The Innovation and Entrepreneurship Latinamerican Scoreborard: The impact of University-Industry Cooperation in Ecuador

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7 July 2008

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1. Introduction

One of the structural problems in Latin-American has been the lower innovative capacity and lower generation of economically exploitable knowledge. This phenomenon has been produced by the absence of government's incentives and strategies in order to be competitive inside the Knowledge Based Economy. More concretely, political, institutional and social factors have contributed negatively within this reality. As a consequence, the knowledge generation in this region is insufficient not only to satisfy its necessities but also to be competitive in the global context. At difference, the developing regions have recognized the significance impact of R&D investment and Education in their sustainable growth. A clear example has been the collaboration agreements among government, university, and industry in order to share resources and capacities.

In the Latin-American context, this analysis requires robust indicators that help to evidence the causes of this problematic. In this respect, the absence of harmonized politics and common variables that allows studying the evolution of R&D in the Latin-American region is the main limitation for this analysis. Based on that, this report brings an exploratory analysis that allows identifying the critical factors and the possible solutions at this R& D problematic. In parallel, the case of the National Innovation System implanted in Ecuador is evaluated. This report uses the methodology proposed by the European Commission in the study about the "European Innovation Scoreboard 2007" [1]. Specifically, this methodology is adapted at the Latin-American reality.

In summary, the results will provide the current picture of the innovation and entrepreneurship in Latin-American Countries. In this line, the impact of university and industry collaboration is also evidenced in the National Innovation System of Ecuador. Regarding with the structure, this report is structured in four sections that provide information about the main characteristics of Ecuador and its National Innovation System; the description about the methodology applied in this analysis; the results obtained to Latin-American Countries; and the conclusions obtained with this investigation.

2. The Innovation and Entrepreneurship in Ecuador

2.1 Ecuador Profile

Officially, Ecuador is namely Republic of Ecuador. The government system is a Representative Democratic Republic. The current president is Rafael Correa. This country is localized in South America and bordered by Colombia (on the north), Peru (east and south), and the Pacific Ocean (west). Also, this country includes the Galápagos Islands localized in the Pacific Ocean. Thus, Ecuador straddles the Equator, from which it takes its name. It has an area of 256,371 km2 and its capital city is Quito. Other relevant characteristics are summarized in the next table.

Tabla 1: Ecuador Profile

Capital	Quito
Official Languages	Spanish, Quechua
Government	Presidential Republic
Independence	From Spain May 24, 1822
Population (2007 estimations)	13,755,680 (65th)
GDP (2006 estimations per capita)	$4,776 (111th)
Currency	U.S. dollar[2] (USD)

[1] European Commission (2007): European Innovation Scoreboard. Comparative analysis of innovation performance. Pro INNO EUROPE Paper No.6.

By several years, the economy of Ecuador has been supported by the exportation of primary products such as petroleum, banana, shrimp, and flowers. In this respect it is important to mention that the industrial products that are exported do not have a highest technological component. At the same time, other contributors for the economy have been the ecotourism and the transferences of money from immigrants. Within this panorama, it is necessary to transform the productive matrices in order to promote the sectors with more competitive advantages. In this case, the best way is with the establishment of an efficient R&D normative. A clear example of these initiatives has been the *National Innovation System* implemented in the current governmental period.

2.2 National Innovation System of Ecuador

The National Innovation System of Ecuador was developed by the Secretaria Nacional de Ciencia y Tecnología –SENACYT- (National Science and Technology Department). This initiative was encouraged by the government within the strategic lines implemented on the Human Development Plan 2007-2010. The main aim of this system is the investment in science and technology in order to contribute to the economic and social development (SENACYT, 2007).

At the same time, this legislation promotes the collaboration among government, university and industry in order to achieve the objectives defined. Concretely, the main actions are associated with:

- The promotion of human, social, and productive development
- The diffusion of science, technology and innovation
- The transversally and convergence
- The reinforcement of the system
- The sustainable funding

In this context, the priority economic sectors are associated with the sustainable agriculture; the environment and sustainable development; the industrial and productive reinforcement; the renewable energy alternatives; the information and communication technologies; the biotechnology; and other scientific research areas (see Annex 1).

2.3 Main R&D Indicators from Ecuador

Before to start the analysis of the R&D scores of Ecuador it is important to have an idea about the most relevant indicators associated with these activities. In this sense, Table 2 provides a comparative of the R&D indicators of Ecuador in 1998 and 2003. As can be seen, there is a tendency to reduce the expenditure in science and technology (from 0,09% R&D/GDP to 0,07%). In this line, the R&D strategy shows that the main resources were funding by the government (90%).

In 2003, the percent of resources for research developed by private organizations without economic objectives evidenced a significant increment (17% in 1998 to 41% in 2003). At the same time, the reduction was observed in the government research institutions (62% in 1998 to 35% in 2003) and higher educational institutions (16% in 1998 to 10% in 2003). As a consequence, a decrement of human resources in science and technology, and a reduction of patents applications and patent granted were observed. At this moment, the first data analysis evidenced the weakness of government's incentives and strategies in order to be competitive inside the Knowledge Based Economy.

[2] Sucre until 2000 followed by the U.S. dollar and Ecuadorian centavos coins.

Table 2: R&D Indicators from Ecuador

		1998	2003
GROSS DOMESTIC PRODUCT (GDP) Million		19 722,6	27 200,0
R & D EXPENDITURE (million)	ACT	52,3	49,1
	R & D	18,2	18,6
R & D EXPENDITURE vs. GDP	ACT	0,27%	0,18%
	R & D	0,09%	0,07%
R & D EXPENDITURE BY INDIVIDUAL USD	ACT	4,30	3,87
	R & D	1,50	1,46
R & D EXPENDITURE BY TYPE OF RESEARCH	Basic Research	30,1%	22,0%
	Applied Research	63,9%	54,8%
	Experimental	6,0%	23,1%
	Total	**100,0%**	**100,0%**
R & D EXPENDITURE BY SOURCE OF FUNDS	Government	90,6%	
	Enterprises		
	Higher Education		
	Private Organizations	0,5%	
	Foreign	8,9%	
	Total	**100,0%**	
R & D EXPENDITURE BY APPLICATION AREA	Government	61,9%	34,9%
	Enterprises	4,7%	12,9%
	Higher Education	16,1%	10,8%
	Private Organizations	17,2%	41,4%
	Total	**100,0%**	**100,0%**
R & D HUMAN RESOURCES Persons	Researchers	1.422	845
	PhD Students		
	Technical support	874	710
	Staff	1.019	706
	Total	**3.315**	**2.261**
EJC	Researchers	1.014	645
	PhD Students		
	Technical support	874	
	Staff	1.019	
	Total	**2.907**	**645**
PATENTS APPLICATIONS	Residents	100	18
	Not residents	440	404
	Total	**540**	**422**
PATENTS GRANTED	Residents	18	2
	Not residents	291	38
	Total	**309**	**40**

