Measuring Innovation in Latin America:
What we did, where we are and what we want to do

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(I) Introduction

Measuring firm level innovation in Latin America is not something new. More than 30 years have already gone since the first studies looking at plant levels patterns of technological accumulation were carried out. The first, and perhaps, more influential programme of research in this area in the region was the collection of studies initiated by Jorge Katz and colleagues in 1975 and that continued until 1982. As pointed out by Bell (2006) "*this programme generated a wealth of empirical material and theoretical insight about the emergence of localised technological creativity in industrialising economies*". In other words, through a series of very deep interviews and case studies Katz and colleagues shifted the attention from simply looking at the determinants and impacts of technology transfer from the North towards the analysis of those factors underlying the creation of local absorptive capacities (and this done well before this concept was popularised).

The amount of learning and empirical evidence collected during these early studies set the frame not only to systematically start collecting information about innovation in Latin America but also for doing it in a way that goes well beyond the Frascati Manual (the state of the art during the 80s). More than ten years had to passed until the first attempts were carried out.

This paper, specially prepared for this conference, aims at describing the evolution and current situation regarding to the implementation of innovation surveys in Latin America. The paper also analyses the possibilities and limitations to be overcome in order to build a set of innovations indicators that are homogeneous and comparable both within the Latin American context and between Latin America and the European Union. The document is structured in two sections. Section (II) presents a short history of Latin American innovation surveys with particular focus on the main efforts to adopt these tools to the Latin American context (with special reference to the Bogotá Manual). Section (III) takes a sample of countries (Argentina, Brazil, Chile and Uruguay) and analyse the main issues regarding to how countries are asking about innovation (by looking at the questionnaires) and to whom they are asking to (the sampling methodologies). This section closes with a comparative exercise between the Chilean and the UK innovation surveys using microdata. Section (IV) presents the conclusions.

(II) Innovation Surveys in Latin America: a short history.

The evolution of innovation surveys in Latin America can be categorised in three waves. The Latin America region was very quick to respond to the publication of the OSLO Manual and the implementation of the 1st CIS. As early as 1995, several Latin American countries produced the first generation of innovation surveys. This first generation led, after a strong debate and analysis of results, to the first attempt to harmonize the surveys: the Bogotá Manual. Although not all the countries adopted the recommendations suggested by the Manual, its main impact was to diffuse the concepts and ideas underlying the OSLO manual across the region. As a consequence, a second round of innovation surveys took place by the end of the 90s and across a large group of Latin American countries. A third wave of innovation surveys on a smaller sample of countries began in 2001. These three waves are described with detail in the following sub-sections.

(II.1) The 1st round of Innovation Surveys in Latin America (1995-1997)

This first round includes those Innovation Surveys conducted in five Latin-American countries between 1995 and 1997.[1] These surveys constituted the first attempt to systematically collect data on innovation processes, since no country had made a similar exercise before, except for an experiment carried out in 1988 in Uruguay.[2]

The Oslo Manual and the first Community Innovation Survey undoubtedly influenced the design of this first round. However, there was no supranational coordination behind it, but it was conducted mostly as a result of domestic, independent initiatives. Thus, while the innovation measurement system had not been yet completed in Europe, several Latin-American countries were venturing into their own experience in surveying. The interest in the Innovation Surveys and the rapid spread of the CIS and the Oslo Manual throughout Latin-America may be the result of a combination of factors, three of which are discussed below.

The context of profound economic changes undergone by Latin-America throughout the 90's has been a decisive factor. Halfway through the decade, the demand for information about aspects overlooked by the traditional statistical systems led to new enquiries and surveys. The liberalization of trade, deregulation of economic activities, privatisation of public utilities and inflow of

[1] We might also include the experience of the State of São Paulo, with a higher GDP than many Latin-American countries, where a Survey on innovation was conducted in 1997 on the firms located within its territory.

[2] The survey was conducted in 1989, taking 1988 as a reference period. The survey was conducted by DINACYT-CONICYT.

significant Direct Foreign Investment all had a deep impact on the prevailing sectors, firms and strategies in the region. The change was particularly visible in countries with a relatively higher degree of industrial development such as Argentina, Brazil, Chile, Colombia and Mexico.[3] Both the authorities and specialists of these countries were eager for data that would confirm or refute the benefits of the reforms implemented.

Secondly, in the mid 90's, several Latin-American countries implemented a new generation of scientific and technological policies based on the concept of National System of Innovation.[4] In this context, the innovation activities carried out by the firms were given a central role within the System, revitalising the role of small- and mid-sized businesses and incremental innovations. The policy on science and technology would no longer be focused on the efforts of a small number of research teams and laboratories within public institutions, universities and large corporations: the aim was to design and manage a complex system comprising several activity levels and types of agents. As a result, new requirements for information emerged. It was necessary to survey aspects connected with the innovation activities carried out by the firms, the interplay between the scientific and productive networks, the access to external information and technology, the obstacles and motivations that govern their behaviour and the goals attained regarding new products and processes.

Thirdly, the evolutionist and neo-Schumpeterian approaches upon which the Oslo Manual is based were easily and quickly assimilated by the structuralist circles, which were so important in Latin-America.[5] This ensured solid analytical skills and a deep understanding of the basic criteria underlying the Innovation Surveys. In other words, the arrival of the Oslo Manual was considered as a way of "closing the loop" and converging with the research agenda of early 80s.

Thus, Innovation Surveys encountered several bases for support that allowed for rapid expansion and application, although with aims that were not always coincidental. For some, the Surveys were to be the tool used to confirm that the economic reforms were driving a massive industrial modernisation. For others, they became a tool for designing and managing Systems of Innovation. Yet

[3] Benavente, Crespi, Katz, Stumpo (1996).

[4] Chudnovsky (1999); Melo (2001).

[5] In the 1960s, Jorge Sábato emphasised the importance of designing the scientific policy with a systematic perspective. This proposal was known as the "Sábato triangle", its vertices being the State, the scientists, and the private sector (Sábato and Botana, 1968). It was this approach, rather than the linear model, which served as a reference for analysing the technological change of the structuralist circles in Latin America. In this regard, the approach of the National System of Innovation was easily assimilated and incorporated as a contribution to a school of thought with a long track record. Molero (Introduction, 1981) describes the development of Latin-American structuralism and its links with the SPRU and other European research centres.

others took an interest because they considered them to be a potentially rich source of information to spot the pillars of Latin-American firms' competitiveness. Therefore, these multiple bases also meant conditioning factors for their design and very diverse institutionalisation processes

Table II.1. The 1st round of Innovation Surveys in Latin America

	ARGENTINA	CHILE	COLOMBIA	MÉXICO	VENEZUELA
Survey Number	I	I	I	I	I
Reference period	1992-1996	1994-1995	1993-1996	1994-1996	1994-1996
Collection period	1997	1995	1997	1997	1997
Agency responsible for survey	INDEC-SECYT	INE-SETPI	COLCIENCIA-DNP	INEGI-CONACYT	OCEI

Source: Based on RICYT-Subred de Indicadores de Innovación

(II.2) The Bogotá Manual: background and contribution.

The results of the first round of Surveys allowed Latin-American specialists to verify that there were substantial differences between the innovation processes developed in the region and those carried out in Europe. Some of the characteristics observed from the survey results of Latin American firms – which concerned analysts – were: informal organisational settings for conducting innovation, fewer R&D projects undertaken, innovation mainly based on the acquisition of technology embodied in capital equipment, the importance of organisational change in innovation processes, fewer resources devoted to innovation activities, and fragmented flows of information within national systems of innovation.[6]

One of the main forums where these consensuses were forged was the *Red Iberoamericana de Ciencia y Tecnología* (Ibero-American Science and Technology Network) (RICYT).[7] Between 1996 and 2000, three RICYT workshops on science

[6] Lopez; A. and Lugones, G.; 1997; Sutz, J.; 2000; Salazar and Holbrook; 2003; Lugones and Peirano; 2004.

[7] The RICYT started operating in 1994 and has had the financial support of the Ibero-American programme CYTED and the Organisation of American Sates (OAS) and other multinational organisations. The RICYT was created with an aim to collecting Science and Technology

and technology indicators took place, showcasing various contributions and analyses of innovation processes in Latin-America.[8] Based on these contributions and with the financial aid of the OAS, between June 1999 and August 2000 a work team comprised of specialists from the RICYT Coordination, COLCIENCIAS and several science and technology institutions drafted the Bogotá Manual[9].

The main purpose of the Bogotá Manual was to complement the Oslo Manual, laying down some additional guidelines to ensure that innovation processes in Latin-America are properly recorded. Particularly, the aim was to shift the focus of analysis away from technological innovation in a narrow sense, i.e., Technological Product and Process (TPP) Innovation, towards the concept of "technological effort" or "innovating activity".

On a conceptual level, this broader approach required elaborating upon such concepts as "absorption capabilities" and "organisational innovation". The Manual enshrined the principle that technological opportunities depend on each firm's "technological capabilities". Therefore, the dynamics of technological change involves a very heterogeneous impact and a wide diversity of inputs that cannot be organised around the determining factors traditionally accepted in analysing developed economies, such as sector or size.

As regards surveys, this shift in focus is reflected in the recommendation of adopting a broad definition of "innovation" that covers only those improvements that are novel for the firm that has implemented them. Furthermore, it is established that "firms making technological efforts" shall also comprise those firms whose attempts at innovating failed or are not yet completed.[10] The proposal also involved ensuring a detailed record of innovation expenses not confined to R&D activities. These elements resulted in a substantially broadened list of actions that constitute "innovating activities" and, naturally, an increased volume of data to be collected.

