on foreign investment versus indigenous research and development as source of innovation, or the role of the government, more or less interventionist. Even among European countries, who share many historical and socio-economic similarities, there are enormous differences in economic strategies pursued from one country to the next.

Government initiatives

Socio-cultural differences between the developed world and the developing one are important and need to be approached in understanding clearly what is at stake. What is a stake is the respect of the socio-cultural foundations of countries in such a way that they effectively blend traditional ways of functioning with modern approaches facilitating their integration into modernity and the global economy. The experience shows that this is key to success. It has been clearly illustrated by the experience of Asian developed countries, notably Japan. Bostwana is another example of a country whose remarkable development is primarily due to the effective use of traditional modes of governance, which were protected from the destructive impact of colonization[29]. This has allowed the establishment of a sound economic policy, exploiting, in particular, the wealth generated by diamonds.

In the same way that developing countries have indigenous knowledge as a specific wealth, they have traditional ways of governance and conducting business which need to be respected and exploited. Thus, when focusing on innovation policy matters, the key is to build on countries' specific strengths while, at the same time, correcting potential weaknesses.

Changing behavioral patterns requires the establishment of appropriate incentives. However it is not easy and is all the more difficult when such patterns are deeply entrenched in anthropological roots such as family structures, religious backgrounds and even linguistic bases which determine world thoughts and relations to reality. In any event, it is important to make as clear and explicit as possible these behavioral patterns and related policy scenarios.

Authoritarian bias can have some positive impact, as demonstrated in the Arab world with the launching, in the recent years, of large pioneering initiatives or broad reforms by enlightened leadership (see box below). At the same time there might be not enough consideration given to the needs of the private sector, and this may explain why these initiatives are not yet producing all expected results in terms of enterprise development and job creation.

[29] See Why Bostwana prospered? Clarck Leith, 2003.

Box 6. Arab leadership and innovative initiatives

The Arab world exhibits currently a series of important initiatives for taking advantage of the information revolution and the process of globalization. From East to West, it is worthwhile mentioning four examples, all led by the countries' top leadership who initiated the projects (since 2000 or so), and monitoring closely their implementation :

In Dubai, as mentioned above, an internet city and a media city are being built in attracting global investors and a highly qualified labor force, thanks to a business climate aligned to best global norms and strong tax incentives. Powerful agencies have been established to support the development of the two cities, managing both technological, FDI and real estate aspects.

In Jordan, an ICT based national development strategy is being designed and implemented under the King's guidance and impulse, based on the establishment of competitive IT industries and services. The strategy encompasses notably broad institutional and regulatory reforms as well as massive educational projects (in which IT giants such as Microsoft and Cisco are mobilized).

In Tunisia, the Five Year Development Plan includes "knowledge economy" as a key dimension. Elaborated through a large consultation process, policy measures are taken in multiple domains, such as education, research, trade, industry, agriculture, and regional policies with the planned creation of ten technopolises in the coming decade.

In Mauritania, key reforms have been implemented in the telecom infrastructure (with now teledensity reaching 15 percent), in education (with significant increase of enrolment in basic education reaching 70 percent of the population), and in the business climate. Innovation effort are focused on tourism, taking advantage of the country specificities (the nomad and desert culture notably).

Coming back to the Asian models, it is interesting to discuss the Chinese approach. Building on typical Chinese features, the innovation policy combines both very effective features and more problematic ones as discussed briefly in Box 7.

Box 7. China's innovation policy thrusts

China illustrates the application of a number of policy principles outlined above. It:

- Built on strengths, first in attracting FDI for cheap mass production manufacturing; then moving up in establishing gradually an indigenous RD capability;
- Exploited change agents, such as local communities, top universities, high tech diasporas;
- Launched pilot operations, e.g. technoparks along the coast, those of which worked effectively, were then scaled up.

These come from features inherent in the Chinese culture: pragmatism, openness, experimentation, adaptation to long term trends with ability to seize short term opportunities, etc. On the other hand, some problematic aspects of the Chinese culture have not been sufficiently corrected: lack of attention to public goods (support of basic research, public investment in technology infrastructure), governance based on personal relationships (Guanxi) leading to neglecting of fair competition, etc.