3. Methodology

The methodology of this study is based on the model applied in the "European Innovation Scoreboard 2007" [3]. More specifically, this report follows its key categories (inputs and outputs) but with an adequacy in the variables used. The main reason was associated with the available data for Latin-American Countries. In this line, the main data source was the KAM (Knowledge Assessment Methodology[4]) that is an interactive benchmarking tool created by the Knowledge for Development Program (World Bank, 2008). This objective is helping countries to identify the challenges and opportunities that they face in making the transition to the knowledge-based economy. Therefore, the KAM provides more than 83 structural and qualitative variables for 140 countries. These variables measure the performance of the Knowledge Economy (KE) pillars:

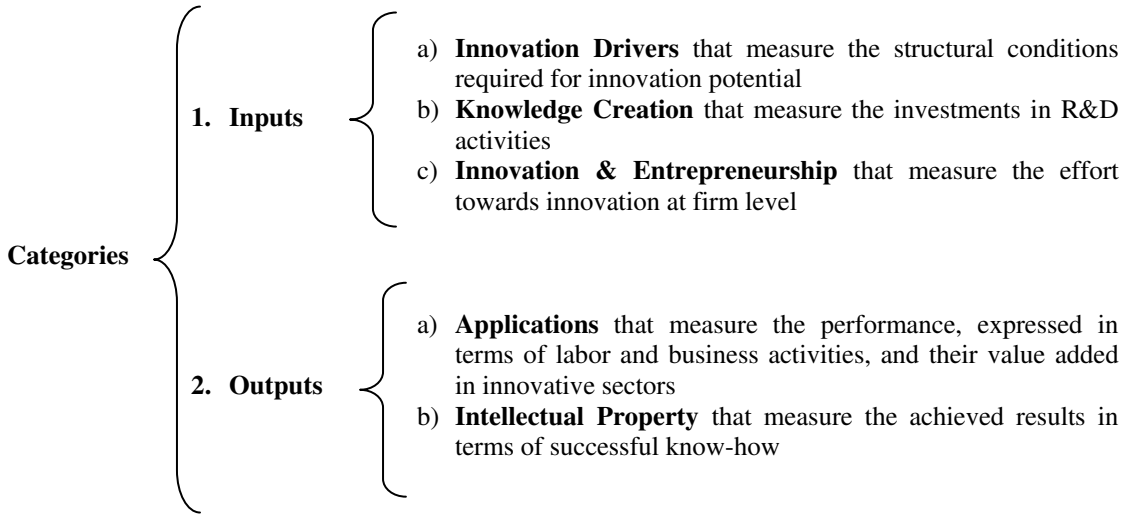
[3] European Commission (2007): European Innovation Scoreboard. Comparative analysis of innovation performance. Pro INNO EUROPE Paper No.6.

[4] www.worldbank.org/kam

Economic Incentive and Institutional Regime; Education; Innovation; and Information and Communications Technologies.

In this paper were selected only 24 variables associated with the Knowledge Economy pillars for Ireland, Spain, United States, Japan, and 21 Latin-American Countries. Following the European Commission Methodology, these variables were grouped in two main themes (inputs and outputs) and classified into five dimensions (see Figure 1). For further information see the Annex 2 that describes with more detail all categories, their indicators, their variables, and their definitions.

Figure 1: Categories and Indicators Data



The next step was calculating the scores by each indicator of every Latin-American Country. This procedure consisted on calculate scaled scores of the indicator data by first subtracting the lowest value found within the group of Latin-American Countries. Afterwards, the difference was dividing between the highest and the lowest value founded within the group. Therefore,

a) The maximum scaled score was equal to 1
b) The minimum scaled score was equal to 0

Finally with the scaled scores obtained (see Annex 3), the Summary Innovation Index was calculated as the average value of all scores where the indicators for which data was available receive the same weight. Therefore, the index is by definition between 0 and 1 for all countries. In general terms, this methodology allows proving comparison among all indicators by countries.

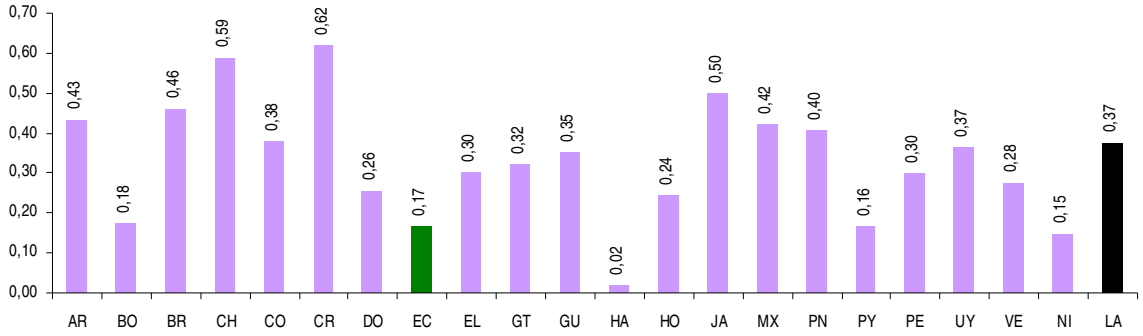
4. Results

4.1 Global Findings

Global Index: The global innovation and entrepreneurship results show that Latin-American has an index of 0,37 points (see Figure 2). At difference of development countries, this would represent a lower level of innovation. Inside this group, the Latin-American leaders in innovation are Costa

Rica (0,62), Chile (0,59), and Jamaica (0,50). While that countries such as Ecuador (0,17), Paraguay (0,16), Nicaragua (0,15), and Haití (0,02) evidenced lower levels of innovation and entrepreneurship. In this context, the most relevant contribution of this investigation is identifying the factors associated with these results. Based on that, partial indexes are estimated and analyzed in the following part (see Annex 4).