Thus, the Bogotá Manual's express goal is to serve as a set of methodological guidelines to standardise the production of indicators in Latin-America, ensuring the possibility of making international comparisons of their results and to record

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indicators. To supplement this and to improve the quality of these indicators, the RICYT has also published the set of Methodology Manuals prepared by the OECD across Latin America and conducted technical assistance and training activities for the Science and Technology Government Organisations. Website: www.ricyt.org.

[8] Cartagena 1996; Santiago de Chile 1997 and Mexico 1999 and in the RICYT's Workshops on Innovation Indicators held in Bogota (1997 and 2000) and Caracas (1998).

[9] Bogotá Manual, 2001.

[10] These considerations constitute a departure from the CIS rather than from the Oslo Manual. Peirano (2000) addresses this issue in detail.

the specific features of the region's innovation process. This attempt to capture specific features has led to creating a view of innovation surveys as something more than just a tool for recording the technological progress of firms. Rather, the aim has been to create a set of relevant statistical data in order to reveal the sources and dynamics of business competitiveness of Latin-American firms.

In short, the Bogotá Manual, as its language proclaims, does not seek to replace the Oslo Manual but to supplement it, so much so that it has the same virtues and limitations, perhaps even more so owing to its broader overall objective. Holbrook and Hughes' comment on the Oslo Manual perfectly illustrates this point:

"*Unlike its predecessor, the OECD Frascati Manual, which provides a precise set of definitions for the national statistical agencies of OECD member nations, the Oslo Manual is both a textbook on the nature of innovation and national systems of innovation, and a compendium of socio-economic questions on the nature of innovation in a free-market economy*" [11].

(II.3) The 2nd round of Innovation Surveys in Latin-America (2000-2001).

Between 2000 and 2001, at least ten Latin-American countries conducted Innovation Surveys. This has undoubtedly been the most active period, featuring not only Brazil's entry into the group of countries with Innovation Surveys but also the entry of other countries with lesser relative development and poor statistical systems. Indeed, the publication and circulation of the Bogotá Manual and the consolidation of the RICYT have been two key factors that explain such boom, even though it was short-lived. Quickly, the Bogotá Manual became an indispensable reference and formed the basis for a comprehensive training of human resources across the region.

Thus, the Bogotá Manual was an important contribution towards ensuring that countries, even those with the lowest level of relative development, adopted two of the fundamental pillars proposed in the Oslo Manual. The first pillar is the focus on the subject as the guiding principle underlying innovation surveys in Latin-American. The second one is the use of the "chain-link model"[12] as the main source of reference to analyse the innovation process, considering the advantages it involves for a context where R&D has little relevance. In addition, after the publication of the regional Manual, there was a higher uniformity in the structure of surveys and the issues addressed.

[11] Holbrook & Hughes, 2001.
[12] Kline and Rosenberg, 1986.

Table II.2. The 2nd round of Innovation Surveys in Latin America

	ARGENTINA	BRAZIL	URUGUAY	CHILE	MÉXICO	CUBA	ECUADOR	PANAMÁ	PERÚ	TRINIDAD Y TOBAGO
Survey Number	II	I	I	II	II	I	I	I	I	I
Reference period	1998-2001	1998-2000	1998-2001	1997-1998	1999-2000	2000-2001	2000	1999	1999	2000
Collection period	2002	2000	2001	2000	2000	2002	2001	2001	2000	2001
Agency responsible for survey	INDEC-SECYT	IBGE-FINEP-MCT	DINACYT-CONICYT	INE-PIT	INEGI-CONACYT	MCYT	FUNDACYT	SENACYT	COCYTEC-INEI	NIHERST

Source: Based on RICYT-Subred de Indicadores de Innovación

However, no progress was made towards adopting a common questionnaire or generating directly comparable records, and no significant agreements were reached concerning the construction of samples or the policy governing access to the results.

The most important attempt to overcome these limitations was made in 2002 in the context of the EU-MERCOSUR-Chile Statistical Cooperation Project. A team of European and Latin-American experts, together with the people responsible for the innovation surveys in Argentina, Brazil, Chile, Uruguay and Paraguay, drafted a common proposal for indicators and methodological criteria[13]. However, since participation in the project was not binding, the countries did not implement the agreed recommendations.

As with the Oslo Manual, the experience gained from each round of surveys spurred the debate over methodological as well as conceptual aspects. This was again channelled within the RICYT, and a project for revising the Bogotá Manual was undertaken. During 2004, specialists and those responsible for Innovation Surveys drew up a set of papers that lay the basis for the RICYT's Innovation Indicators Workshop of that year.

The main consensus reached in this Workshop was that the Innovation Surveys must provide enough information to establish: (i) the patterns of the firms' innovation strategies and their impact on competitiveness, economy and society;

[13] Angulo, 2004.

(ii) the technological conduct, using as primary indicator the breakdown of the expenditure of innovation activities. The subject approach and the basic measurement tool were ratified, based on efforts, results and capabilities. In order to elaborate upon the concept of capabilities and to have a practical tool for measuring them, it was proposed to collect information about human resources, linkages, quality assurance systems and TICs[14].

In addition to these conclusions, the Workshop revealed the persistence of gaps and weaknesses. These issues could have been put together as a research agenda on which to continue work. For example, some key aspects to understand innovation in Latin America cannot be adequately measured, such as technology absorption processes. Nor was it possible to explain why the rate of innovative firms is relatively high compared with Europe. At the same time, the Workshop acknowledged the difficulties in making accurate comparisons among the countries in the region.

As a result of the announcement of the revision of the Oslo Manual and the invitation to RICYT to participate in the project a contribution was prepared that served as a basis for UIS-UNESCO to look into the situation regarding Innovation Surveys in other developing regions and draft a document that was incorporated as an Annex to the Oslo Manual, version 2005.[15]

(II.3) The 3rd round of Innovation Surveys in Latin-America (2000-2001).

Between 2003 and 2005, five countries conducted Innovation Surveys. All five countries had experience in the area. No new country was incorporated in this period. Furthermore, six countries that had taken part in the first or second round of Innovation Surveys were not able to follow up on their initiatives. Perhaps the most striking case is that of Mexico, one of the largest countries in the region and a OCDE member, who only conducted two surveys.

[14] Lugones, Peirano, 2005.
[15] Oslo Manual, 2005.

Table II.3. The 3rd round of Innovation Surveys in Latin America

	ARGENTINA	BRAZIL (II)	URUGUAY	CHILE	COLOMBIA
Survey Number	III	II	II	III	II
Reference period	2002-2004	2001-2003	2002-2004	2001-2002	2003-2004
Collection period	2005	2003	2005	2002	2004
Agency responsible for survey	INDEC-SECYT	IBGE-FINEP-MCT	DINACYT-CONICYT	INE-PIT	DANE-COLCIENCIA- DNP

Source: Based on RICYT-Subred de Indicadores de Innovación

Presently, Argentina, Brazil, Chile and Colombia have completed a new (the fourth) round of surveys, the results of which will be available soon. Meanwhile, Uruguay is preparing its Third Innovation Survey. Thus, it can be said that only this set of five countries have been able to follow up on innovation surveys.

However, it must be noted that this continuity does not mean institutionalisation. For example, the institution responsible for conducting the survey in Colombia has changed again and, with it, so did the questionnaire and the criteria used. In the case of Uruguay, surveys have been funded through financial aid from the IADB, and currently funds are being negotiated to ensure that the third survey is conducted, which undermines its periodicity. In Argentina, the questionnaire has been altered in each of the exercises and, although a stable team has been established within the Argentinean Office of Statistics, funding is not always guaranteed. Brazil and Chile are the countries with the most stable records and where surveys seem to be already consolidated.

In 2006, the ECLAC and the RICYT agreed to implement a work plan to form a common base for innovation indicators. This is a new strategy, as it aims to achieve the convergence of Surveys through regular consultation with the Statistics Institutes in order to collect data for a common set of indicators. It is expected that this will lead countries to gradually modify their surveys and procedures so as to be able to produce a set of core indicators comparable across countries.

However, this does not mean that the main problems have been overcome. The results carried-out so far have once again confirmed that it is possible to make only general comparisons.[16] The questionnaires that supply the data for each

[16] See Lugones, Peirano, Suarez (2006) for a detailed analysis of the possibility of comparing the surveys.

country are far from being similar, and not only do the populations of concern[17] differ across countries, but also the samples are obtained through random methods, which makes it impossible to make up a panel of firms with data for different years. Moreover, there are regulatory and cultural factors that hamper access to micro-data.

(III) Where we are: the state of the art in Argentina, Brazil, Chile and Uruguay

Following the conceptual framework set by the Oslo Manual (or its Latin American adaptation: the Bogotá Manual), all innovation surveys implemented so far in Latin America have adopted a "subject" approach where the unit of analysis is the firm and its innovation behaviour as opposite to an "objective" approach where the unit of the analysis is some innovation output. In theory, this common conceptual framework might allow for harmonized basic definitions for the key variables (such as innovation outputs, R&D, impacts, linkages and obstacles). However, different national characteristics and also different objectives by those public institutions in charge of funding and collecting the data, led that actual implementation has been very heterogeneous and sometimes-large differences among the questionnaires and methodologies can be observed. This section is organised into two sub-sections: what different countries are asking (in other words differences at the level of the questionnaires) and to whom they are asking (or in other words differences across the sampling strategies).