Innovation orientations

Similarly at the micro level, it is crucial to take into consideration, traditional values and practices for improving the management of enterprises. Culture specificities do not disappear with globalization, and it is by tapping into their potential, and possibly correcting their weaknesses, that modernization is possible[30]. As pointed out earlier, innovation, results fundamentally from the blending of knowledge and entrepreneurship, and it is the conditions under which this knowledge is brought to the market place which determines the failure or success of the innovation process.

From this point of view there are marked differences throughout the world in terms of innovation performance, even amongst industrialized countries. Western countries are traditionally more science-oriented than their Asian counterparts which tend to be more technology-oriented. On the one hand, the later approach presents definitive advantages, notably in that it facilitates adaptive engineering in a pragmatic manner and explains notably their success in mass productions; on the other hand, it does not stimulate long term science investments. Related to this, there is the attitude that copying is not only authorized, but even more, it is recommended. It goes without saying that this creates serious divergences between regimes of patent protection at the international level, and related issues such as counterfeiting.

However, a scientific orientation is not necessarily an advantage, particularly when it makes science a religion in the form of scientism. This is notably a syndrome of which Russia, influenced by the Soviet heritage (but not only by it), has been suffering. This approach, based on the assumption that innovation is a natural extension of research (basic research), neglects, however, fundamental parts of the innovation value chain such as commercialization issues, for example, which are critical to the successful exploitation of research capabilities. Such an approach leads also to an exclusive focus on high tech productions, a disastrous restriction as we discussed it. At the same time, the Russian population, including the scientific community, has developed fantastic technical skills for repairing, sometimes fully building, many types of products of the daily life to compensate the deficiency of related services (plumbers, mechanics, etc.). However this asset is not much exploited.

8. Evaluation of innovation systems and policies

The preceding sections have outlined the basic concepts around which innovation policies and programs can be elaborated. There is a need to evaluate these policies when they are at work, as well as to appraise innovation capabilities, systems and climates in order to define or fine tune government interventions. This requires the gathering of information of both a qualitative and quantitative nature covering a large variety of topics.

[30] See on this point Ph. d'Iribarne, Le Tiers monde qui réussit, Paris 2003 which includes case studies from Mexico, Cameroon, Argentina and Morocco. The book is being translated in English.

Contexts, efforts and performances

The first thing is to assess the overall context. Of course, usual data on the business environment, the education level, the information infrastructure is important and generally available. More detailed information on innovation systems, as collected within the WBI KAM, is also interesting, although there is a lack of such data for a number of less developed countries.

Box 8. Variables for innovation systems(WBI Knowledge Assessment Methodology – 120 countries included in the Data Base).

Gross Foreign Direct Investment as % of GDP
Royalty and license fees payments / mil. pop.
Royalty and license fees receipts / mil. pop.
Researchers in R&D
Total expenditure for R&D as % of GNP
University-company research collaboration
Scientific and technical journal articles
Admin. Burden for Start-Ups
Patent applications granted by the USPTO
High-Tech exports as % of manuf. Exports
Royalty and license fees payments ($ mil)
Royalty and license fees receipts ($ mil)
Science & engineering enrolment ratio (% of tertiary level students)
Researchers in R&D / mil. pop.
Manuf. Trade as % of GDP
Entrepreneurship among Managers
Scientific and technical journal articles / mil. Pop
Availability of Venture capital
Patent applications granted by the USPTO / mil pop.
Private sector spending on R&D

With regard to innovation performances, it is important to identify appropriate proxy variables. For medium income countries, data relating to the evolution of the patenting activity (including deposits in national regimes), levels of business RD, the capacity of retention of educated workforces, and the rates of the creation and growth of new firms, are relevant.

For low income countries, some of those data are losing their relevance. In particular, the lower the development of a country, the less interesting and relevant is the data on research and development. It would be more interesting today to capture data on know-how and, notably, on local indigenous knowledge in the developing countries; however, this would require new types of data surveys. The creation and development of firms is also an issue difficult to track, particularly given that a large share of newly created enterprises operate in the informal sector.