Figure 2: Innovation-Entrepreneurship Index



Innovation Drivers: This partial index represent the structural conditions such as human resources, infrastructure, and legislation required for innovation. In this respect, the conditions for innovation in Latin-American countries have a score of 0,47 points. In the case of Ecuador, this country has 0,22 points and it is ranked in the 18th position of only 21 countries. The better conditions for innovations are observed in countries such Chile (0,74), Costa Rica (0,63) and Jamaica (0,65). The worse conditions are identified in Paraguay (0,14) and Haití (0,06). In general terms, this index evidenced the essential elements inside an R&D strategy. In the case of Ecuador those variables shows lower values as a consequence of the politics mentioned adobe (see 2.3). More concretely, the strong impact observed in the reduction of potential Scientifics (see Annex 4.1).

Knowledge Creation: This partial index is associated with the production of knowledge such as the investment in Education and R&D activities. In this panorama, the data evidenced an small indicator of 0,39 points for Latin-American Countries, and 0,16 points for Ecuador (17th position). In this case, the higher investments of Chile (0,68), Costa Rica (0,67) and Brasil (0,62) is observed in R&D Expenditure/GDP, as well as, the number of scientific publications. On the other side, Paraguay (0,09), República Dominicana (0,14) and Haití (0,00) invest less money in these areas. A possible explanation could be associated with the government strategies. In other words, some governments focused the money to cover the main necessities of their population than invest in science and technology.

Innovation & Entrepreneurship: This partial index reflects both the factors associated with the entrepreneurial opportunities and the elements required to develop these activities (financial credits and venture capital structure, collaboration agreements, procedures to start a business, and potential entrepreneurs). At the firm level, Latin-American countries evidenced a lower effort to innovation and entrepreneurship with a score of 0,36 points. In this panorama, Ecuador (0,14), Paraguay (0,06) and Haití (0,01) have a weak action in these areas. At the same time, it is important to recognize the strong effort of Chile (0,68), Panamá (0,75) and Jamaica (0,66) because they show the higher scores

in this group. In summary, the main problematic in innovation and entrepreneurship are linked with the lack of venture capital, and the weak relationship between University and Industry.

Applications: This measure of performance explains the value added produced by innovative sectors in Latin-America (0,30 points). Based on that, the technological contribution of Ecuador has a score of 0,18 points. The major contributions are observed in countries such as Costa Rica (0,68), México (0,38) and Jamaica (0,39). The main explanation is because these countries have a higher exportation in technology.

Intellectual Property: This partial index measures the achieved results in terms of successful know-how. In Latin-America this index is 0,34 points while Ecuador only has 0,13 points. In this context, the successful intellectual property strategy has been implemented in Chile (0,48), Costa Rica (0,62) and Brasil (0,39). These countries have better results associated with the generation, absorption, and commercialization of knowledge.

4.2 Relation between University-Industry in Latin-American Countries

In this section are presented the main results and factors associated with every lower and higher scores (see Table 3). The idea is to identify the strengths and weakness inside the R&D Strategies developed by the Latin-American Countries in comparison with developing countries.

Table 3: Main Results

	Standardized Values						Real Values					
	EC	**LA**	**IR**	**ES**	**US**	**JP**	**EC**	**LA**	**IR**	**ES**	**US**	**JP**
Index Final	**0,17**	**0,37**	**3,42**	**1,26**	**16,06**	**13,76**						
INPUT - Innovation drivers	**0,22**	**0,47**	**1,33**	**1,29**	**1,68**	**1,95**						
Science and Engineering Enrolment Ratio (%), 2006		0,46	0,39	0,73	0,06	0,24		24,15	22,56	29,84	15,59	19,49
Researchers in R&D / Mil. People, 2006	0,00	0,33	3,36	3,17	5,85	6,71	50,18	309,70	2.681,11	2.528,97	4.628,20	5.300,49
Internet Users per 1000 People, 2005	0,05	0,36	0,66	0,85	1,60	1,70	46,60	163,76	275,70	348,40	630,00	667,50
Extent of Staff Training (1-7), 2007	0,10	0,44	1,19	0,62	1,29	1,38	2,90	3,63	5,20	4,00	5,40	5,60
Gross Secondary Enrollment, 2006	0,24	0,54	1,08	1,20	0,77	0,90	64,66	81,11	111,64	118,08	94,12	101,56
Intellectual Property Protection (1-7), 2007	0,33	0,55	1,67	1,38	1,62	1,71	2,70	3,15	5,50	4,90	5,40	5,60
Employment in Industry (%), 2005	0,60	0,58	0,98	1,09	0,57	0,98	21,20	20,84	27,80	29,70	20,60	27,90
INPUT - Knowledge creation	**0,16**	**0,39**	**1,90**	**1,49**	**2,58**	**2,09**						
Total Expenditure for R&D as % of GDP, 2006	0,01	0,27	1,38	1,24	3,06	3,64	0,06	0,28	1,24	1,12	2,68	3,18
Private Sector Spending on R&D (1-7), 2007	0,22	0,43	1,44	0,67	2,00	2,00	2,60	2,98	4,80	3,40	5,80	5,80
Public Spending on Education as % of GDP, 2006		0,39	0,45	0,37	0,61	0,27		4,39	4,80	4,30	5,90	3,60
Quality of Science and Math Education (1-7), 2007	0,33	0,56	1,72	1,00	1,33	1,61	2,70	3,11	5,20	3,90	4,50	5,00
Scientific and Technical Journal Articles / Mil. People, 2005	0,02	0,22	5,33	4,42	7,24	4,54	1,65	21,40	509,73	422,51	692,46	434,14
Quality of Management Schools (1-7), 2007	0,22	0,50	1,09	1,22	1,22	0,48	3,50	4,14	5,50	5,80	5,80	4,10
INPUT - Innovation & entrepreneurship	**0,14**	**0,36**	**1,23**	**0,85**	**1,70**	**1,17**						
University-Company Research Collaboration (1-7), 2007	0,39	0,52	1,61	0,83	2,06	1,67	2,60	2,84	4,80	3,40	5,60	4,90
Availability of Venture Capital (1-7), 2007	0,06	0,37	1,56	1,17	1,78	1,00	2,20	2,77	4,90	4,20	5,30	3,90
ICT Expenditure as % of GDP, 2006	0,00	0,46	0,18	0,09	0,85	0,73	3,00	6,06	4,20	3,60	8,70	7,90
Days to Start a Business, 2008	0,09	0,11	0,60	0,14	1,35	0,32	0,02	0,02	0,08	0,02	0,17	0,04
Domestic Credit to Private Sector as % of GDP, 2006	0,15	0,31	2,23	2,04	2,48	2,15	24,30	36,78	181,30	167,50	200,60	175,20
OUTPUT – Application	**0,18**	**0,31**	**5,69**	**1,18**	**29,85**	**25,50**						
Prof. and Tech. Workers as % of Labor Force, 2004	0,43	0,42	0,86	0,84	0,68	0,35	15,88	15,81	23,58	23,17	20,32	14,54
Intensity of Local Competition (1-7), 2007	0,19	0,17		0,18	0,84	0,59	4,20	6,79		7,10	31,80	22,50
High-Tech Exports as % of Manuf. Exports, 2005	0,25	0,45	0,90	0,95	1,10	1,15	7,60	4,60	5,50	5,60	5,90	6,00
OUTPUT - Intellectual property	**0,13**	**0,34**	**6,96**	**1,47**	**44,49**	**38,10**						
Patents Granted by USPTO / Mil. People, avg 2002-2006	0,09	0,35	16,71	3,17	127,61	109,46	0,22	0,90	42,45	8,04	324,12	278,03
Total Royalty Payments and receipts(US$/pop.) 2006	0,00	0,09	3,01	0,45	4,40	3,34	0,00	4,32	141,64	21,17	207,54	157,53
Firm-Level Technology Absorption (1-7), 2007	0,30	0,59	1,15	0,80	1,45	1,50	3,80	4,37	5,50	4,80	6,10	6,20