(III.1) Questionnaire related issues

In this sub-section we take the Argentina, Brazil, Chile and Uruguay innovation surveys questionnaires as case studies to illustrate the pervasiveness of these differences[18]. In all the cases we will make references to how different questions are phrased and how they compare against similar questions in the CIS (harmonized questionnaire).

[17] For instance, in some of the countries, the surveys only cover manufacturing firms (Argentina, Brazil and Uruguay), while in other countries they also include the mining and energy sector (Chile) or the services sector (Colombia). They also differ in the unit of analysis used (some countries used the establishment while others used the firm) and in the firm's minimum size.

[18] Given that in each country different innovation surveys have taken place over the time each one of them with a different questionnaire, in this analysis we will use the questionnaire implemented during the latest survey in each country as a reference.

(A) The Argentinean case

Argentina has already a tradition of implementing innovation surveys. The first innovation survey was collected in 1997 with reference to the information period 1992-1996 (over a sample of 1639 firms). A second innovation survey was taken in 2002, with reference to the information period 1998-2001 (and a sample of 1688 firms). Finally, a third innovation survey was collected in 2005 for the period 2002-2004. In this section we describe the main characteristics of this third effort.

The 3rd Argentinean Business National Survey on Innovation, R&D and ICTs (2002-2004) is organised in 4 chapters. Answering the questionnaire is compulsory and while quantitative questions use 2004 as year of reference, qualitative questions regarding innovation outputs take the interval 2002-2004 as period of reference.

Chapter 1 of the Argentinean survey collects business basic economic information such as main economic activity, legal organisation, number of plants owned by the firm, information regarding if the firm is actually part of a larger group and percentage of foreign control (as % of total capital shares). In some extent this section is very similar to the CIS. The only difference is that no information regarding turnover, employment and exports is asked in the Argentinean survey. This information is pulled out from the Manufacturing survey later on.

Chapter 2 of the Argentinean survey is about innovation and R&D. In this section the survey starts asking for both presence (Yes or No) and total expenditures in each one of the following innovation activities: intramural R&D, extramural R&D, purchase of machinery, hardware and software, acquisition of external knowledge, training, industrial design and consultancy. These categories are very similar to the ones included in CIS4 (harmonized questionnaire), the only exceptions are that while the CIS4 includes information regarding marketing expenditures but omits collecting information regarding industrial design, the Argentinean survey is the other way around. Additionally, the Argentinean survey opens the information regarding investment for innovation into three components: machinery and equipment, hardware and software. In the CIS 4 (harmonized questionnaire) this information is not classified by sub-components. Finally, in the CIS4 while the quantitative information regarding expenditures is asked for the last year of the information window only, in the Argentinean survey information is collected for each one of years during the period 2002-2004.

Despite the differences pointed out above, for the majority of the innovation activities expenditures included both in the CIS and in the Argentinean survey, the methodological definitions and notes are the same.

There are more differences, however, regarding innovation outputs. Overall the Argentinean survey only asks about new or significantly improved products or processes, without asking for any additional information regarding to if product innovation is new for the firm only or if it is new for the market. Also, there is no additional information request regarding to who developed the innovations and, in case of the product innovations, the percentage of total turnover that is explained by product innovations. In addition to this, the Argentinean survey follows the Botogá Manual and includes in this section the collection of information regarding organisational changes either in the production process or in any other aspects relative to the organisation. A final difference between both surveys is that the Argentinean survey does not make any reference to innovation activities that are still ongoing or were abandoned.

In this Chapter, the Argentinean survey also includes a section specific for R&D. In this section, Frascati Manual definitions are used to further classify R&D expenditures for 2004 into basic research, applied research and experimental development. This entire section is missing in the CIS 4 (harmonized questionnaire).

In this Chapter, the Argentinean survey also includes a section regarding the different sources available for funding innovation activities. The information is collected for both total innovation activities and just R&D. Main sources of funding are classified into two categories: internal resources and external sources. External resources refer to funds coming from clients, suppliers, NGOs, universities, financial institutions, multilateral organisms and from the National Science and Technology Promotion Agency. This question is less detailed in the CIS where qualitative (Yes or No) financial information is collected regarding to public sources only.

The third Chapter of the Argentinean survey is about human resources. This chapter is organised into two sections. In the first section, information regarding total employment in 2004 is split according employees´ educational achievements (basic, technical, professional engineers and others professionals). In the second section, additional information is collected for those employees working on innovation activities in 2004. Here the information being collected refers to if those employees are located into formal or informal units or if they are allocated to R&D work or other innovation activities.

Finally, information regarding to formal R&D employees is further divided into full time or part time employees and on how many of them are researchers or research support staff. This information regarding human resources for innovation is completely missing in the CIS 4 (harmonized questionnaire)

The fourth and final chapter in the Argentinean survey is about ICTs. The first section of this chapter refers to the degree of ICT adoption (ICT investments in 2004, ICT related training, in-house mainly developed ICT, stock of computers, percentage of workforce with access to PCs, etc). While the second section collects information regarding to the actual use of ICTs (e-mail, internet, etc). There is no information regarding ICTs in CIS 4 (harmonized questionnaire).

There are several sections included in CIS4 that are completely missing in the 3rd version of the Argentinean innovation survey. Sections about sources of information and co-operation for innovation activities, on the effects of innovation, on the factors hampering innovation and intellectual property rights are completely absent in the 2002-2004 Argentinean survey. This does not mean that these questions are completely omitted from the survey strategy: in order to save time to the respondents and also to reduce the fatigue in answering the questions, several modules are not included in all surveys. Hence, several of the questions missing in the 3rd innovation survey are already included in the previous ones and they will be included in future surveys. This strategy seems to be reasonable under the light of the recent decision of collecting the survey on annual basis. Indeed, if one analyses the 4th innovation survey (for 2005), it is found that questions about patents, obstacles to innovation and R&D cooperation are indeed included in the survey.

(B) The Brazilian case

Brazil´s first innovation survey was collected in 2001 for the period 1998-2000 (10,000 firms), the second innovation survey was collected in 2004 for the period 2001-2003 (10,600 firms), while the third survey was collected in 2006 for the period 2003-2005.

The description in this section refers to the 2005 Survey on Technological Innovation (PINTEC). The questionnaire has several sections and overall, it follows very closely CIS 3. The questionnaire starts requesting some basic information about the firm such as year of start-up and structural changes. The second section requests additional information regarding ownership, origin of foreign capital, employment, sales (these two only for the final year) and the firm's main market.

The third section of the Brazilian surveys is about product and process innovations. The subsection about product innovation asks if during the last 3 years the firm has introduced a new or significantly improved product and if that product is new for the firm or for the entire Brazilian market. In case of having several innovated products, firms are also asked to describe their main product innovation and also to identify its degree of novelty. They also need to provide information regarding who developed this significant product innovation.

The subsection regarding process innovation is similar. Companies are requested to answer if they have introduced any process innovation during the last three years and if these innovations are just new to the firm or also to the Brasilian market. They are also requested to describe their main process innovation and to provide information regarding its novelty and who developed the innovation.

The section about product and process innovation closes with some information regarding if the firm had innovation projects that were either incomplete or abandoned during the three years period. Overall this section is very similar to CIS 3. After this a first filter is introduced, with those firms with neither product or process innovations nor abandoned activities asked to go to the obstacles question.

The fourth section of the Brazilian survey is about innovation activities. The following innovation activities are defined in the questionnaire: internal R&D, external R&D, acquisition of external knowledge, acquisition of software, purchase of machinery and equipment, training, marketing related to innovation, technical preparations for production and distribution of innovations. Quantitative information regarding these items is asked for the last year of the information window only, while the qualitative information refers to the time interval 2003-2005.

The section about sources of funding of innovation activities (section 5th) is more general than the CIS. It asks for internal and external sources and within the last ones among private or public ones. Also the sources of funding are classified according to if they fund R&D only or if they are also used to fund other innovation activities.

The section about internal R&D activities starts asking if these activities are permanent or casual. Then there is a long list of questions about the qualifications of the R&D staff, first according to educational achievement (PhD, MA or BA) and then according to scientific disciplines (chemical and physics, engineering, medical degrees, biology and other life sciences and statistics and mathematics). On the top of this, these different categories are split into full or

part time personnel and postgraduate qualifications. There are no similar questions to this in the CIS.

The section about the impacts of innovations starts by classifying the innovative products into novelty (new to the firm, new to the Brazilian market, new to the world market) and the corresponding shares of these product innovations on total internal turnover and exports. The second question in this section asks for qualitative impacts of product and process innovations. As in the CIS the impact categories being considerer are product (and market) related, process related and others.

The section about sources of information for innovation classifies the same ones into internal sources, market-based sources, public research organisations and others. This section is very similar to the CIS and there are no further differences here. The only aspect that is different refers to a particular question about if the external sources are located in Brazil or in foreign countries.

The section about cooperation for innovation starts asking in the firm has had any cooperation for innovation during the previous three years. The section continues asking about partner locations: Brazil in the same state, in another state, in the Mercosur, in USA, EU, etc. Respondents are also asked about the intensity of the cooperation and, finally, there are some questions regarding the reasons for the cooperation (that is R&D, training, design, technical assistance, etc).

The section about government support is phrased with some detail. In particular, firms are asked about their participation in several particular programs such as R&D tax credits, ICT law, grants, scholarships, etc. Again, this is done with more detail than in the CIS

The section regarding patents and other methods for intellectual property rights protection has two subsections asking for explicitly written methods (such as patents, trademarks, copyrights, etc) or implicit or strategic methods (such as secrecy, lead time, complexity, etc). These are just yes-no questions. Finally, and regarding only to patents, there is a question about whether a patent application has been done and where (Brazil or a foreign country).