The introduction of innovation surveys, similar to those conducted in developed countries[31], can also be useful in developing countries, although they would need to be adapted to the specific challenges and needs of the countries concerned.

Technology audits examining the quality and potential value of technological assets and competencies of a given country can usefully be implemented. They have to be focused on specific sectors and compare systematically available technological items to international competition, appraise the strengths and weaknesses of the supporting enterprise structure, evaluate the research and educational infrastructure, etc. Such work should be conducted by international groups with an in depth knowledge of the concerned sectors. There is so far little experience in these types of audits, and it deserves being shared and expanded[32].

Another type of investigation useful for assessing innovation climates, defining policy actions and stimulating change is the auditing of obstacles to innovation as discussed earlier (section 5). This should be designed in ad hoc manner, performed by respected bodies (commissions linked to administrative and judiciary authorities) and conceived as a process by which there is a clear follow-on, and not as a one shot event.

Organizations, programs and strategies

With regard to the research and technology infrastructure, it is important to assess:

- technological services such as metrology, testing, quality control institutes: the level of activities of technology infrastructure has to be evaluated with respect to demand and the required sophistication
- research structures: data is needed to assess their budgetary structures and judge their openness. The same applies to university and academic institutions to view how they are positioned in the international science (bibliometrics), or how they relate to the local communities (services, RD contracts, etc.)
- extension services operating in agriculture or manufacturing
- techno-parks which have to be evaluated from the viewpoint of enterprise numbers, employment, growth rate, etc.

For all the above, what matters is to evaluate against what is realistic to expect in function of the level of development. This is why it is important to constitute sets of data which allow relevant benchmarking and comparisons.

It is also important to bear in mind that for innovation programs, tangible results in terms of turnover, export, or jobs created do not appear overnight. Generally five to ten years are necessary for tangible economic results. Innovation programs have therefore to be assessed through intermediary variables such as increase in research and innovation expenses, intensification of linkages between university and industry in various forms, and other variables attesting of a change of behavior favorable to innovation.

[31] As designed by the European Union (Innovation trend charts) and the OECD.

[32] Most of this expertise lies in international consulting firms and remains in the form of "proprietary technology".

In addition, it is of crucial importance to assess in a more qualitative ways, the behaviors of key organizations – notably of those agencies and ministries in charge of promoting innovation. Here we are interested in scenarios of more or less repetitive nature, as well as in understanding those forces which push or impede changes and the nature of changes and policy reforms which are at stake.

Finally, we are interested in strategies and tactics followed by governments. What are their key choices, how they integrate innovation policies within their overall development policies, and again what repetitive scenarios do appear. All of these data are useful for a better understanding of the political economy of change, as well of culturally driven factors and trying to improve government actions.

Evaluation mechanisms

Few governments, even in the developed countries, have established systematic evaluation mechanisms for their innovation policies and instruments. Often, these evaluation exercises take place at the occasion of the establishment of a national commission entrusted to propose a strategic plan or a broad reform. Piecemeal information is then captured and interpreted, without the required rigor and objectivity. At least for facilitating the work of these "one shot commissions" it would be important that bodies in charge of innovation policies at various level gather systematically and regularly data on the implementation, impact and outcome of programs.

Another type of intervention which can be significant are those conducted by international organizations. The practice has been extensively developed by the OECD with its reviews in the fields of science, technology and innovation for OECD countries and countries in transition of Eastern Europe and Russia. These reviews, conducted with the help of international examiners[33], did not necessarily lead to major reforms, but were useful in that they initiated informed policy debates among key policy making actors under the eyes of the international community. In recent years, other international organizations, such as UNCTAD and UNESCO, have begun to use and adapt the OECD methodology to implement similar types of policy reviews in a number of developing countries.

A key to success in any form of evaluation is the development of a real ownership by concerned government bodies and communities. This is why it is important to establish appropriate mechanisms favoring their involvement, e. g. in the drafting of related reports etc. It is also crucial to create dynamics of self evaluation in key institutions and communities. Films and documentaries of an analytical, rather than a promotional nature can play a big role as means of awareness raising and confidence building. They can operate at a town level, an industry level, etc[34].