Notes: EC: Ecuador; LA: Latinoamerica; IR: Ireland; ES: Spain; US: United States; JP: Japan
Source: KAM, World Bank

The Case of Ecuador corroborates the relevance of some factors involved in the evolution of its R&D strategy. These factors are associated with the inputs and outputs of knowledge generation, innovation and entrepreneurship. Concretely,

- The University-Industry relationship that has a higher contribution in the Innovation & Entrepreneurship Indicator. For example, in development countries such as Spain (0,83) and Ireland (1,61) this variable has a higher score. In the Case of Ecuador (0,39) is evidenced a lower participation between the university and industry (See Annex 4.6).

- The R&D Expenditure/GDP is one of the most important variables inside the Knowledge Creation Indicator in developing countries like Ireland (1,24%) and Spain (1,12%). In Ecuador, the R&D strategy evidenced a lower expenditure in science and technology activities. One explanation could be associated that the financial recourses are used to cover social necessities.

- The patents applications not only evidenced a value added but also the possible commercialization of this new knowledge. In this line, Ireland has a higher score (42,45) that corroborate the importance of this intellectual property outputs for the economic development. In Ecuador this capacity is extremely lower only 0,22 pat./Mill. People.

Finally, these results were contrasted with an exponential regression. This technique allows us to identify that there are countries with similar tendencies. Specifically, this type of regression helps to classify the Latin-American countries in four groups based on their GDP per capita and the Innovation-Entrepreneurship index.

$$y = \alpha e^{\beta x}$$

Figure 3: GDP per capita vs. Innovation Entrepreneurship Index

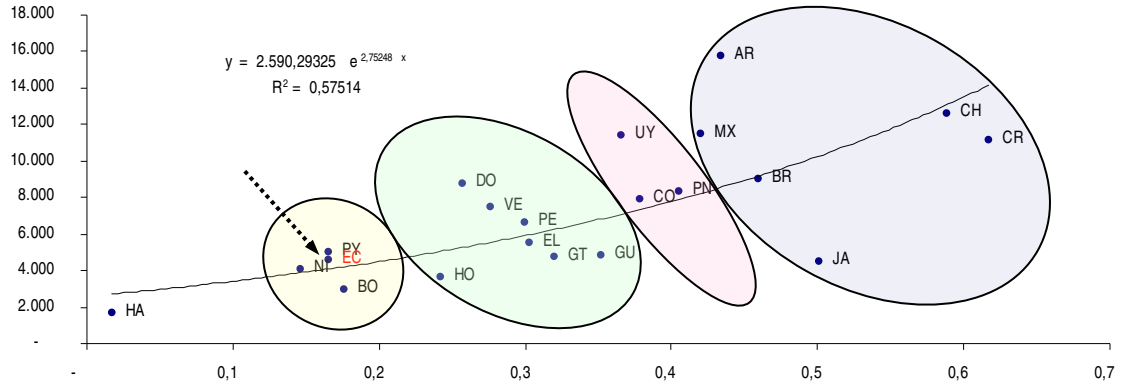


Table 4: Exponential Regression

Parameter	Est value	St dev	t student	Prob(>|t|)
b0	7,859526371	0,194873635	40,33139927	0,000000000
b1	2,752480777	0,542731472	5,071533381	0,000067779
Residual St dev	0,364451088			T = b0 + b1.x1
R2	0,575138451			T=logY
R2(adj)	0,552777317		Y=Exp(T)	2590,293248
F	25,72045083			
Prob(>F)	0,000067779			

According with the exponential regression results, Ecuador is classified inside the group with lower GDP and lower Innovation & Entrepreneurship Index (see Figure 3 and Table 4). This means that the country is facing the transition towards to the Knowledge Economy. The insights are the actions that the current government is development in order to reinforce the social, economical and political structures.

5. Conclusions

This report presents an exploratory study about an approximation of the Innovation & Entrepreneurship Scoreboard in Latin-American. The main limitations are associated with methodological deficiencies that would require more adjusts and additional calibrations. However, the results provide a current picture of the Knowledge Economy in the Latin-American context.

In this panorama, Ecuador would be considerate such a weak country because the majority of its indicators evidenced the deficiencies of its past R&D Strategy. In this perspective, the country needs strong measures focused on promoting the innovation such as a real alternative to economic and social development. Particularly, the evidenced corroborate that a lower investment in R&D activities generated lower technological and innovative outputs (patents and technological value added).

Therefore, it is required that all educational-governmental-industrial spheres work together in order to develop and implement strategies that allows reinforcing its fragile economy. A clear example is the National Innovation System that tries to bring the structures and elements required in this process. At the same time, it is important to know the experience of other countries that have experimented this process. But the most relevant effect of this paper is not identifying the deficiencies even thought understanding that the education, collaboration, and resources are other necessities that need to be covered globally. In this idea, this problematic is not only of the Latin-American countries but also is a global problem that require the collaboration and help of strong countries.

6. References

EU (2007): European Innovation Scoreboard. Comparative Analysis of Innovation performance, PRO INNO EUROPE, European Commission, Paper No.6.

WORLD BANK (2008): Knowledge Assessment Methodology, KAM, [URL: www.worldbank.org/kam]

RICYT (2007): Red de Indicadores de Ciencia y Tecnología -Iberoamericana e Interamericana- (2007): [URL: www.ricyt.org].