Firms without innovation activities are first asked why they did not innovate. The possibilities are due to previous innovations, due to market conditions or other factors. If this last option is ticked, they are asked for a large set of potential obstacles. The list is similar in the CIS.

After this the questionnaire focuses on strategy and organisational changes. These changes refer to changes in the corporation strategy, changes in management, changes in structure, changes in marketing concepts, aesthetic changes in products and implementation of new control methods and certification norms. All these questions are just yes or no answered questions.

Finally, the questionnaire closes with a particular question regarding if the firm is producing or using biotechnology and, for those firms specialised in R&D, with a particular question regarding the sector of activity where the R&D results will be implemented.

Overall, it is possible to say that the PINTEC is very close to the CIS. If anything some questions are asked even more precisely than in the CIS. The only big difference is the large module regarding human resources for R&D.

(C) The Chilean case

Chile shows a long tradition of collecting innovation surveys. The first Chilean innovation survey was collected in 1995 for the reference period 1992-1995. The second survey was collected in 1998 for the reference period 1996-1998. A third survey was implemented in 2001 for the period 1999-2001 while a fourth survey was carried out in 2005 for the period 2002-2003. One important aspect of the Chilean survey is that the time window for the qualitative questions has been reduced. Indeed, while during the first three surveys this time period was three years, for the last survey this window has been reduced to two years. We assume that the reason for proceeding like this is to match the time window for the qualitative questions with the same time frame for the quantitative questions. The cost of this is that it is more difficult now to compare the results across the different innovation surveys. A shorter time frame could reduce the percentage of firms reporting innovations.

The description in this section refers to the 4th Chilean survey. After brief sections about identification and economic performance, the survey starts with a module about innovation outputs. Innovations are classified into the following groups: product innovations, service innovations, process innovations, innovations in packing, innovations in product design and organisational innovation.

In the questions about product and process innovations several sub-questions are used to ask if the innovation was just an improvement on existent products or processes, or if the innovation was new to the firm only but already existent among the competitors. Regarding the question about organisational change, there are sub-questions about changes in the administration, in labour organisation and in production organisation. All these questions are answered

using yes/no responses. This is an improvement on the previous innovation surveys where they used to be answered using a likert scale rather than a single yes or not question. That is innovations were asked in terms not only of presence but also in terms of economic importance for the firm.

Similarly to the harmonized CIS and also to the Brazilian PINTEC, a filter is included in the questionnaire. Firms with negative responses to product, process, service, packing, product design and organisational innovations are filtered out and are asked to answer only those questions regarding to machinery investment, intellectual property rights, obstacles and innovation perspectives.

The second section in the Chilean survey is about innovation objectives. The following categories of objectives are considered: keep or increase market shares, improve the production process, implement quality systems, improve the work and safety conditions and reduce damage to the environment.

The 3rd section of the Chilean survey is about innovation sources. In this section, sources are classified into four categories: internal sources (within the same firm and from routine activities, within the same firm but from casual activities and from the group that owns the firm); external sources (consultants, clients-suppliers, competitors, private research organisation); institutional sources (universities or other higher education institutions, public research organisations) and other sources (conferences, trade missions, exhibitions, publications, trade associations). This question has important differences with respect to the CIS: external sources (clients and suppliers) are merged together, similarly, public domain based information sources such as patents, publications, etc. are also bundled together. The 3rd section of the Chilean survey also includes a module on innovation cooperation. First, firms are asked if they had any sort of cooperation for innovation activities either with firms and institutions. Then a filter is included and if the response is affirmative, firms are asked about the type of cooperation (within the group, suppliers, clients, competitors, consultants, universities and public research organisations) and the nationality of the partner (domestic or foreign).

The 4th section of the survey is about embodied technical change. In this section several questions are included regarding the vintage of the equipment, its mechanisms for control (manual, mechanical or electronic) and about any technical assistance received in order to learn how to use the equipment. There is no section similar to this in the CIS. The 5th question of the survey is about intellectual property rights and know-how agreements. This section first asks about number of intellectual property rights owned by the firm (this includes patents, plant varieties and copyrights but not trade marks), then it asks about the number of intellectual property rights applications and finally, about the

number of know how agreements signed by the firm to acquire new disembodied technology.

The 6th section of the Chilean Survey is about those factors hampering innovation. These factors are classified into three components: economic factors, human resources related factors and other factors. Each one of these factors is further split into several elements as it is done in the CIS. The 7th section of this survey is about the impact of product innovations. In this case, impact is measured by innovation sales as a proportion of both total turnover and exports. Different to the CIS, the answers to these questions are done using an ordinal scale based on ratio intervals. The following intervals are used: 0%, 1%-10%, 11%-30%, 31%-70% and 71%-100%.

The 8th section of the Chilean Survey is about the innovation activities. First, firms are asked if during the last two years they have done the following activities (Yes or No answered questions): intramural R&D, external R&D, acquisition of external knowledge, training, preparations (setting and preparing new equipment) and marketing innovation. The survey follows with section 9th about costs and funding of innovation activities. This section starts by asking if the firm has an R&D laboratory. After this the firm is asked about expenditures on innovation activities different to R&D (such as know how agreements, training, machines setting up, marketing of innovations and acquisition of machinery and equipment for innovation). For these sort activities (excluding R&D) firms are asked about funding sources (own resources, public funds and external private funds). And in the case of using public funds, firms are asked about the use of different public programs including Fontec, FDI, Fondef, Fia and Innova Bio Bio.

The 10th section of the Chilean survey is about R&D. This section closely follows the Frascati Manual approach. R&D expenditures are first classified into three categories: basic research, applied research and experimental development. Within each one of these categories the following sources of funds are reported: internal funds, government funds, international funds and other. Note that the categories for sources of funds used in these questions do not correspond to the categories used for other innovation activities (section 9th). This makes answering this part of the questionnaire very complex. Additionally, the possibilities for the integration between this question and the previous questions become highly problematic. Section 10 continues with some questions about R&D outsourcing. Three possibilities for R&D outsourcing are considered here: universities, public research organisations and other firms. In all these cases firms should answered about how they funded these outsourced activities (using own resources, government resources and other sources). In the case of R&D outsourcing, firms

are also asked if outsourced activities are carried out nationally or internationally.

The 11th section of the Chilean survey is about R&D personnel. Here the Frascati´s influence becomes also evident. Firms are asked to report for the following categories of personnel according educational achievements: PhDs, Masters, Engineers, Technicians and Administrative. Firms also have to report about the time dedication of R&D employees (full or part time). However, there is no question here regarding the scientific field of education for these personnel.

The Chilean survey closes with a question about innovation perspectives for the next three years for product, process and organisation related innovations.

(D) The Uruguayan case

This section refers to the description of the 2003 Survey on Innovation Activities collected by the Ministry of Education Science, Technology and Innovation Division of Uruguay[19]. After the identification section, the first substantial section of the Uruguayan survey is about innovation activities. The set of innovation activities closely resembles the ones in the Argentinean Survey. The survey considers 9 different innovation activities: internal R&D, external R&D, capital goods, hardware, software, know-how agreements and consultancies, industrial design, management and training.

This section is very detailed and it requires a massive response effort by the interviewed. First, firms are asked to estimate the amount of resources invested in these activities in 2003. Second, they have to inform if this investment has increased or decreased with respect to the previous year. Third, firms are asked to report about the results of these innovation efforts or if they were abandoned. Finally, for the period 2001-03, they are asked to report the orientation of investments in innovation activities. Four alternatives are provided for this: product, process, organisation and commercialisation (these questions are asked using simple yes or no options).

The section about innovation activities is complemented with a subsection about training indicating its type and the number of employees trained in each category. The following categories of training are considered: product innovation, process innovation and management (this further includes

[19] Uruguay was the first Latin American country to implement an innovation survey in 1988. However, this effort is left out of this description, which focuses only on those surveys implemented after the publication of the Oslo Manual.

managerial skills, administration, information technology, industrial safety and quality control).

Section C of the survey is about human resources applied to innovation activities. The section opens with a question about the number of employees involved in these activities asking if their involvement was in a formal innovation unity or on casual basis. In further questions the information regarding to these innovation employees is classified by the scientific discipline of the staff, their time allocation to these activities (full or part time) and gender.

Section D is about financing innovation. The following sections are considered: cash flows, external resources from shareholders or related companies, suppliers, clients, public sector, commercial bank, international cooperation and headquarter (if a multinational).

Section E is about the innovation outputs. The following categories of innovation outputs are considered: product, process, organisation and commercialisation. Answers to these questions are just simple yes or no. After this, firms must report about the degree of novelty of these innovations: new to the firm, to the domestic market or at international level. In an additional question firms have to answer about the importance of product innovations by using the share innovation on total turnover and exports. In further questions firms are asked to use a likert scale to report about the importance of the economic impacts of the different innovations. These impacts are classified into product, process, market and others. Several subclasses are added into these different categories. Section E finishes with information about patenting behaviour. Firms have to report about patent applications and grants and to where these applications were submitted.

Section F of the Uruguayan survey is about innovation objectives. Although there are more than 20 potential objectives, respondents are asked to report up to five of them only. These 20 objectives are classified into market, costs, quality, products, processes, opportunities and regulation related innovation objectives.

Although firms with innovation activities answer sections C, D, E and F only, all the firms answer section G about sources of information regarding innovation activities. The different sources included here are the same ones as in the CIS and other Latin American Surveys. In Section H firms answer about those factors hampering innovation. By using a likert scale, firms are asked to report if those obstacles refer to microeconomic, market related and macroeconomic limitations.

