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Chapter 5
Challenges and Opportunities for Universities in Small Latin American Countries[1]

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1. Introduction

All over the world universities experience an increasing pressure to extend their traditional tasks of providing society with research and qualified graduates with an obligation to enhance interaction with external actors, especially private firms. However, the willingness to tie universities and systems of innovation more closely together should not reduce the attention paid to the traditional tasks. Empirical research shows that the main role that universities play in innovation from the point of view of business firms, as shown by innovation surveys, is to provide firms with knowledgeable and creative people. The increasing interaction between universities and other actors in the innovation system (firms, technological service institutes,

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hospitals, farms, consultors, public agencies, other educational institutes, etc.) involves a variety of forms such as joint labs, spin-off, licensing, research contracts, mobility of researchers, co-publications, conferences, exhibitions, and specialized media, informal contracts with professional network and flow of graduates. Most countries have implemented multifaceted strategies to stimulate such collaboration between universities and other actors in the innovation system. Both the routes taken and the speed with which these transformations of universities take place vary from country to country and even between universities within countries. However, it is not an easy task to design and implement fruitful collaboration between actors with different objectives, cultures, resources, power structures, and knowledge bases. The task, in fact, is "to bridge knowledge-systems rather than simply building links between scientific institutions and industry" (Turpin and Brito 2003: 3); not surprisingly, these efforts have shown mixed results. These mixed results recognize different origins, besides the intrinsic difficulty of the task. One of them is especially worth mentioning: the misleading assumptions upon which policy designs are built. In countries of the South, one of the most common misleading assumptions is related to the eagerness of firms both to innovate and to interact with knowledge institutions to improve their innovative capabilities. Consequently, ideological as well as concrete pressure is put on the universities, conceptualized as selfish and self-centered, and the knowledge weakness of the entrepreneurial side is not recognized. This is not only a problem of underdevelopment, being also recognized in transition economies. Discussing the level of university-industry-government relations in Hungary, Inzelt states that "the continuing low innovativeness of Hungarian business companies is the main factor hampering collaborations (with universities)" (Inzelt 2004: 993).

Moreover, there are immense variations among technological fields, sectors, and countries in the capabilities and opportunities for universities to fill out their new and growing role in the learning economy. However, there seems to be some general challenges that most, if not all, universities have to face and respond to. In this chapter we focus especially on two interrelated groups of challenges and opportunities[2]:

1. *Changing dynamics of knowledge production involving:*
   - "The new mode of knowledge production"
   - Increased commodification/privatization of knowledge
   - Increased internationalization of knowledge production and knowledge diffusion
2. *Ongoing transition of contemporary universities implying:*
   - Extensive increase in the number of university students
   - Changing curricula and increased focus on lifelong learning
   - Increased dependency on external funding
   - Increased focus on external relations
   - Changing governance structure

The new roles of universities in the learning economy seem easier to adopt if these institutions are immersed in a dynamic and innovative productive fabric: this suggests that for universities in the North these new roles can be more smoothly integrated with previous ones than in the South. However, empirical evidence shows that even if this is so, transformation in general terms faces difficulties and

[2] The list is, of course, not exhaustive.

obstacles everywhere, after all, universities are among the oldest and most universal institutions of the modern world, showing thus some common reactions to current trends to change them.

The aim of this chapter is to pinpoint some of the main challenges and opportunities for learning and innovation capability building in small "neo-peripheral countries." Section 2 provides a short presentation of the specific historical role that universities have played in Latin America. Section 3 discusses implications of the changing dynamics of knowledge production, section 4 takes a closer look at the challenges and opportunities related to the ongoing transformation within the contemporary universities in small countries, and section 5 concludes by pointing out the need for "gardening policies".

2. A Latin American Academic Revolution

The nature of universities has been evolving from medieval times, when religious orthodoxy was the prevailing norm in the "university of faith" (Muller 1998). Teaching was then its only defining role—a state that lasted for many centuries. A fundamental structural change occurred when the "university of faith transformed itself in the university of reason" (Muller 1998: 215). The change came to be called the Academic Revolution. It is usually symbolized by the founding of the University of Berlin by Alexander von Humboldt in 1809-1810. His main idea was that research is as important and legitimate a role for the university as teaching, and that both would benefit if jointly performed.