SENACYT (2007): Matrix of Science, Technology, and Innovation Areas, Secretaría Nacional de Ciencia y Tecnología, [URL: Senacyt]

7. Annexes

Annex 1: Matrix of Science, Technology, and Innovation Areas

Matriz de áreas: ciencia, tecnología e innovación

ÁREAS PRIORITARIAS		ÁREAS TRANSVERSALES			BIOTECNOLOGÍA	COOPERACIÓN	CAPACITACIÓN
		INVESTIGACIÓN CIENTÍFICA Estudios y caracterización	INNOVACIÓN Y TRANSFERENCIA TECNOLÓGICA Productividad y competitividad	FORTALECIMIENTO SISTEMA Articulación de redes y actores			
20 %	Incremento de la productividad agropecuaria y agrícola sostenible	MEDIO AMBIENTE AGRICULTURA INDUSTRIAS	Uso del suelo, especies, variedades, cultivos, manejo integrado Cultivos cooperativos, por variedades y procesos asociativos Agricultura orgánica Agricultura alternativa Preservación de recursos naturales Utilización eficiente de los recursos no renovables				
25 %	Manejo ambiental para el desarrollo	MEDIO AMBIENTE INDUSTRIAS TURISMO ELECTRICIDAD	Biorremediación ambiental, biotecnología ambiental Recursos forestales Sistemas de información sobre biodiversidad Biorremediación Recursos oceánicos y marinos Manejo y recuperación de cuencas hidrográficas y sus recursos biológicos				
15 %	Fomento industrial y productivo	AGRICULTURA INDUSTRIAS MINAS	Centros de innovación, incubadoras y parques tecnológicos Productos y servicios con finalidad de mercado interno y externo Nuevos productos Electromecánica y metalúrgica, fotoquímica, industria electrónica, semiconductores sólidos				
15 %	Energía, diversificación y alternativas renovables	AMBIENTE ELECTRICIDAD INDUSTRIAS	Biocombustibles Energías renovables Generación de energía a partir de fuentes naturales Geotermia				
5 %	Tecnologías de información y comunicación	TODOS	Acceso, telesalud, teleeducación, gobierno en línea				
20 %	Recuperación de la investigación científica	AGRICULTURA EDUCACIÓN, CULTURA SALUD MINAS TURISMO	Fortalecimiento de la masa crítica e infraestructura de investigación a nivel institucional y nacional Preservación de la vida, bioinformática, ciencias ómicas, terapia genética y celular e ingeniería genética				

LA MATRIZ DEFINE LAS ÁREAS PRIORITARIAS EN CIENCIA Y TECNOLOGÍA DEL GOBIERNO. LA TEMÁTICA DE INVESTIGACIÓN EN CADA CUADRO DEVIENE DE LA PROPUESTA Y CONSENSO ENTRE ACTORES Y DEMANDANTES.
Las Líneas Temáticas son ejemplos a ser dicutidos y consensuados a nivel interinstitucional y nacional.

Annex 2: Categories, Indicators and Variables

Input - Innovation drivers

Science and Engineering Enrolment Ratio (%), 2006	This includes the fields of science (except social science), engineering, manufacturing and construction
Researchers in R&D / Mil. People, 2006	The total number of researchers engaged in R&D, as reported in the selected R&D indicators section of the UNESCO yearbook weighted by million population
Internet Users per 1000 People, 2005	The indicator relies on nationally reported data. In some cases, it is based on national surveys (they differ across countries in the age and frequency of use they cover), in others it is derived from reported Internet Service Provider subscriber counts.
Extent of Staff Training (1-7), 2007	This is based on the statistical score on a 1-7 scale of a large sample group in a particular country responding to the question of whether "in your country, the general approach to human resources is to invest" (1= little in training and development, 7 = heavily to attract, train, and retain staff).
Gross Secondary Enrollment, 2006	The ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education show.
Intellectual Property Protection (1-7), 2007	This is based on the statistical score on a 1-7 scale of a large sample group in a particular country responding to the question of whether intellectual property protection is strong in their country (1= weak or nonexistent, 7 = is equal to the world's most stringent).

Input - Knowledge creation

Total Expenditure for R&D as % of GDP, 2006	Included are fundamental and applied research and experimental development work leading to new devices, products, and processes.
Private Sector Spending on R&D (1-7), 2007	This is based on the statistical score on a 1-7 scale of a large sample group in a particular country responding to the question of whether companies spend heavily on research in their country. (1= do not spend, 7 = spend heavily relative to international peers).
Public Spending on Education as % of GDP, 2006	This consists of public spending on public education plus subsidies to private education at the primary, secondary, and tertiary levels.
Quality of Science and Math Education (1-7), 2007	This is based on the statistical score on a 1-7 scale of a large sample group in a particular country responding to the question of whether math and science education in you country's schools (1 = lag far behind most of the countries, 7 = are among the best in the world).
Scientific and Technical Journal Articles / Mil. People, 2005	This refers to scientific and engineering articles published in the following fields: physics, biology, chemistry, mathematics, clinical medicine, biomedical research, engineering and technology, and earth and space sciences. National Science Foundation, Science and Engineering Indicators. weighted by million population

Input - Innovation & entrepreneurship

University-Company Research Collaboration (1-7), 2007	This is based on the statistical score on a 1-7 scale of a large sample group in a particular country responding to the question of whether companies' collaboration with local universities in research and development activities in their country is (1= minimal or nonexistent, 7= intensive and ongoing).
Availability of Venture Capital (1-7), 2007	This is based on the statistical score on a 1-7 scale of a large sample group in a particular country responding to the question of whether entrepreneurs with innovative but risky projects can generally find venture capital in their country. (1= not true, 7= true).
ICT Expenditure as % of GDP, 2006	Information and communications technology (ICT) expenditures include external spending on information technology ("tangible" spending on information technology products purchased by businesses, households, governments, and education institutions from vendors or organizations outside the purchasing entity), internal spending on information technology ("intangible" spending on internally customized software, capital depreciation, and the like), and spending on telecommunications and other office equipment. World Information Technology and Services Alliance, Digital Planet 2004: The Global Information Economy, and Global Insight, Inc.
Days to Start a Business, 2008	Duration of all procedures required to register a firm
Domestic Credit to Private Sector as % of GDP, 2006	Indicator refers to financial resources provided to the private sector, such as through loans, purchases of non-equity securities, and trade credits and other accounts receivable that establish a claim for repayment. For some countries these claims include credit to public enterprises. International Monetary Fund, International Financial Statistics and data files, and World Bank and OECD GDP estimates.
Quality of Management Schools (1-7), 2007	This is based on the statistical score on a 1-7 scale of a large sample group in a particular country asked to rate the "quality of local management schools". (1= limited or of poor quality, 7 = among the world's best).