Section I is about linkages with the national system of innovation. Several agents are considered: universities, technology centres, training centres, laboratories, banks, suppliers, clients, related firms, consultants, public programs and

headquarters. Firms also provide information regarding the type of relationship (among the following ones: asking for funds, information, training, assistance for organisational change, tests, technical assistance, design and R&D).

Section J is about ICTs. In the first question of this section, the respondents use a scale to allocate their employees among the following different types of ICT use: mobile phones, PCs, emails, Internet and Intranet. In other questions under this section, firms are also asked if they have a web page, if they are connected by email with suppliers or clients and the reasons for using internet (market research, information searching, ecommerce, communication with clients and providers and advertisement).

Finally, section K of the survey is about quality control. There are several very detailed questions about the use that firms make with information collected during the activities of quality control.

The Uruguayan survey is complemented with another survey collecting basic information about the firm (legal status, ownership, date of start-up, number of establishments, total employment and its distribution according skills and scientific disciplines, employment rotation, total turnover and market orientation).

(E) Comparability across surveys[20]

This section summarises the discussion of the above by focusing on a set of key indicators and exploring the extent to which some degree of comparability, both among the Latin American surveys and also with regards to the CIS, can be achieved. We have focused on the following indicators:

(+) Innovation activities
(+) Human resources
(+) Innovation Outputs
(+) Sources of Ideas for innovation
(+) Innovation cooperation
(+) Public programs

For all the indicators the benchmark is the CIS IV harmonized questionnaire, which is compared respectively with the 3rd Argentinean survey, the 3rd PINTEC, the 4th Chilean Survey and the 2nd Uruguayan survey. Across the different comparisons, we distinguish among those variables where we have

[20] This section builds on and updates Lugones, G, D. Suares, F. Peirano and P. Gutti (2005): "Documento base para la construcción de un set de indicadores de innovación homogéneos y comparables para America Latina".

straightforward comparability (e.g. variable definition and measurement is an exact match with the CIS IV) and those variables where some comparability is possible but only after some re-arrangement of the raw data. This might be due to either different sub-categories in each questions or to a different scaling. We attach a perfect match variable a letter "H", otherwise we allocate a letter "L". Finally a NA means that the whole question was not available in one of the questionnaires.

Table III.1 shows the results for innovation activities. Here we found that we have relatively high levels of comparability in three categories: intramural R&D, external R&D, acquisition of external knowledge (such as licenses) and training. Comparability is very low regarding marketing innovation activities (missing in Argentina and Uruguay) and other preparations (a sort of residual with definitions that change across the different countries). Finally, comparability is in some extent possible for the acquisition of machinery, software and equipments where except in the case of Chile, for the remain Latin American countries considered here, this question is asked split into these three components while in the CIS 4, the task for consolidating them is left to the interviewed.

Table III.1 Innovation Activities

Innovation Activities	CIS IV			Argentina			Brazil			Chile			Uruguay		
Innovators only	Yes	No	Amount	Yes	No	Amount	Yes	No	Amount	Yes	No	Amount	Yes	No	Amount
Intramural (in house R&D)	X	X		H	H	L	H	H	L	H	H	L	L	L	H
Extramural R&D	X	X		H	H	L	H	H	L	H	H	H	L	L	H
Acquisition of machinery, equipment and software	X	X		L	L	L	L	L	L	NA	NA	H	L	L	L
Acquisition of other external knowledge	X	X		H	H	L	H	H	L	H	H	H	L	L	H
Training	X	NA		H	H	L	H	H	L	H	H	H	L	L	H
Market introduction of innovations	X	NA		NA	NA	L	H	H	H	H	H	H	NA	NA	NA
other preparations	X	NA		L	L	L	L	L	L	L	L	L	L	L	L

Table III.2 is about human resources for innovation. This question is completely missing in the case of the CIS IV. In the case of the question about the number of employees in R&D activities comparability is possible across the four Latin American surveys considered here. Information regarding educational levels of

the R&D personnel is available only for Brazil and Chile, while information about scientific field of education is available only for Brazil and Uruguay.

Table III.2 Human Resources

Human Resources	CIS IV	Argentina	Brazil	Chile	Uruguay
Innovators only	Amount	Amount	Amount	Amount	Amount
R&D	NA	A	A	A	A
Other Innovation Activities	NA	A	NA	NA	A
Education Achievement	NA	NA	A	A	NA
Function	NA	A	NA	A	NA
Scientific Discipline	NA	NA	A	NA	A

The situation regarding innovation outputs is summarised in Table III.3. Regarding the introduction of new or significantly improved products that are new to the firm we have high comparability among the CIS IV , Brazil and Uruguay. Comparability in the case of Chile is harmed by the fact that this country asks for product innovations separately from service innovations. In the case of Argentina and Chile comparability is affected by the fact that these countries differentiate between new products and technologically improved products while in the other cases these two categories are merged together. With respect to the variable products new to the market, except in the case of Brazil where the question is similar to the CIS IV, comparability in the remaining countries is harmed by the fact that they ask about products new to the domestic market vs. products new for the international markets. This might lead to some aggregation problems because is not clear if the new to the world innovations are also computed as new to the domestic market as well.

Regarding process innovations, comparability is relatively high between CIS IV and Uruguay, but is low for the case of the other countries. The reason for this is that, except Uruguay, in the other countries the question about process innovation is split between improved processes and new processes. And, in the cases of Chile and Brazil, a question about novel of process innovation is also included.

For the remaining categories of innovation outputs considered in CIS IV comparability is almost impossible due to the fact that many of these questions are completely omitted in the Latin American surveys considered here. Regarding Patent applications some comparability is possible between CIS IV and Brazil, Chile and Uruguay. For copyrights and industrial designs some comparability is restricted to Brazil and Chile.

Table III.3 Innovation Outputs

Innovation Outputs	CIS IV			Argentina			Brazil			Chile			Uruguay		
All firms	Yes	No	Amount	Yes	No	Amount	Yes	No	Amount	Yes	No	Amount	Yes	No	Amount
New to the firms product / service innovations	X	X	L	NA		H	H		L	L		H	H		
New to the market product / service innovations	X	X	NA	NA		H	L		L	NA		L	H		
New production processes	X	NA	L	NA		L	NA		L	NA		H	NA		
New or improved logistics and delivery	X	NA	NA	NA		L	NA		H	NA		L	NA		
New or improved support and maintenance	X	NA	NA	NA		NA	NA		NA	NA		NA	NA		
Abandoned innovation activities	X	NA	NA	NA		L	NA		NA	NA		NA	NA		
Apply for Patents	X	NA	NA	NA		L	NA		NA	L		H	H		
Register an industrial design	X	NA	NA	NA		H	NA		NA	L		NA	NA		
Register a trademark	X	NA	NA	NA		H	NA		NA	NA		NA	NA		
Claim copyrighy	X	NA	NA	NA		H	NA		NA	L		NA	NA		

The situation regarding sources of ideas for innovation is described in Table III.4. Here we find that comparability is high among the CIS IV, Brazil and Uruguay. Comparability is impossible with Argentina because this question is completely missing in the version of the survey we are analysing here (although it has included again for the next version of the survey). Comparability for Chile is harmed by the fact that sources of ideas for innovation are grouped into 4 categories: internal sources, external sources, institutional sources and other sources. The different components included in the CIS IV are cited as examples in the headings of these large four categories.

Table III.4 Sources of Ideas for Innovation

Sources of Ideas for Innovation	CIS IV	Argentina	Brazil	Chile	Uruguay
Innovators	Ordinal Scale	Ordinal Scale	Ordinal Scale	Ordinal Scale	Ordinal Scale
Within your entreprise or enterprise group	X	NA	L	L	L
Suppliers of equipment, materials, components	X	NA	H	L	H
Clients or customers	X	NA	H	L	H
Competitors or other enterprises in your sector	X	NA	H	L	H
Consultants, commercial labs or private R&D labs	X	NA	H	L	H
Universities or other higher education	X	NA	H	L	L
Public research organisations	X	NA	L	L	L
Conferences, trade fairs and exhibitions	X	NA	L	L	H
Scientific Journals and publications	X	NA	L	L	H
Professional industry associations	X	NA	NA	L	L

Regarding cooperation for innovation activities (Table III.5) the situation similar to the case of information sources. Here we have good comparability among CIS IV, Chile and Uruguay. In the case of Brazil comparability is affected by the fact

that this question is answered using an ordinal scale, mixing propensity to cooperate with some partner with the actual impacts from this cooperation.

Table III.5. Cooperation for Innovation

Innovation Activities Cooperation	CIS IV	Argentina	Brazil	Chile	Uruguay
Innovators	Yes No	Yes No	Yes No	Yes No	Yes No
Cooperation for innovation activities	X	NA	H	H	NA
Type of partner					
Other enterprises within the group	X	NA	NA	H	L
Suppliers	X	NA	L	H	H
Clients	X	NA	L	H	H
Competitors	X	NA	L	H	NA
Consultants	X	NA	L	H	H
Universities	X	NA	L	H	L
Government	X	NA	L	H	L

Finally, Table III.6 summarises the results regarding government support for innovation activities. We found that while CIS IV asks only about incidence and regional origin of the support (e.g. local government, national government or EU), only one Latin American country –Chile- includes this dimension and for one particular region. CIS IV does not ask about specific programs, however Brazil and Chile require information for 6 and 5 programs respectively.