"Academic revolutions" can be characterized by a drastic redistribution of power inside the academies that implies a profound organizational change, and by the adoption of a new defining mission by the universities in

the context of great cultural and social changes. A similar situation is to be found in Latin America in the first decades of the twentieth century, mainly as a result of the University Reform Movement (*Movimiento de la Reforma Universitaria*). It emerged as a revolution "from below" and "from inside" against the *ancien regime* of a very old type of university. Its turning point was the 1918 student rebellion against traditional teaching and traditional authorities in the old University of Cordoba, Argentina. Their Manifesto became the "Marseillaise" of the URM, a movement that spread quickly. In every country of Latin America, including Brazil, students formed organizations, challenged the academic *status quo*, and obtained increasing support for their projects concerning the reform of the university (Arocena and Sutz 2005).

One main trait of the Latin American University Reform Movement was the fight for a new governance system, which would ensure that academic and governance autonomy would be granted to the university and that students could become part of the government of the institution. The movement also proposes that universities should adopt a third mission explicitly in addition to the two "classical" missions of teaching and research. It was called extension, that is, the collaboration with the least favored sectors of the population through cultural diffusion and technical assistance. The close connection among those three roles or missions was considered essential for providing a comprehensive education.

This academic revolution shaped the story of Latin American higher education throughout the twentieth century profoundly influencing the self-perception universities have of their relations with society. The concept of the third mission has been changing though, particularly in the last twenty years with the push towards more direct relationships with business firms and the economies of countries in

general. Tensions arise between the tradition of social engagement and the emerging forces that drive universities to a broader understanding of what social engagement means. One problem remains: while the social conditions in Latin America have not improved much, maintaining thus the validity of the traditional view, the new interests to forge stronger links with business firms come rather from universities and governments than from firms themselves. The current situation, as well as a comparison with some highly industrialized Nordic countries, can be observed in the following table.

Table 5.1: Education, R&D, and Patent Indicators

	Human Development Index HDI rank 2005	R&D expenditures % of GDP 2002-2005[a]	Gross enrolment ratio[b] in Tertiary education 2005	Total number of researchers per million people 1990-2005[a]	Patents granted to residents per million people 2002-2005[a]	Internet users per 1000 habitants 2005
Norway	2	1.7	80	4587	103	735
Sweden	6	3.7	82	5416	166	764
Finland	11	3.5	92	7832	214	534
Denmark	14	2.6	80	5016	19	527
Uruguay	46	0.3	41	366	1	193
Costa Rica	48	0.4	25	...	...	254
El Salvador	103	0.1	19	47	...	93
Nicaragua	110	0.0	18	73	1	27

[a] Data refer to most recent year available during the period specified.
[b] Gross Enrollment Ratio (GER). Number of pupils enrolled in a given level of education, regardless of age, expressed as a percentage of the population in the theoretical age group for the same level of education. For the tertiary level, the population used is the five-year span following the average age of completion of secondary school.
Sources: UNESCO, 2007; UNDP/HDR, 2007.

The basic socio-economic statistics in Table 5.1 indicat a learning capability gap between the Nordic welfare states and the Latin American group of countries_ although there are also differences within the two groups of countries. Despite this divide, the universities face many of the same challenges but their opportunities to meet these challenges are clearly unequal.

3. Changing Dynamics of Knowledge Production

3.1 The "New Modes of Knowledge Production"

The so-called "new modes of knowledge production" or "Mode-2 knowledge production" was put forward by Gibbons and his colleagues more than 10 years ago (Gibbons et al. 1994, Nowotny et al. 2001) to describe a shift towards closer interaction between science and society. Science had become contextualized. According to Gibbons et al., the new mode of knowledge production implies: a) an increasing transdisciplinarity (not only interdisciplinarity), b) expansion of the actors involved to include not only different knowledge producers, but also a very heterogeneous group of "users", and c) an enclosure of "research components" in a wider range of social, economic, cultural, and media related activities (Nowotny et al. 2001). These trends have been especially visible within fairly new technological areas such as biotech, ICT—both hardware and software, medical, and bio-chemistry, in which collaboration between universities and the industry has become crucial for knowledge production, but the mutual dependency between universities and the industry, and the fuzzy demarcation between basic and applied research, are also found in other science and engineering areas, such as material science, industrial design, construction, and agriculture. Although the characteristics of the "new mode of knowledge

production" to a certain degree always have been present within most social sciences and humanities, we may argue that they are more clearly reflected today.