Output - Application

Prof. and Tech. Workers as % of Labor Force, 2004	This involves calculation of total number of technical and professional workers as a percentage of the labor force. Data were obtained from Table 2C - Total employment, by occupation.
High-Tech Exports as % of Manuf. Exports, 2005	High-technology exports are products with high R&D intensity, such as in aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery.
Employment in M. and H-tech manufacturing (% workforce)	The proportion of total employment recorded as working in the industrial sector. Industry includes mining and quarrying (including oil production), manufacturing, electricity, gas and water, and construction.
Intensity of Local Competition (1-7), 2007	This is based on the statistical score on a 1-7 scale of a large sample group in a particular country responding to the question of whether competition in the local markets is intense in their country. (1= limited in most industries and price-cutting is rare, 7 = intense and market leadership changes over time).

Output - Intellectual property

Patents Granted by USPTO / Mil. People, avg 2002-2006	Shows the number of U.S. patent documents (i.e., utility patents, design patents, plant patents, reissue patents, defensive publications, and statutory invention registrations) granted. This is the variable above weighted by million population.
Total Royalty Payments and receipts(US$/pop.) 2006	These are payments between residents and nonresidents for the authorized use of intangible, non-produced, non-financial assets and proprietary rights (such as patents, copyrights, trademarks, industrial processes, and franchises) and for the use, through licensing agreements, of produced originals of prototypes, such as manuscripts and films. International Monetary Fund, Balance of Payments Statistics Yearbook and data files.Royalty and License Fees Payments (per mil pop.) + Royalty and License Fees Receipts (per mil pop.).
Firm-Level Technology Absorption (1-7), 2007	This is based on the statistical score on a 1-7 scale of a large sample group in a particular country responding to the question of whether the companies in you country are (1= not able to absorb new technology, 7 = aggressive in absorbing new technology).

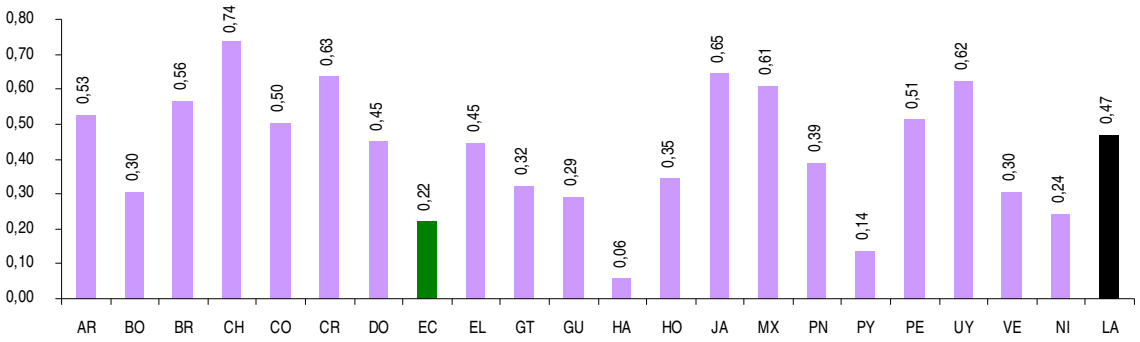
Annex 3: R&D Latin-American Indicators from the KAM