Table III.6. Government support for innovation activities

Government Support of Innovation Activities	CIS IV	Argentina	Brazil	Chile	Uruguay
Innovators					
Asked yes or no	X	X	X	X	X
Regional programs	X	NA	NA	X	NA
Number of programs	NA	NA	6	5	NA

One final problem that must not be ignored is the fact that the time frames for the surveys are not exactly the same across the different countries. For example, using the last surveys as frame, Chile asks for the years 2002-2004, Brazil for the years 2003-2005, Uruguay for years 2001-2003 and Argentina for the years 2002-2004. There are two consequences from this. First, the fact that Chile asks over two years might while the rests of the countries, including CIS IV ask over three years might underestimate Chilean innovative performance if the probability of innovation is uniformly distributed over the three years period. Some sort of adjustment to the Chilean data about innovation outputs might be required. Second, even when the time dimensions are similar the actual time of the survey is different and, hence results could be affected by the different phases of the business cycle. For example, although Argentina and Uruguay ask for

innovation over a three years period, Uruguay´s time frame includes the year 2001 that was affected by a severe recession while Argentina takes only the period starting in 2002, which is during the recovery. Business cycles are very volatile in Latin America and this could affect not only the levels but also the composition of innovation activities. This macroeconomic asymmetry, which is problem to be controlled for, is also a source of variation that can be exploited in the empirical work.

Questionnaires are not the only source of differences that might affect comparability among the surveys. Differences in the sampling methodology and on how the actual fieldwork is implemented can also affect comparability among surveys.

(III.2) Methodological methods

(III.2.1) Methods and Sampling

This section briefly summarises the main sampling strategies applied during the implementation of the Latin American innovation surveys considered here. The following parameters are taken into consideration: frameworks, sample size, response rates and sectors being covered.

Table III.7 summarizes some key methodological aspects of the Latin American innovation surveys. Two important characteristics across all countries are that surveys are collected by the different National Offices of Statistics and that the reporting unit in all the cases is the firm. Additionally, as answering the surveys is made compulsory in all cases, responses rates are quite high. In fact response rates in the Latin American innovation surveys are always higher than in the CIS.

There are, however, some country specific characteristics. In the case of Argentina, the sample size is around 2,000 firms in all surveys so far implemented and it is obtained on the basis of a random sample using the manufacturing survey as a sampling framework. In the case of Brazil the sample size has increased during the 3 waves of the survey and the sampling methodology is based on a stratified sample taken from the manufacturing, telecommunication, software and R&D registers.

As in the Brazilian case, the Chilean survey also shows consistent growth in the sample sizes, which is due to an increase in the set of economic sector being sampled. Indeed, while the first two waves of the Chilean survey only covered the manufacturing sector and had sample sizes a bit larger than 500 observations.

The 3rd wave of the survey showed an increase in the sample size to almost 900 firms including also mining and electricity sectors. Finally, the last version of the survey shows a dramatic increase in the sample size to almost 3,000 observations, including all sectors except trade, hotels and restaurants and personal services. In the Chilean survey the frames for sampling are different depending the sectors. In manufacturing the frame is always the national manufacturing survey, while for electricity and mining is the economic census and for all the other sectors is the Tax Service. As in the case of Brazil, the Chilean sample is also based on a stratified sample.

As it is possible to infer from the Table III.7 there are a lot of similarities among the different Latin American innovation surveys. This should allow for a better comparability among the countries in the region. On the other side, there are more differences, in particular with respect to the response rates and frames with the CIS surveys. Hence much care should be applied at the moment of comparing the Latin American innovation surveys with the CIS experiment. For a more complete analysis regarding the possibilities for comparing the Latin American innovation surveys with the CIS see Viotti and Baessa (2006).

Perhaps the best way of learning about the limitations for comparability of innovation surveys and understanding how some of these limitations can be overcome is by experimenting and engaging in a comparability exercise. In order to illustrate this point, we will concentrate in a case study comparing the UK microdata (CIS 3) with the Chilean microdata (4th innovation survey).

Table III.7. Methodological aspects of Latin American Innovation Surveys

VARIABLE	ARGENTINA	BRAZIL	CHILE	URUGUAY
Status	Compulsory	Compulsory	Compulsory	Compulsory
Collecting Agency	Statistics Office (INDEC)	Statistics Office (IBGE)	Statistics Office (INE)	Statistics Office (INE)
Method of Collection	Postal	Face to face interviews + pone	Postal	Postal
Frequency	Yearly (1)	Every 2 years (4)	Every 3 years	Every 3 years
Framework	Manufacturing Survey (2)	Mining and quarrying Manufacturing, telecommunication, Software and R&D registers	All sectors excluding trade, hotels and restaurants, housing and public sector	Manufacturing register
Reporting Unit	Firm	Firm	Firm	Firm
Minimum size cut-off point	10 employees	10 employees	10 employees manufacturing US$65,000 the rest	5 employees
Panel	No manuf. Yes services	No	No	No
Sample size	2333 (total) 2133 (manuf) 200 (panel svs)	14,400 (total) 13,500 (manuf) 900 (svs)	3298 (total) 1022 (manuf) 161 (electricity) 65 (mining) 2050 (rest)	814
Response rate	78%	91%	85%	98%
Number of variables (3)	189 (100)	208 (67)	170 (95)	339 (138)
Combined with other surveys	Yes (ICT)	No	No	Yes (ICT)

Note: (1) quantitative questions asked on annual basis. Innovation outputs asked over the last three years. It will also rotate modules between surveys. (2) Starting work with a census of large service firms. (3) Number of quantitative variables. (4) From 2003, before it was done every 3 years.

(III.2.2) Chile vs UK: an example using the microdata.

This exercise focuses on the manufacturing sector only. We make use of the microdata from the 4th Chilean Innovation Survey and the UK CIS 3. Following the results from section III.1 of above we focus our comparison on those variables where the degree of comparability is the highest. Table III.8 lists the variables and how they are respectively defined in each one of the surveys (we select this list of variables following Mohnen, Mairesse and Dagenais (2006). As it is possible to infer from the table only for those variables regarding to R&D activities we have very close matches. In all the other cases we only have approximations due to fact that either the qualitative question is not structured in the same way or that when it is (for example in the case of perceived competition), the Likert scale used for the answers does not have the same number of points.

Table III.8. Comparing Chile with the UK. Variables definitions.

Variable	Chile	UK
Product Innovation (0/1)	If yes to technologically improved or new for the firm or new for domestic market or new for the world products	If yes to any technologically new or significantly improved products that were new to the firm
Novel Product Innovation (0/1)	If yes to technologically new for domestic market or new for the world products	If yes to any technologically new or significantly improved products which were also new for the firm's market
Share Innovated Products	Sales of innovated products and services on turnover. We took the middle points of each interval, except the inferior and superior limits for the extremes	Sum of share of turnover that goes to products that are new to the firm and significantly improved
Innovators	If yes to technologically improved or new products or services, processes or packing, product design or any organisational change	If yes to any technologically new or significantly improved or new or significantly improved processes products or any organisational change
High Technology Sector (1/0)	Vehicles (34-35), Chemicals (23-24), Machinery (29) and Electrical (30-33)	Vehicles (34-35), Chemicals (23-24), Machinery (29) and Electrical (30-33)
Capital Expenditure (0/1)	Yes if has purchased a new equipment within the last three years	Yes if capital expenditure in 1998 is positive
R&D (0/1)	Yes if firm declare doing internal R&D in 2003 o 2004	Yes if intramural R&D expenditure is positive
Continuos R&D (0/1)	Yes to question about doing continuous R&D	Yes to continuously doing R&D
Cooperation (0/1)	Yes to cooperation actions for innovation activities	Yes to any cooperation agreement
Perceived Competition (0/1) *	One if intensity about to increase market shares objective is higher than sample average.	One if intensity about to increase market shares objective is higher than sample average.
Inf within firm (0/1) *	One if intensity of information sources from inside the firm is higher than sample average.	We first sum the within firm and within group information sources and we allocate a dummy if sum is higher than sample average
Inf from institutions (0/1) *	One if intensity of information sources from institutions is higher than sample average	We first sum universities, government and other PRO sources and we allocate a dummy if sum is higher than sample average
Inf from market (0/1) *	One if intensity of external information sources is higher than sample average	We first sum suppliers, clients, consultants and commercial laboratories sources and we allocate a dummy if sum is higher than sample average
Inf public (0/1) *	One if intensity of other sources is higher than sample average	We first sum conferences, trade associations, press, publications and patents sources and we allocate a dummy if sum is higher than sample average

Note: (*) In these questions firms have to provide their answers using a Likert scale and the cut-off values we chose to define our dichotomous indicators correspond to the sample mean responses. In the Chilean case the Likert scale had five points (N,1-4) while in the UK case the scale have four points (0,1-3)

Before presenting the results, it is also important to explore the differences in the sampling frameworks between both surveys. In the case of Chile, the data are a stratified sample taken using the national manufacturing survey as a frame. This might not be a problem if the manufacturing survey sample is a representative sample of the whole Chilean manufacturing. The problem is that is not. The aim

of the Chilean manufacturing survey is to get information to build output and employment trends *at aggregate level* for the whole manufacturing sector. As a consequence the sample used for the manufacturing survey is strongly biased towards the inclusion of the largest manufacturing firms in the economy. In order to achieve this, it sets a sampling threshold for all manufacturing plants with 10 or more employees. A threshold of 10 employees in the case of Chile is quite high. Some simple figures could illustrate this point. According the Tax Service there are 50,000 manufacturing firms formally registered in the Chilean economy. The manufacturing survey samples about 5,000 establishments[21] with 10 of more employees, these 5,000 establishments explain about 85% of total sales registered in the Tax System records for the manufacturing sector. In other words, the manufacturing survey is a framework of very large manufacturing firms. The Chilean innovation survey takes a sample from THAT framework[22].