The new demand for transdisciplinarity may impose a special pressure on small countries' universities. On the one hand, it is necessary for small countries to invest in a broad spectrum of knowledge areas or technological fields just to be able to maintain an absorptive capacity in relation to new knowledge produced externally. On the other hand, due to lack of resources, it is necessary to specialize in a few selected areas in order to be able to maintain membership in national and international research communities. The relatively limited resources in money, labs, and people (compared to large, rich countries) may push the small countries' national research priorities in more traditional and guaranteed directions at the expense of the more experimental and tentative research areas and approaches, leaving only little room for variety; thus a "conservative Matthew effect" is likely to appear. The increased focus on pervasive evaluation and accountability may, if not used thoroughly, clip the wings of creativity and variety, which from a long-term perspective are crucial. This dilemma is partly reflected in the current discussion of "centers of excellence" going on both at the national and the European level and is, of course, even more present in small countries in the South.

Seen from a system of innovation perspective, focusing on a few high-tech areas with contemporary fashion is probably a less fruitful strategy for small "less favoured" countries with few R&D resources. Of course, it is necessary to be able to implement the newest technologies that the domestic and foreign manufacturing sector demand in order to be competitive, but it is important to include a broader perspective on the role of demand-driven innovation than just related to private industries. A research policy

should also aim at creating and maintaining a certain degree of variety and "gardening" linkages to existing strongholds in the countries' knowledge base within agriculture, health care, energy systems, water supply, and other fundamental building blocks supporting a long-term sustainable development. This also has to do with the fact that further development of areas such as education, health, and exploitation of natural resources require local solutions and adaptation. In the Latin American case, molecular biology, genetics, and immunology are important examples of existing strongholds in the local knowledge base (ECLAC 2004).

3.2 Increased Commodification of Knowledge

The enhanced possibilities for universities and research institutions in the North to take out patents have revitalized the classical dilemma between, on the one hand, broad and easy access to public financed research and, on the other, private appropriation as one of the basic incentives to innovate. But it may be more important that the increasing tendency to treat information and knowledge as commodities introduces a basic contradiction in the learning economy. On the one hand, firms and now also universities try to capture knowledge economies through intellectual property rights. On the other hand, knowledge is socially produced in groups and networks, which may be destroyed or damaged when knowledge is treated as a commodity. Furthermore, the commodification of knowledge is accompanied by increasing costs of developing and maintaining an adequate knowledge infrastructure, including various transaction costs following the commodification process and protection of property rights.

Most European countries have recently implemented equivalents to the American Bayh-Dole Act hoping for future revenues from patents taken out by universities.

However, in the American case, this has hitherto mainly been a success for a limited number of US universities (such as Stanford and MIT) that have been able to generate a few "cash cows." For the majority of American universities it has not had the expected income generation effect (Mowery et al. 2001, Mowery and Ziedonis 2002). In the Danish case, for instance, a new patent act was implemented in 2000 (L347) aiming to increase the commercialization of public research. The new act has given the public research institutions the possibility of taking over the rights to an invention made by a public researcher if they pay a "fair" compensation. Furthermore, L347 gave the public research institutions an obligation to work actively for putting the research to commercial use. It is, of course, too early to evaluate the long-term effects, but a recent evaluation (Danish Ministry of Science, Technology and Innovation 2004) confirms that setting up the necessary institutional infrastructure related to IPR is both a costly, risky, and lengthy learning process. After four years the IPR area is still a money losing concern for all 21 involved Danish public research institutions. Only a few of these institutions expect to break even within the coming years, while others doubt that the area will ever become self-financing.[3]

It is an important question whether the changing IPR regime in public research will influence the internal and external collaboration patterns in the long run. Will university management allocate more resources to areas with higher probability for being granted patents? Will the demand for secrecy influence interaction among colleagues, students, and external partners?

[3] The increased focus on commercialization of public research may eventually have other positive effects; for instance, it may stimulate the interest for private external co-funding.

If the commodification of knowledge is a challenge for small universities in the North, it certainly is even more so for the universities in the South. Seen from the perspective of developing countries, the knowledge commodification process seems mainly to add to the barriers to putting knowledge to the service of development processes.[4] Countries in the South in general lack financing, specialized lawyers, and other necessary skills and power to support IPR negotiations, and most of them also lack the whole institutional set-up in the form of regulations, patent office system, business lawyers, etc., to implement and exploit the IPR agreements. A report from ECLAC (2004) summarizes the Latin American experience so far in the following way:

> "Evidence has recently started to emerge about the effects of the homogenization of intellectual property systems on the developing economies. Among the negative aspects are the increased prices of patented products and technologies and the curbing or obstruction of national learning processes by blocking the practices of imitation and reverse engineering (Commission on Intellectual Property Rights, CIPR, 2002). Moreover, as already noted, in Latin America and the Caribbean the number of patents applied for by non-residents grows much faster than the applications by residents. This tendency is associated with the use of patents by foreign companies to promote the marketing and importation of their products, which often works to the detriment of the development of local technological capacity.