INPUT - Innovation drivers	AR	BO	BR	CH	CO	CR	DO	EC	EL	GT	GU	HA	HO	JA	MX	PN	PY	PE	UY	VE	NI	LA	IR	ES	US	JP
Science and Engineering Enrolment Ratio (%), 2006	19,02		15,89	28,18	35,59	23,34			23,45	18,77	14,29		23,09		31,34	20,47						24,15	22,56	29,84	15,59	19,49
Researchers in R&D / Mil. People, 2006	768,04	120,07	462,06	832,74	127,08	425,26		50,18					65,13		331,46	97,46	85,52		375,39	206,51		309,70	2.681,11	2.528,97	4.628,20	5.300,49
Internet Users per 1000 People, 2005	177,10	52,30	195,00	171,80	103,90	254,20	168,60	46,60	92,60	79,40	213,00	70,40	36,10	403,90	180,60	63,80	33,90	164,50	192,90	124,70	27,20	163,76	275,70	348,40	630,00	667,50
Extent of Staff Training (1-7), 2007	3,60	2,70	4,20	4,30	3,70	4,80	3,40	2,90	3,70	3,80	3,30		3,70	3,70	3,80	3,90	2,80	3,50	3,40	3,50	3,00	3,63	5,20	4,00	5,40	5,60
Gross Secondary Enrollment, 2006	85,58	88,50	105,65	90,79	82,23	79,20	69,07	64,66	64,82	51,12			67,26	87,06	84,68	70,21	66,65	92,42	106,94	74,44	66,49	81,11	111,64	118,08	94,12	101,56
Intellectual Property Protection (1-7), 2007	2,80	2,00	3,30	4,00	3,50	3,70	3,30	2,70	3,30	3,10	2,00		3,30	3,50	3,50	4,10	2,30	2,70	3,90	2,10	2,80	3,15	5,50	4,90	5,40	5,60
Employment in M. and H-tech manufacturing (% workforce)	23,50	28,20	21,00	23,00	18,80	21,60	21,10	21,20	23,70	20,00	22,60	10,70	20,90	17,70	25,70	17,20	15,80	23,80	21,90	19,80	18,00	20,84	27,80	29,70	20,60	27,90
INPUT - Knowledge creation																										
Total Expenditure for R&D as % of GDP, 2006	0,44	0,28	0,91	0,68		0,37		0,06					0,05	0,07	0,41	0,24	0,08	0,15	0,26	0,25	0,05	0,28	1,24	1,12	2,68	3,18
Private Sector Spending on R&D (1-7), 2007	2,90	2,40	3,80	3,30	3,10	4,00	2,70	2,60	2,70	3,20	2,80		2,70	3,50	3,10	3,00	2,20	3,10	2,80	3,00	2,40	2,98	4,80	3,40	5,80	5,80
Public Spending on Education as % of GDP, 2006	3,80	6,40	4,40	3,50	4,80	4,90	1,80		2,80		8,50			5,30	5,40	3,80	4,30	2,40	2,60		3,10	4,39	4,80	4,30	5,90	3,60
Quality of Science and Math Education (1-7), 2007	3,30	2,60	2,80	3,00	3,80	3,90	2,40	2,70	3,10	2,70	3,40		2,80	3,10	2,80	2,90	2,30	2,10	3,60	2,90	2,60	3,11	5,20	3,90	4,50	5,00
Scientific and Technical Journal Articles / Mil. People, 2005	78,92	4,05	52,93	95,67	8,90	24,26	0,70	1,65	0,00	1,28	5,44	0,12	1,81	17,09	37,85	12,79	0,76	4,88	61,71	20,09	1,59	21,40	509,73	422,51	692,46	434,14
INPUT - Innovation & entrepreneurship																										
University-Company Research Collaboration (1-7), 2007	2,90	2,10	3,40	3,50	3,20	3,70	2,60	2,60	2,30	3,20	2,30		2,70	3,40	3,20	2,90	1,90	2,60	2,70	2,90	2,30	2,84	4,80	3,40	5,60	4,90
Availability of Venture Capital (1-7), 2007	2,80	2,30	2,50	3,90	2,90	2,80	2,50	2,20	2,90	2,90	2,20		3,10	2,60	2,80	3,90	2,10	3,00	2,40	2,70	2,30	2,77	4,90	4,20	5,30	3,90
ICT Expenditure as % of GDP, 2006	6,90	4,90	6,40	5,20	8,00	7,30		3,00					4,60	9,70	3,30	8,20		5,90	7,80	3,70		6,06	4,20	3,60	8,70	7,90
Days to Start a Business, 2008	31,00	50,00	152,00	27,00	42,00	77,00	22,00	65,00	26,00	26,00	44,00	202,00	21,00	8,00	27,00	19,00	35,00	72,00	44,00	141,00	39,00	53,57	13,00	47,00	6,00	23,00
Domestic Credit to Private Sector as % of GDP, 2006	13,00	36,10	36,50	82,40	27,70	39,30	26,70	24,30	43,70	26,80	60,20	14,30	49,00	26,50	22,40	88,60	17,20	17,70	26,20	13,20	33,40	36,78	181,30	167,50	200,60	175,20
Quality of Management Schools (1-7), 2007	4,90	3,20	4,10	5,30	4,50	5,10	3,60	3,50	4,20	4,30	3,30		3,50	4,30	4,40	3,70	3,00	4,40	4,40	4,20	3,90	4,14	5,50	5,80	5,80	4,10
OUTPUT – Application																										
Prof. and Tech. Workers as % of Labor Force, 2004	21,29	15,04	13,28	10,81	12,62	21,55		15,88	10,64				8,31	26,03	15,74			17,79	16,35	10,92		15,81	23,58	23,17	20,32	14,54
High-Tech Exports as % of Manuf. Exports, 2005	6,60	9,20	12,80	4,80	4,90	38,00	1,30	7,60	4,10	3,20	1,10	3,50	2,20	0,40	19,60	0,90	6,60	2,60	2,40	2,70	5,20	6,79		7,10	31,80	22,50
Intensity of Local Competition (1-7), 2007	4,20	4,10	5,30	5,70	4,90	5,10	4,40	4,20	4,90	5,00	4,20		4,20	5,10	4,90	4,80	4,10	5,10	4,20	3,70	4,00	4,60	5,50	5,60	5,90	6,00
OUTPUT - Intellectual property																										
Patents Granted by USPTO / Mil. People, avg 2002-2006	1,40	0,02	0,75	0,93	0,24	2,54	0,07	0,22	0,24	0,15	0,00	0,00	0,12	0,46	0,95	0,45	0,00	0,15	0,41	0,89	0,04	0,90	42,45	8,04	324,12	278,03
Total Royalty Payments and receipts(US$/pop.) 2006	1,76	0,21	0,55	3,36	0,25	0,12	0,00	0,00	0,35	0,01	47,12	0,00	0,00	4,78	0,83	0,00	33,24	0,06	0,02	0,00	0,00	4,32	141,64	21,17	207,54	157,53
Firm-Level Technology Absorption (1-7), 2007	4,20	3,20	4,90	5,20	4,20	4,90	4,80	3,80	4,40	4,80	3,70		4,20	4,90	4,40	5,00	3,40	4,30	4,20	4,60	3,50	4,37	5,50	4,80	6,10	6,20

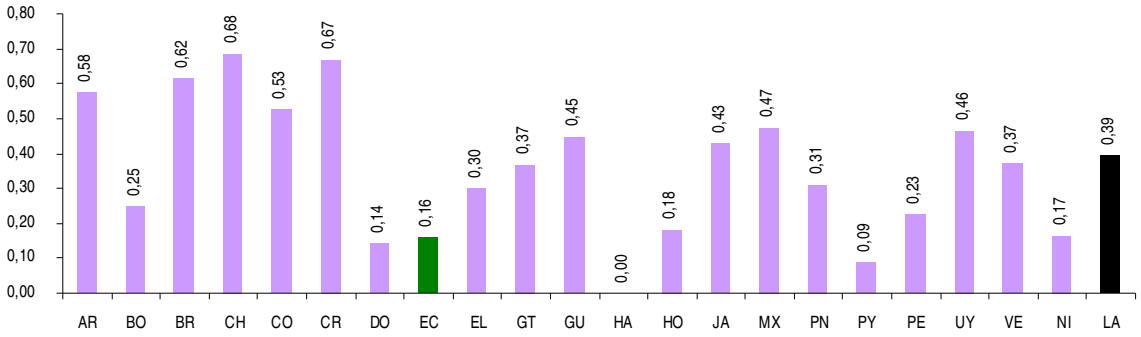
Notes: AR: Argentina; BO: Bolivia; BR: Brazil; CH: Chile; CO: Colombia; CR: Costa Rica; DO: Dominican Republic; EC: Ecuador; EL: El Salvador; GT: Guatemala; GU: Guyana; HA: Haiti; HO: Honduras; JA: Jamaica; MX: Mexico; NI: Nicaragua; PA: Panama; PY: Paraguay; PE: Peru; UY: Uruguay; VE: Venezuela RB; LA: Latin America; IR: Ireland; ES: Spain; US: United States; JP: Japan.