Our comparison group is the UK CIS 3. According to Eurostat guidelines, the population of the CIS 3 is determined by the size of the enterprise and its principal activity. At least all enterprises with 10 or more employees in any of the specified sectors were included in the statistical population. Countries could also include enterprises with less than 10 employees, if they were treated separately. In the case of the UK-CIS 3, the sample frame is the ONS Inter-departmental Business Register (IDBR). The IDBR covers about 98% of business activity (by turnover) in Great Britain. From there a stratified sample is taken for the British CIS. In relative terms this sample will include a larger proportion of small firms than in the Chilean case.

Before we started our work, both samples were also subject of some standard data cleaning procedures aiming at controlling for outliers, missing observations and inconsistencies. We first eliminated all firms with less than 10 employees because this is inconsistent with the sampling frameworks (less than 3% of the observations were lost in both cases due to this), we also deleted firms with missing data for employment and sales either at the beginning or at the end of the time period. We also deleted from our samples all firms with annual sales growth (between 1998-2000 for the UK survey and between 2002-2003 for the Chilean survey) higher than 100% and lower than –100%. Finally, we also dropped from the datasets firms with R&D investment ratios higher than 1 (which means R&D employment higher than total employment) and the top and bottom percentiles of employment and sales distributions. After this, sales figures were converted in 2003 international dollars using IMF conversion rates and UK wholesale price index.

[21] In Chile the difference between establishments and firms is very small due to the fact that only 8% of the firms are actually multiplant firms.

[22] For more details regarding how the ENIA sample is built see INE (2004): "Encuesta Nacional Industrial Annual 2004", Volumes I and II.

Table III.9. Descriptive Statistics.

Variable	Chile	Obs	UK	Obs
Full Sample				
Sales (2003 International U$S, 000) *	5276.29	1048	5327.99	2818
Employment*	54.00	1048	50.00	2818
Sales per Employment (2003 International U$S, 000) *	97.62	1048	102.78	2818
Product Innovation (0/1)	0.36	1048	0.29	2818
Novel Products (0/1)	0.22	1048	0.13	2818
Share Innovated Products	0.09	1048	0.06	2818
Innovators	0.53	1048	0.35	2818
High Technology Sector	0.26	1048	0.38	2818
Capital Expenditure (0/1)	0.69	1048	0.80	2818
Innovators				
R&D (1/0)	0.58	555	0.56	983
Continuous R&D (0/1)	0.37	555	0.46	983
Cooperation (0/1)	0.11	555	0.31	983
Perceived Competition (0/1)	0.74	555	0.62	983
If within firm (0/1)	0.62	555	0.46	983
If inst (0/1)	0.35	555	0.40	983
If market (0/1)	0.57	555	0.49	983
If public (0/1)	0.62	555	0.46	983

Note: (*) median, for the rest of the variables is the mean.

Table III.9 shows the results from this first comparison. The top panel of the Table shows the descriptive statistics for the full sample, while the bottom panel describes the average results for the innovators sample only. This is due to the fact that the Chilean questionnaire has a filter after the innovation section. Although the UK questionnaire does not have any filter and firms are asked to answer all questions, we have decided to also restrict the sample for the UK for innovators in order to make comparison easier.

The first variable in Table III.9 is sales: the median Chilean manufacturing firm had sales for about US$ 5.3 million in 2003 while the median UK manufacturing firm declared sales for US$ 5.3 million in 1998 as well. At the same time the median Chilean firm employed 54 workers in 2003, while the median UK firm had 50 workers in 1998. In general, we can say that the size of the firms across both samples is relatively the same. This striking result is clearly a consequence of the differences in the sampling frameworks among the surveys. Indeed, from the discussion of above we already know that the Chilean survey is biased towards a higher sampling of large manufacturing establishments, while the UK methodology produces a more balanced sample across the different sizes.

Talking plain, we are comparing the "cream" of the Chilean manufacturing sector with the "average" UK manufacturing firm. As a consequence of these differences in the sampling frameworks, labour productivity is roughly the same in both countries. These differences should be taken into consideration at the moment of comparing the innovation performances of both countries.

Regarding to innovation outputs, we have that 53% of Chilean firms can be considered innovators (products, processes, services, packing, design and organisational change innovations), this figure is only 35% for the UK (that include products, processes and organizational change innovations). With respect to product innovations we have that 36% of Chilean firms introduced some product innovation and that 22% introduced novel products (either for the national or international markets), similar figures for the UK are 29% and 13%. For the other variables, we see that Chile has a productive structure more biased towards low high technology industries (the percentage of firms operating in high technology sectors in Chile is 26%, the same variable for the UK is 38%).

Moving to the innovators sample, we have that 57% of Chilean firms had R&D activities (56% in the UK), while 37% of Chilean firms carried out continuous R&D (this figure for the UK is higher: 46%). With respect to the sources of information for innovation: market and public sources had a higher intensity in Chile while institutional sources had a higher intensity in the UK. Within firm sources of information had a higher intensity in Chile and the intensity of competition was perceived as more intensive in Chile as well. Finally, firm's propensity to cooperate in order to carry out innovation activities is higher in the UK.

It might be interesting to compare high productivity Chilean firms with high productivity UK firms. Unfortunately, we lack the information regarding the UK register to make a similar analysis as in the Chilean case. One way of moving forward is to use the UK sample and assume that the UK CIS sample is a representative sample of the UK manufacturing sector. Under this assumption we can select the largest UK manufacturing plants that explain 85% of total UK sample manufacturing turnover.

Table III.10 shows the results of comparing the "cream" of Chilean firms with the "cream" of UK firms. As it is possible to see from the sample, the frontier UK firm was more than 8 times larger than the frontier Chilean firm in term of turnover and 6 times larger in terms of employment. Overall, labour productivity was 50% higher in the UK frontier representative firm.

Table III.10. Descriptive Statistics, UK adjusted sample (largest 85%).

Variable	Chile	Obs	UK	Obs
Full Sample				
Sales (2003 International U$S, 000) *	5276.29	1048	44672.1	774
Employment*	54.00	1048	314.00	774
Sales per Employment (2003 International U$S, 000) *	97.62	1048	149.75	774
Product Innovation (0/1)	0.36	1048	0.45	774
Novel Products (0/1)	0.22	1048	0.22	774
Share Innovated Products	0.09	1048	0.08	774
Innovators	0.53	1048	0.54	774
High Technology Sector	0.26	1048	0.44	774
Capital Expenditure (0/1)	0.69	1048	0.96	774
Innovators				
R&D (1/0)	0.57	555	0.66	419
Continuous R&D (0/1)	0.37	555	0.59	419
Cooperation (0/1)	0.11	555	0.37	419
Perceived Competition (0/1)	0.74	555	0.60	419
If within firm (0/1)	0.62	555	0.64	419
If inst (0/1)	0.35	555	0.48	419
If market (0/1)	0.57	555	0.52	419
If public (0/1)	0.62	555	0.42	419

Note: (*) median, for the rest of the variables is the mean.

Looking at innovation outputs we found that UK frontier firms have introduced more product innovation than Chilean frontier firms. Interestingly, both samples show the same intensity regarding novel products, suggesting that UK frontier firms are more innovative regarding improving on technologically existent products. Regarding innovation inputs, many of the results depicted in table III.9 remain: Chilean firms have a higher propensity to spend in R&D, but this is activity is more casual and sporadic than in the UK case. UK frontier firms are more likely to cooperate than Chilean firms and also they are more permeable to technological information flowing from public research institutions. On the other hand, Chilean frontier firms are more biased towards the use of market and public sources of information.

We close this section by looking at some partial correlations between innovation outputs (measured by the introduction of novel products to the market) and different explanatory variables. We want to emphasise that we not dealing with issues of causality here. Rather than this, we aim to carry-out an exploratory analysis of the correlations between innovation inputs and outputs. The explanatory variables used in this experiment are the same listed in Table III.9. For the estimations we will make use of large sample because that allows having

more comparable firms in terms of size and labour productivities. In all the regressions we also control for sector affiliation.

The dependent variable for the Chilean case is the introduction of a novel product (a product which is new to the market). That is a (0/1) variable. However, due to the fact that the Chilean survey includes a filter for innovators, all innovation input variables are defined only for this subset of firms. This introduces a problem of selectivity in the sample. In order to, at least partially, control for this problem we estimate a probit model with sample selection[23]. The selection equation depends on size (ln of employment, measure with one year lag) and two dummy variables: presence of capital investment one year before and the high technology sector dummy. We do not impose any exclusion constrain and these same variables are also included in the main probit equation. As a consequence, identification in our probit equations is based on the functional assumption of jointly normality of the errors in the two equations. Note that this sample selection probit model is relevant for the Chilean sample only. The UK survey does not include any filter and hence information about innovation inputs is available for all firms.

Table III.11 summarises the results of this estimates. For the Chilean sample we have that the probability of being an innovator increases with size, capital expenditures, labour productivity and being located in a high technology sector. All these variables are statistically significant (column 1). Column (2) shows the results for the Chilean sample when the dependent variable is the introduction of a novel product innovation. In this case, we have that also size, a high technology sector, investment and labour productivity increase the probability of launching a novel product. Additionally, doing R&D and doing it continuously also makes novel product innovation more likely. From the other variables, the only one significantly different from zero and positively correlated with innovation is using information from public sources. Note that we obtain a significantly positive and very high cross-equation correlation, this could be suggesting the influence of omitted unobserved factors, such as the quality of management and the environment of the firm, that are common to both the selection and the innovation equations.