[4] As pointed out by Lall, there are huge variations among developing countries in their capability to make the most of the new IPR regimes and TRIPS agreements (Lall 2003).

> Furthermore, the management of intellectual property systems in the countries of the region is poorly coordinated with their innovation promotion and production development policies. This lack of a strategic approach gives rise to under-utilization of the potential flexibility and opportunities offered by the current legislation and weakness of the institutional structures responsible for applying the prevailing rules" (ECLAC 2004: 219)

There is, of course, no simple realistic solution to these asymmetric power relations, but their existence certainly reinforces the necessity of public universities in the North and the South to gate a long tradition of "open source" approaches to knowledge production and networking.

3.3 Increased Internationalization of Knowledge Production and Knowledge Diffusion

The growing internationalization of knowledge production and knowledge diffusion affects universities and firms in several ways. Mergers and restructuring by MNCs may from one day to another relocate R&D activities from one country to another. Outsourcing of high-skilled labor (as, for instance, the well-known outsourcing of programming to India) is another indicator of this internationalization process. Increased international research collaboration, international staff and student mobility, and a growing focus on international publishing are some of the more direct ways universities and research institutions experience this. Universities and research institutions have to balance between an increasing pressure (and maybe temptation) towards international engagements, on the one hand, and, on the other, obligations to collaborate with domestic firms

and other actors in the national innovation system. For some universities, "internationalizing" towards developing countries is a way of raising funds, while for many universities in those countries, mainly private ones, establishing partnerships with Northern universities is a legitimization strategy. This dilemma is more present in countries where the domestic production structure is dominated by SMEs within low-tech industries that do not invest much in R&D and have very little or no tradition of collaborating with universities. In these cases the public science base will be pushed to link increasingly with the demands of foreign firms, either through their locally established R&D and related activities, or through their demands for high technology components, sub-systems, and services (Patel and Pavitt 1999).

It is a fact that many developing countries are characterized by low reliance on local knowledge and high reliance on foreign embodied science and technology increasingly controlled by multinational corporations. In Latin America, for example, Katz (1999) has documented a trend to replace locally produced equipment with imported goods. Furthermore, R&D activities are frequently terminated when public firms are privatized or moved abroad whenever domestic firms are bought by multinational ones.

As shown by Patel and Pavitt (1999), the lion's share of foreign innovative activities is located within the "Triad" countries, showing that the process of internationalization of technological activities can at best be described as "triadization" rather than globalization. Hence co-operative research among developed countries is quite strong; moreover, this type of cooperation has been an explicit policy target, for instance, in the European Community. The latter holds true both for academic as well as entrepreneurial research co-operation. In the South, however, the situation

is reversed, particularly in relation to enterprises. Enterprises in Southern countries hardly show research co-operation; it is almost non-existent between firms in the North and in the South. When enterprises from more developed countries invest in Latin America, it has mainly to do with an interest in getting access to internal markets, like in the case of Brazil, or to get access to regional markets, as the Mercosur, rather than achieving knowledge collaboration.

Another related, but perhaps even more serious issue is the "brain-drain effect", occurring when there is no possibility for people with a higher education to get a relevant job in their home country. It is, however, interesting to notice that for some economies (e.g., China, Hong Kong, Taiwan) this trend has reversed, and researchers are now returning to their home country, resulting in net inflow of people with research experience forming a solid base for local capability building. For the moment, this is far from the case in most Latin American countries, where brain-drain is accelerated by the combined effect of expulsion trends in the home country and attraction efforts from developed countries requiring highly trained people. Presently, three quarters of all foreign postgraduate students in the United States, which is the main destination for Latin American and Caribbean students at an academic level, remain in the country after completing their studies. Thirty years ago, it was around half (Lema 2000, ECLAC 2004).