Annex 4: Innovation Indexes

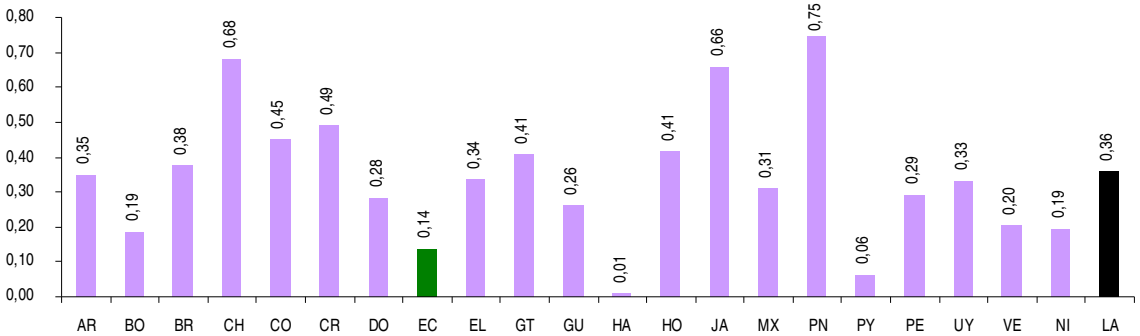
4.1: Innovation Drivers



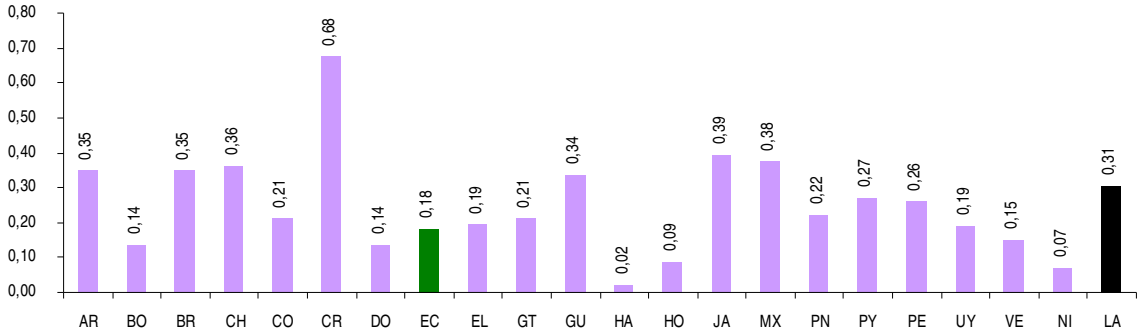
4.2: Knowledge Creation



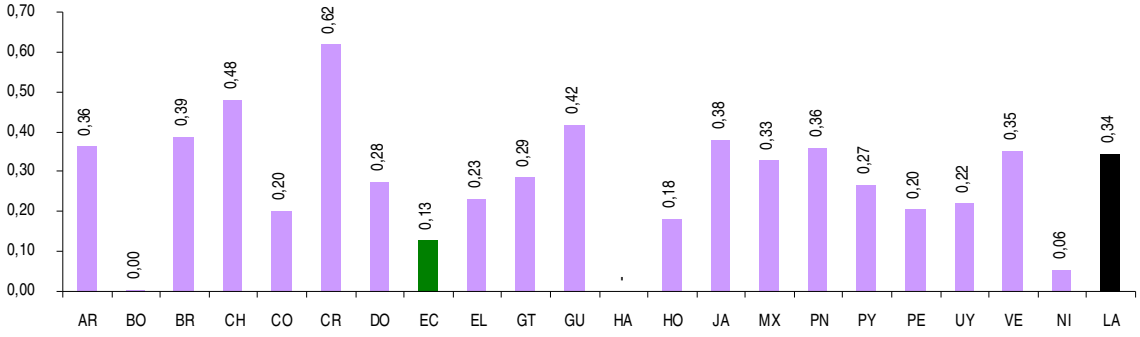
4.3: Innovation and Entrepreneurship



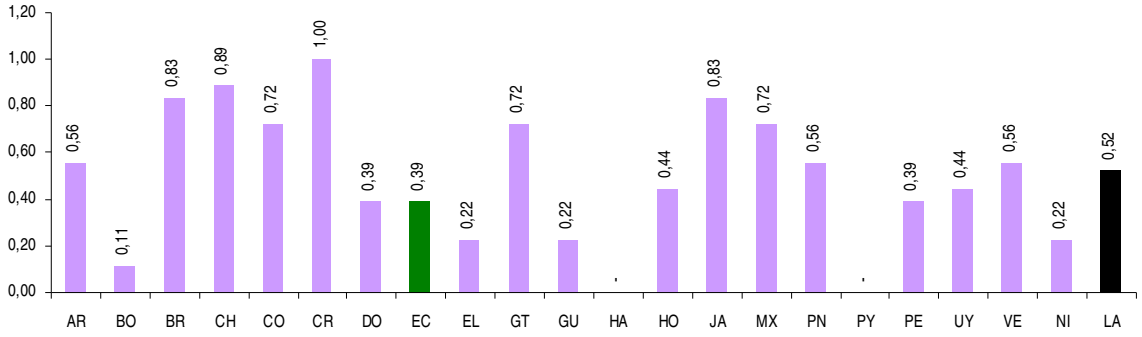
4.4: Application



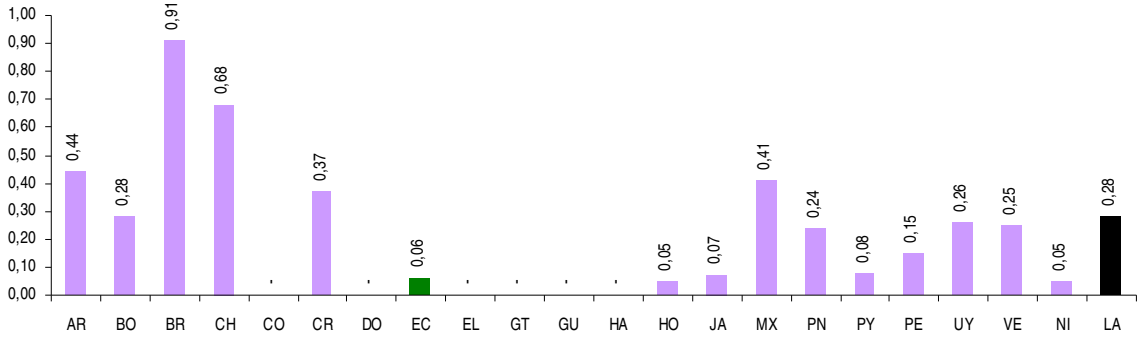
4.5: Intellectual Property



4.6: RD Cooperation University - Enterprises



4.7: R&D / GDP



4.8: GPD per capita