Column (3) of Table III.11 shows the unconditional results for the UK. In this case we have that capital expenditures, R&D activity and continuous R&D are all positively and significantly correlated with innovation as in the Chilean case. We also found some interesting differences. We got that perceived competition, information from suppliers and clients and cooperation were also correlated with innovation. None of these variables was significant in the Chilean case. On the

[23] See Van de Ven and B.M. Van Pragg (1981).

other hand, public sources of information that where significant in Chile were no longer significant in the UK. As an overall assessment we can say that market mediated information sources and transactions are more relevant for innovation in the UK than in Chile.

Table III.11.
Maximum likelihood estimates of the Probit model with sample selection

	CHILE	CHILE	UK
COEFFICIENT	Propensity to Innovate	Intensity of Innovation	Intensity of Innovation
Log of employees (t-1)	0.205***	0.104***	-0.0192
	(0.021)	(0.036)	(0.031)
Capital Expenditure (t-1)	0.767***	0.566***	0.191*
	(0.070)	(0.11)	(0.11)
High technology sector (0/1)	0.275***	0.339***	0.0621
	(0.063)	(0.095)	(0.071)
Log labour productivity (t-1)	0.0667***	0.0647*	0.0741
	(0.021)	(0.038)	(0.055)
R&D (0/1)		0.251**	0.349***
		(0.11)	(0.084)
Continuous R&D (0/1)		0.279***	0.522***
		(0.11)	(0.085)
Cooperation (0/1)		0.211*	0.411***
		(0.13)	(0.088)
Perceived Competition (0/1)		0.126	0.693***
		(0.10)	(0.096)
Inf Institutions (0/1)		-0.0414	0.0479
		(0.089)	(0.083)
Inf market (0/1)		0.0312	0.321***
		(0.089)	(0.10)
Inf public (0/1)		0.292***	-0.0339
		(0.097)	(0.093)
Constant	-1.700***	-2.649***	-2.594***
	(0.14)	(0.24)	(0.28)
Observations	1048	1048	2818
Cross-equation correlation		0.90***	

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

In order to assess the economic impact of these results we also computed the marginal effects (see Table III.12).

Table III.12.
Estimated Marginal Effects for the Probit model with sample selection.

	CHILE			UK
	Effects on the	Effects on the	Effects on the	Effects on the
COEFFICIENT	Expected Propensity to	Expected propensity of novel products	Expected propensity of novel products	Expected propensity of novel products
	Innovate	Conditional on being innovative	Unconditional	Unconditional
Log of employees (t-1)	0.0814	-0.0017	0.0298***	-0.00280
	(0.0084)***	(0.0170)	(0.0091)	(0.0045)
Capital Expenditure (t-1)	0.2979	0.0728	0.1383***	0.0257*
	(0.0251)***	(0.0514)	(0.0221)	(0.014)
High technology sector (0/1)	0.1081***	0.1021**	0.0971***	0.00915
	(0.0221)	(0.0510)	(0.0281)	(0.011)
Log labour productivity (t-1)	0.0265***	0.0151	0.0174*	0.0108
	(0.0814)	(0.0183)	(0.0100)	(0.0080)
R&D (0/1)		0.1270**	0.0677**	0.0598***
		(0.0510)	(0.0310)	(0.017)
Continuous R&D (0/1)		0.1421**	0.0753**	0.0925***
		(0.0520)	(0.0281)	(0.018)
Cooperation (0/1)		0.1070*	0.0571*	0.0735***
		(0.0660)	(0.0371)	(0.019)
Perceived Competition (0/1)		0.0640	0.0339	0.105***
		(0.0510)	(0.0271)	(0.015)
Inf institutions (0/1)		-0.0210	-0.0111	0.00708
		(0.0410)	(0.2391)	(0.012)
Inf market (0/1)		0.0151	0.0083	0.0469***
		(0.0457)	(0.0239)	(0.015)
Inf public (0/1)		0.1480***	0.0787***	-0.00493
		(0.0491)	(0.0261)	(0.013)

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The first column in Table III.12 shows the marginal effects for the selection equation in the case of Chile. We see that 1% increase in size increases the probability of being innovative by 0.08%. Similarly 1% increase in labour productivity leads to an increase of 0.03% in the probability of being innovative. On the other hand, being in a high technology sector gives 10% higher probability of being innovative, while having invested in the previous year increases the probability of being innovative by almost 30%. Column (2) shows the marginal effects for innovators only. Here we find that size and investment are no longer significant. We also observe that doing R&D increases the probability of introducing a novel product by 12%, doing continuous R&D increases the same probability by 14% and doing R&D cooperation increases the same probability by 10%.

Table III.12, column 3 shows the unconditional results. In this case we see that an increase of 1% in size and labour productivity, increases the probability of introducing a novel product by 0.03% and 0.02% respectively. Also, having invested in the previous year increases the unconditional probability of introducing a novel product by 13%, while being in a high technology sector increases the same probability by 9%. With respect to the innovation inputs, we get that spending in R&D increases the unconditional probability of novel products by 6%, while doing continuous R&D by 7%. R&D cooperation and using public sources increase the likely of introducing a novel product by 5% and 7% respectively. The final column in Table III.12 shows the marginal effects for the UK sample. The UK results confirm that past investment have higher effects in Chile than in the UK, that R&D has a higher marginal effect in Chile than in the UK, but that continuous R&D has a higher marginal effect in the UK. R&D cooperation seems to have slightly higher pay-offs in the UK. The differences among the coefficients are quite small and it still has to be analysed if they are statistically different across the samples. What is clear though is that perceived competition induces 10% higher innovation probability in the UK and that using market information (clients and suppliers) lead to 5% higher probability of innovation in the UK.

(IV) Conclusions.

Over the last ten years, Latin American innovation surveys have become key research inputs of a new generation of innovation studies[24] and science and technology policy makers increasingly use them as well. However, many of these advances are confined to country level studies and very little is what has been advanced on the comparability side. Indeed, following the conceptual framework set by the Oslo Manual (or its Latin American adaptation: the Bogotá Manual), all innovation surveys implemented so far in Latin America have adopted a "subject" approach where the unit of analysis is the firm and its innovation behaviour as opposite to an "objective" approach where the unit of the analysis is some innovation output. In theory, this common conceptual framework might allow for harmonized basic definitions for the key variables (such as innovation outputs, R&D, impacts, linkages and obstacles). However, different national objectives by those public institutions in charge of funding and collecting the data, led that actual implementation has been very heterogeneous and sometimes-large differences among the questionnaires and methodologies

[24] As examples of an ever increasing list of research outputs we can cite the papers Marin and Bell (2006) and Chudnovsky et.al (2006) using the Argentinean innovation survey and the work by Benavente (2006) with the Chilean innovation survey.

are observed. And even more worrying is that heterogeneity across the surveys seems to be increasing.

After over ten years of experience in Innovation Surveys' in Latin America, two types of situations can be observed. Firstly, there are countries experiencing serious difficulties in their statistical systems, which prevent them from developing a systematic form of measurement in the area of innovation. Secondly, a group of countries has emerged which have achieved some degree of continuity in this task, but the absence of a supra-national institution that sets a common standard and weak incentives for generating comparable indicators conspire against data's quality and exploitation possibilities, reducing the social return of these efforts and preventing their consolidation.

Despite this situation, this paper clearly shows that there are, indeed, several questions in the surveys that are very similar to the ones included in the CIS and that, with some limitations, this should allow for some minimum comparability. This is particularly true for the Brazilian and Chilean surveys. The departures are a bit larger for the Uruguayan and the Argentinean surveys. In the questionnaires, the largest differences with respect to the CIS are related with a higher emphasis human resources (both overall and for innovation related employees) and embodied technical change. This is consistent with a fact that innovation processes in catching-up countries are far more incremental and adaptative.

In general we can say that there exist some chances to build a set of homogenous and comparable indicators although, in many cases, some sort of adjustments will have to be considered in order to increase the sample of countries. In order to implement these adjustments; some access to the raw microdata might be required. Particularly encouraging is the finding that information regarding efforts in innovation activities is particularly well covered. This might allow for very detailed analysis of the different innovation strategies followed by the firms. However, in order to increase comparability across the surveys, a higher data processing harmonization might be required. This includes procedures to make samples more similar and the criteria needed to generate both simple and complex indicators. These tasks should be responsibility by those actors more interested in reaching some degree of convergence among the surveys: analysts and researchers.

A complementary approach to increase comparability is by increasing the degree of coordination by those actors less interested on reaching harmonization: the national offices of statistics. It is their responsibility the decisions on key variables such as timings, sampling frameworks, questionnaire designs, etc. In order to reach this is necessary some compromise and involvement by policy

makers, in particular the different Science and Technology secretaries and ministries in the region. Institutional harmonisation should be seen as a preliminary step towards reaching a full methodological and research convergence. The last one is not possible without the former one.

Finally, the accumulated experience is very rich and abundant, and so is the list of problems and challenges to be faced. On a theoretical level, we still need to better understand the specific features of innovation in developing economies. On a methodological level, it is necessary to develop better measurement tools to address certain issues more adequately and improve the constitution of panels and samples. As regards institutions, it is important to guarantee that enough resources are available to conduct the surveys, have trained human resources, and adhere to and apply internationally accepted standards and ensure continued efforts. On the analytical level, it is necessary to work to turn databases into new findings and recommendations of policies. And most importantly, it is necessary to make progress simultaneously in all the above areas to enhance interaction and learning among information users.

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