The lack of potential for universities and other research institutes in the "neo-peripheries" to link up with innovative activities in the domestic or foreign private sector makes it even more crucial for these institutions to enter and sustain co-operation with other types of innovative actors, such as universities located in the "centers" and in other "less favored regions", NGOs, domestic health care sector.

4. Ongoing Transformation of Contemporary Universities

Along with the changing dynamics of knowledge production and the accelerating innovation race, we see an ongoing transformation in most contemporary universities. We will especially mention six types of changes that not only influence life within the universities but may also have long-term effects on the collaboration between universities and other actors in the innovation system.

4.1 Extensive Increase in the Number of University Students

The shift from the "elitist university" to the "mass university" has (among other consequences) paved the way for enhancing the knowledge base in the private and the public sector.[5] However, the increasing number of highly educated (young) people has not been accompanied by an equivalent increase in the demand for these people everywhere.

An essential problem in most Latin American countries is the unequal access to education. Furthermore, a relatively high dropout rate for secondary schools clearly affects the intake of the tertiary institutions. In addition, many of the graduates, cannot find a relevant job (here meaning in correspondence with their educational background) in their home country.

[5] The increased intake of university students has (at least in the Danish case) not been followed by equivalent amount of resources allocated to teaching, equipment, and infrastructure. It is clear that continuously budgeting with a built-in productivity increase at some point may contradict a simultaneous demand for quality improvements.

4.2 Changing Curricula and Increased Focus on Lifelong Learning

The new dynamics in knowledge production (transdisciplinarity, commodification, and internationalization) call for changes in both the contents and the structure of the curricula in contemporary universities. We will shortly mention four elements of these changes: (i) "tailor-made" study programs, (ii) problem-based learning, (iii) an increased focus on entrepreneurship, and (iv) lifelong learning activities.

Tailor-Made Study Programs

On the one hand, the task of "modernization" is not an easy one to bring forward in old established organizations with hundreds of years of tradition for autonomy and established scientific disciplines. On the other hand, the exigencies of the moment are not always the most relevant and qualified in a broader, long-term perspective. One dilemma in this context is to what extent universities in less favored regions should tailor selected study programs to current demands from, for instance, large (foreign) companies located in the area. These adjustments may be necessary to attract or keep the (foreign) direct investments in the region. In the best cases this may also generate various forms of spin-offs. Nevertheless, there is always a risk that (foreign) investors may look too narrowly at their own short-term needs without having sufficient knowledge of a broader educational context.[6]

[6] A small illustrative example of this dilemma is when the multinational mobile phone companies with R&D departments located around Aalborg University asked the university to set up a new Master's program in mobile engineering aiming at remedying a current deficiency of communication engineers. Even before the first student finished the program, several of the multinationals had closed down or significantly reduced their R&D departments in Aalborg.

Problem-Based Learning

The transition to a "learning economy" requires an increasing focus on the importance of a "learning to learn" approach and an ability to participate in problem solving activities via interaction with others. Key words in modern firms and organizations are flexibility, dynamics, human resources, co-operation, and individual and organizational learning. This way of thinking has always been taken for granted in relation to research and development activities, but often it is given less consideration when the researcher leaves the lab or office and steps into the class-room as a lecturer.

Problem-Based Learning (PBL) is an ambiguous term and is certainly not a magic formula overcoming all barriers of, for instance, university-industry cooperation. It has, however, important "generic advantages" when it comes to preparing students to cooperate and interact with firms and other actors, especially when the Problem-Based Learning model is combined with Project-Organized Group Work (see box 5.1 for a brief description of the main ideas).

When the PBL universities were founded—most of them in the 1970s—the old academic establishment was more than skeptical of these new learning principles. Of course, there were "teething troubles" to start with, but over time more and more elements of PBL models have gradually been implemented in the curricula in many of these institutions as well, albeit more in the Northern part of Europe than elsewhere. Important demands and pressure for such changes have come from especially two sides: the industry and the enrolled students.

Increased Focus on Entrepreneurship

An emerging trend in university curriculum in the North is an escalating focus on "entrepreneurship" as a "new discipline" especially targeting small firms. It includes graduates *in* small firms, graduates *for* small firms, and

Box 5.1: Problem-Based Learning

In short, Problem-Based Learning and Project-Organized Group Work mean that learning is organized around problems in the sense that the students define and analyze "real life" or theoretical problems within a defined interdisciplinary or subject frame. The students work together in groups of 3-6 students and submit a project report of their joint efforts. Subsequently, the students in a project group go to a joint oral examination with point of departure in the project report, but each student is given an individual mark. A typical semester contains both project work and course work.