[33] OECD reviews use to include firstly a background report of a documentary nature prepared by the OECD staff with the help of national authorities, and secondly an examiner report much shorter and focused on key policy issues and recommendations. More than 50 reviews have been conducted during a period of some 30 years from the early 60s to the mid 90s, in which the demand has fallen.

[34] The WB K4D program has had convincing experiences in Vietnam and Morocco in promoting the development and diffusion of innovation related films.

9. Conclusion: main messages

A few key ideas can be retained from this brief note:

- Conceive innovation in a broad manner, namely as something new to a given context; the notion then becomes fully relevant to developing countries, even the poorest ones, and applies to all walks of life, from the most basic welfare improvements to the building of vibrant competitive industries.
- Adapt innovation ambitions and strategies to countries' technological and institutional capabilities by building on their strengths and specificities (including traditional forms of knowledge and governance) and, where possible, by correcting identified weaknesses.
- Provide support in the form of integrated packages; this applies to all levels: at the micro level for enterprise upgrading, at the meso level for the development of specific regions or industries, at the macro level in the building of a broad climate conducive to innovation which requires a good business environment, an educated population and efficient infrastructure.
- Establish efficient institutions and organizations, operating with sufficient autonomy and in a flexible manner for delivering needed support to innovators (legal, financial, technical, etc).
- Work on specific promising regions and sectors for stimulating dynamics of change and reforms through success stories.
- Act at the global level for increasing innovation opportunities for developing countries in remedying problematic aspects of current patent regimes, facilitating international research cooperation and compensating brain drain processes. Relevant actions may concern both the developing world and the developed one.

ANNEX

Needed initiatives at the World Bank

Improve WB projects related to innovation

The World Bank has been supporting for many years the promotion of innovation in developing countries.

Bank-financed innovation projects are quite heterogeneous, reflecting both country differences and the interests and preferences of Bank and country staff promoting the projects, with the nature of projects supported ranging from more traditional science and technology projects, to broader, more innovation and knowledge economy-oriented programs. The projects can, however, be divided into five main groups[35]:

a. *Science, technology and/or engineering education/training projects*, which finance education and research at academic institutions, and (occasionally) overseas scholarships; except for Algeria, these have all been in East Asia (Indonesia, Korea, Philippines, Thailand);
b. *Science research projects* that finance mainly peer-reviewed research and sometimes pre-selected research centers; these have all been in Latin America (Brazil, Chile, Venezuela);
c. *Technology projects*, which select from a number of different types of components, primarily (i) matching grants for consultancy to the private sector, (ii) MSTQ, (iii) term lending, and (iv) restructuring of public technology laboratories; these projects occur in all Regions, and often have a focus on export competitiveness (and include non-technology components as well, such as export promotion, customs reform etc.);
d. *Combined science research, technology and education projects*, which have components from (b), (c) and sometimes (a) above; to date, these have been only in Mexico and Brazil;
e. *Broader, knowledge economy projects*, such as that currently being identified in the framework of the $100m knowledge economy investment loan for Turkey, which focus on building innovation capacity in a wider context, and which focus not only on technological aspects, but also on softer issues such as promoting entrepreneurship, the formation of clusters etc.

An internal review of the results of a selected number of science and technology projects supported by the World Bank, showed an overall high level of satisfaction with their results. Out of 19 projects reviewed, only 2 projects were rated "unsatisfactory" as opposed to "satisfactory" or "highly satisfactory", and that one the whole, S&T projects have been more successful than typical Bank projects[36]. In general, it was found that:

[35] World Bank 2003 (Ettinger) : "What makes a good science and technology project" , commissioned consultant report.
[36] ibid

- As with all sectors, S&T projects do better when macroeconomic conditions are suitable, highlighting the importance of improving the business environment and infrastructure. The failures in Jamaica and Algeria are evidence for this, as are highly successful results in Korea, China and Mauritius. This is obviously much more important for technology than for pure science components.