In PBL learning models key issues are (Kolmos et al. 2004):

- Learning is organized around problems
- Experience-based learning
- Inter-disciplinary learning
- Exemplary practice
- Social learning (or team-based learning)
- Student-centered, self-directed learning (or participatory learning)

Universities such as Maastricht University in The Netherlands, Linköping University in Sweden, McMaster University in Canada, Roskilde University, and Aalborg University in Denmark were all founded in the 1970s and have been based on PBL thinking from the very start.

graduates *as* a small firm. The instruments are manifold, including for instance incubators, mentors, creativity labs, and Innovation Cups sponsored by private companies. Such initiatives have not least had a special policy attention in peripheral regions as a means of upgrading the technological capabilities of existing local firms and to stimulate new firms in these areas.

Lifelong Learning

Finally, universities in the North are increasingly involved in lifelong learning activities. It involves a broad palette of activities from single yearly arrangements for former students at their "home university" to master programs for schoolteachers, nurses, and other professions including courses for top CEOs. As more and more universities join, the market for such activities becomes tougher and tougher, and mechanisms from the private sector in the form of mergers and exclusive agreements are entering the scene. However, lifelong learning reflects the new role of universities in a learning economy and it underlines the necessity to constantly upgrade the workforce. From a more individual perspective, lifelong learning possibilities are, of course, also to be seen as windows of opportunities.

4.3 Increased Dependency on External Funding

In general, the total research budget in most universities (at least in the North) has expanded in recent years, but the external part is increasing relatively in most cases. The increased dependency on external funding may, on the one hand, stimulate (more or less voluntarily) research collaboration between universities and external partners. On the other hand, the risk exists that such dependency may tend to favor short-term research in a very few selected areas at the expense of long-term basic research in a broader range of disciplines and thus emptying the key source for collaboration in the long run.

The emerging dominance of the competitive rationale for resource allocation to the universities has escalated in the European context since the 1980s, and it may—as stated by Geuna (1999)—have various "unintentional consequences". His analysis suggests "that one of the

possible outcomes of the ongoing changes is the polarization of the university system with, at one extreme, a small group of dynamic research-oriented universities and, at the other extreme, a large group of mainly teaching-oriented institutions" (168). He further argues that such polarization of the university system with a high concentration of research resources in a few institutions is accompanied by an increased dependence on industrial funding of the financially weaker universities, mainly forcing the latter to carry out routine contract research for industrial firms who support only a part of the total costs. In other words, "it represents a form of public subsidy for particular industries for a kind of research that firms can and have to pay for themselves" (170). We may add to this that not only a polarization may occur at the institutional level but also internally between different disciplines, since the possibility of attracting private funding and sponsorship of course differ between, for instance, high-tech areas and more "humble" disciplines within humanities and social science. It is clear that the capabilities to participate in this race are even more unequally distributed between countries in the North and the South.

4.4 Increased Focus on External Relations

The role of innovation as a main key to competitiveness is not new, but the pace seems to be constantly increasing among the participants. In many areas the product life cycle becomes shorter and shorter. It is becoming more and more costly for companies to enter and to maintain a place in the accelerating innovation race. It puts a growing pressure on private and public actors to increase investments in R&D and human resources, lifelong learning schemes, and networking. In most countries, new modes of collaboration between universities and the industry

have been introduced in order to strengthen the participation in the race. Research networks, science parks, joint research ventures, incubator arrangements, and sponsorships are a few examples of such new forms of network-based collaboration involving the various actors in the innovation system.

Seen from a university perspective, they experience an increasing pressure to extend their traditional task of providing society with high quality research and graduates with obligations to enhance interaction with a variety of external actors. The main emphasis has been put on stimulating interaction with the private industry, but an increasing request for interaction has also come from, for instance, regional governments, NGOs, labor market organizations, the health care sector, the primary and secondary educational sector, and the media with the result that the universities are now engaged in this interaction with the society. On the one hand, it is positive to break down the "ivory tower" picture. On the other hand, it is a challenge for most universities to find the right balance walking on all three legs (teaching, research, and external relations) without limping on some of them.

The situation in Latin America is somewhat different than that in Europe when it comes to universities' interaction with the industry and other actors in the innovation system. Since the late 1960s, when Jorge Sábato and Natalio Botana pointed out the crucial role of S&T for the economic development process, the issue of university-industry relations has been present in the Latin American context, but more on the level of discussion than implementation in reality. As in the North there has recently been a growing interest from Latin American policy makers to stimulate the interaction between universities and the industry, and various policy measures have been introduced to promote such interaction. The key problem is not primarily the lack of motivation on the university side, but rather a lack of corresponding innovative capability in the local industry.

From a policy perspective it is important to take into account the peculiar characteristics of each National System of Innovation when implementing policies to promote interaction between universities and the industry or other actors. In the Danish case, for instance, the firms have extensive collaboration with external partners (customers, suppliers, etc.) when they engage in innovative activities, and to a lesser extent collaboration with universities and research institutions. This reflects the specific "Danish mode of innovation" characterized by (i) a majority of SMEs, (ii) a specialization within low-tech products with only a few exceptions, (iii) many SMEs without employees with a higher education or academic training, and (iv) an extended technological service system that in many cases functions as a bridge between firms, universities, and research institutions, or they perform activities that in other countries are carried out by universities or research institutes. One of the important keys to promote cooperation between universities and SMEs in the Danish case is to stimulate SMEs to take on board employees with a higher education. The same may be the case in some of the small "peripheral countries".

4.5 Changing Governance Structure

During the last 10-15 years, universities and research institutions (at least in Europe) have implemented new governance principles with increased emphasis on top-down management, external representation in boards, productivity measurements, and activity-based financing. Although a part of the arguments has been that these changes should improve collaboration with firms and other external partners, it may turn out that the "new" management principles mainly inspired by the private manufacturing sector may conflict with modern research modes and learning organizations (Dasgupta and David 1994).

It may seem as a paradox that at the same time as large research institutes, Knowledge Intensive Business Services, and other knowledge intensive institutions emphasize flexible and non-hierarchical organizations with a high degree of individual responsibility, universities need to replace old traditions of academic autonomy, collective co-ordination, and the professional chair by market orientation, contract steering, external financing, and top-down management. Is it not clear exactly how these 'new' management principles will make it easier for universities to respond to contemporary important challenges as described above.

5. "Gardening Policies"

In this section we briefly discuss "gardening policies" which aim to strengthen a constructive integration of universities in the enhancement of learning and innovation capabilities in small Latin American countries.

This is a main issue for several reasons. We may start by recalling that in Latin America public universities are the main contributors to knowledge generation, while on average the contribution of other public institutions is smaller and that stemming from private universities and firms much smaller. Historically, the relations between Latin American public universities and productive sectors have been quite weak. In the last decades, important efforts have been made to strengthen those ties. Nevertheless, the knowledge demand presented universities both by public organisms and private firms is comparatively small, so we may speak of the loneliness of the university actor in the Latin American innovation systems (Arocena and Sutz 2001, 2005).

In fact, weak interactions among different actors are characteristic of most innovation systems in Latin America,

which are often more virtual than real. This is particularly problematic for small countries; as it is widely recognized in the literature, such countries can partially compensate for many well known disadvantages of small scale production by a positive orientation of the close relations between several different actors that are frequently seen in small nations or regions.

In general, "gardening policies" for fostering innovation systems in the South (Arocena and Sutz 2003a, 2003b) aim to: (i) detect potential sources of interactive learning and innovation; (ii) protect them from the destructive trends that often act in underdeveloped contexts; (iii) promote the most promising experiences; and (iv) carefully prepare the conditions needed for the successful introduction of new institutions and organisms. The analogies with what a good gardener does are quite evident.

In several small Latin American countries, universities have, on the one hand, important research and teaching capabilities, and, on the other hand, close relations with other actors as public organisms, entrepreneurial chambers, NGOs, co-operatives, and even trade unions. In such contexts, "gardening policies" should aim to improve the interactive learning aspects of those relations. A fundamental aspect of such policies is to increase the social demand of high quality knowledge that is addressed to national universities and to internal actors in general. A trend deeply rooted in Latin American history is to buy the needed technology abroad, even when it is locally available. Often the government has the main responsibility of the persistence of such trends. For example, some Uruguayan software firms and the Faculty of Engineering of the Universidad de la República are jointly building a Center for Software Development; the technical capabilities of those firms have been proved by their success in exporting. So international banks working in the country buy their

services, while the public sector does not. Public procurement may be a main tool for promoting endogenous generation of knowledge.