- But while economic stability and growth are essential conditions for the success of technology projects, especially credit lines, S&T projects in general prosper when they are part of a broader liberalization program that forces companies to compete and opens up export markets. Especially for technology projects, improved export prospects was often cited as the greatest inducement for firms to undertake technological improvements (Mexico, Turkey, Tunisian, India, China). This underlines the need to tie innovation support measures into the broader economic development strategy.

- The nature of the appropriate S&T project depends largely on the country's stage of development. In a few of the larger and/or more advanced countries, such as Mexico and Brazil, there is scope for considerable independent scientific research. In many other countries, the need is much more for adapting research done elsewhere.

A number of weak points were, however, highlighted in a number of projects and are important to consider in the context of the future design of Bank actions to stimulate innovation in developing countries:

- Monitoring and evaluation of projects remains to be improved: there appears to be a clear need for formal feedback mechanisms to be built into the design of projects, as well as evaluations by an external and independent body of projects and a before-and-after analysis of countries having received loans for S&T projects.
- The public sector is most developing countries is not very experienced in dealing with issues of S&T, the result being that there has been a long learning curve in this regard, and delays in implementation.
- Problems in the financial and procurement control systems, as well as the lack of experience of many of the implementing agencies with Bank requirements have also caused delays in S&T projects.
- Lastly, the promotion of linkages among the different constituencies involved (domestic and international researchers, SMEs, manufacturers and suppliers, industry) remains rather weak.

Improve the innovation policy making environment

One of the first thing to do in this perspective is to better connect innovation policy with, and integrate innovation policy into, major exercises undertaken by the Bank for defining its action in client countries.

Relate innovation activities to broader work: AAA, CAS and PRSP

Innovation policies touch many aspects of the governmental responsibilities. They also cut across usual departmental frontiers and challenge "silos" in which specialized in depth knowledge is accumulated, but not interconnected. It is therefore important to build appropriate approaches to activities with a governmental wide impact, such as the Country Assistance Strategies, the Development Policy Reviews and large AAA (such as the Knowledge Economy Assessment). This first of all implies the training of a critical mass of specialists in the Bank who would be able to articulate innovation policy concepts and capture their impact in specific country contexts. This is necessary both for gathering appropriate information usually dispersed among different departments as said before; it is also important for ensuring an efficient dialogue with the various agencies and ministries in client countries.

Similarly, it is essential to introduce innovation policy in the PRSP processes since, at the end of the day, innovation should primarily benefit society at large. For this, a pragmatic approach is necessary, with local policy debates focused on well identified needs or achievements, such as the introduction of new technologies, enterprise creation or urban renovation projects.

Develop statistics and new measuring methods

As indicated, it is necessary to develop the statistical apparatus for appraising innovation climates, systems and policies beyond what is currently available. The question today is to have figures and numbers more adapted to the needs and realities of developing countries. In fact, this would require the introduction of new types of surveys to capture the knowledge and entrepreneurial assets of developing countries. It would also be necessary to established sets of comparative data which would facilitate relevant benchmarking by which programs and policies can be judged against efforts made in countries of similar development level.

It is also crucial to organize and nurture a showcase of examples of innovations, which, presented according to a standardized format, could be used for analytical or awareness-raising purposes.

Finally, it is necessary to undertake, at least on a pilot basis, new types of surveys and audits mentioned above: innovation surveys, technology audits and obstacle audits. In drawing upon the experiences already accumulated in other international organizations, it should be possible to advance in these matters of crucial importance for an efficient design and evaluation of policies and Bank assistance programs.

Promote exchanges of experiences

The Bank is ideally placed to organize worldwide exchanges of experience. Of course, this can be done through traditional study tours which, as clearly shown by numerous examples, are crucial to open minds. But this can take place through face to face or VC-based policy dialogues or training courses. Such an exchange of experiences should also take place among policy makers worldwide. In this perspective, the WBI K4D program is planning a Global Innovation Policy Dialogue

involving a number of international organizations, experts working in the different regions, and selected policy making of clients countries. This policy dialogue using video conference facilities is planned to be developed throughout the FY 05 on the basis of one session per month.

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