The previously mentioned expansion of knowledge generation in "mode-2" stresses the relevance of problem-centered research agendas. Such agendas are inherently interdisciplinary; moreover, they open the way for cooperation between academic and non-academic actors. Contrary to what is frequently explicitly or implicitly assumed, non-academic actors should not be restricted to private firms but should also include public firms and other organizations, cooperatives, NGOs, Trade Unions, and several other social movements. Collaboration with them is potentially fruitful especially when social needs are included in the research agenda. Such needs are overwhelming in nearly every country of the South. In Uruguay, the number of persons living under the poverty line more than doubled from 1999 to 2003; facing such a crisis, the public University recently made a call for research projects addressing social emergencies.

Difficulties in combining variety and excellence in research, as discussed in section 3.1, are on average relatively complex in a small underdeveloped country. A usual, natural answer to such a problem is to seek international cooperation. That may aggravate a problem that was also noted before, "brain-drain", and it may shift the research agenda widely away from the most pressing needs of the country. In this way, potential resources for learning and innovation are lost or underutilized. The alternative is not to weaken international cooperation but to upgrade it, for example, by including a joint elaboration of research agendas and installation of centers of excellence in underdeveloped regions. Concerning the combination of variety and excellence, much will be learned from the experience of the biological research center to be located

in Montevideo by the French Pasteur Institute in collaboration with several universities of South America.

Intense commodification of knowledge greatly damages small "gardens" that combine teaching with high quality research, especially if the last is not related with the demands of big firms. Many items of research become very expensive—including some that were usually free of charge—while funding diminishes. Public action, both at the national and the international level, faces new challenges. Some alternatives have already been sketched. Moreover, the time has come to consider a specific aid to public research in the South, and to encourage the shifting of the international research agenda, in the South as well as in the North, towards the most pressing needs of the poor world population. The inspiration can come from international agreements on development aid, for instance by devoting one percent of the highly industrialized countries' efforts on R&D towards the previously mentioned aims. That should not mean funding low quality research; on the contrary, coping with underdevelopment problems requires, among several other issues, both giving priority to such problems in the agenda and fostering a highly sophisticated knowledge demand.

When in section 4 we summarized the current transformation of universities, the first two trends recalled were the quick increase in the number of university students and the increased focus on lifelong learning. In fact, those trends suggest that a true revolution is taking place in education in general: access to advanced knowledge throughout one's life, a privilege of minorities up to now, is being opened to a majority of the population in the North. This learning revolution is perhaps the main aspect of the emergence of learning societies, a phenomenon that also takes place in the North but not in the South. The learning revolution threatens to widen the divides between North

and South, as industrialization did in the past. To cope with such a threat, deliberate actions are required; they must be farsighted and very strong, because what is needed is nothing less than the extension of lifelong advanced learning.

Collaborating with such tasks should be the guiding thread of university policies, both internal and external. It requires significant changes in habits and structures, in order to be able to teach people with very different backgrounds, ages, and working experiences. Multiple initiatives will be needed in order to attain adequate levels of innovation. It follows that the governance of universities should resemble neither the ivory tower nor a vertical structure; beyond the dichotomy between keeping the traditional inward-looking academy governance and importing the traditional top-down firm management, the challenge is to combine internal democracy with an outward-looking social orientation.

The Latin American university tradition of autonomous self-government with the relevant participation of students should not be seen as the model for the future, nor should it be discarded. Student participation in university government is a potential school of citizenship. Now an outward social orientation of universities also requires that different external points of view should be represented in the general decision making processes.

As mentioned in the introduction, in the Latin American tradition a third role was assigned to universities; that role is called "extension" and is not restricted to agrarian "extensionism", but refers more generally to the collaboration of universities with usually neglected social groups in the diffusion of culture and the solution of general problems. That tradition suggests the inclusion in the curriculum of university studies of a kind of "civil service" for students to cooperate with external actors in the social use of knowledge.

In a nutshell, the idea is to think of governance structures and regulations not in terms of entrepreneurial

universities (Etzkowitz 1997; Clark 1998) but in terms of *developmental universities*, where, of course, development means not only economic development but human sustainable development. Advanced lifelong learning is not a business only of universities and related institutions; like walking, it needs two feet, combining learning by studying, mainly in the educational system, with learning by working, mainly in innovative and problem-solving activities. Consequently, universities must cooperate with any set of actors that constitute an actual or potential learning space of social value. Detecting, protecting, promoting, and upgrading such spaces are the core tasks of gardening policies.

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