PERU AND THE KNOWLEDGE ECONOMY: A GENERAL ASSESSMENT[+]

JULIO C. AGUIRRE[♦]
INDECOPI

Abstract

This paper deals with the Knowledge Economy framework, defined by the World Bank as an economy in which knowledge is created, acquired, transmitted and used more effectively by entrepreneurs, organizations, individuals and communities to reach higher levels of economic and social development. Given this definition, the goal of this article is to assess Peru's conditions to integrate itself into such an economy. To do this, the assessment evaluates –from a general perspective- its performance on elements such as investments in education, innovation capability, levels of information infrastructure, and economic and institutional regime. As a result, it has been found that Peru is very far from what a Knowledge Economy is supposed to be. The incoming new government should implement different policies in order to: (i) improve the institutional regime, (ii) attract more foreign direct investment, (iii) develop a more efficient National Innovation System, (iv) improve the quality of human capital, and (v) promote a culture of innovation and technological development to take on the path to a knowledge society.

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[♦] Bachelor in Economics from Universidad del Pacífico (Peru) with a Master's Degree in Economics from Georgetown University/ILADES (USA/Chile). Head of the Analysis and Research Unit – Office of Economics Research – INDECOPI. All the opinions and conclusions expressed in this paper do not represent the position of the institutions to which the author is affiliated. Comments and suggestions to jaguirre@indecopi.gob.pe. Any mistake belongs to the author.

I.- Introduction

Peru is a Lower Middle Income[1] country, with a GDP per capita of US$ 2,360 and 27.9 million inhabitants. In the last eight years, the country has shown a robust economic growth of 4.5% annually (Gross Domestic Product - GDP). In spite of this, Peru is confronting diverse obstacles that hinder its growth at higher rates and reduction of its levels of poverty, which exceed the 50% of the total population. According to many studies on Peru's economy, the main constraints are not only related to institutional regime and infrastructure, but also to human capital and technological aspects. In effect, the latter constraints are also present in other Latin American countries. An article posted in The Miami Herald[2] highlights the declining levels in education and technological skills as factors that place the region behind the rest of the world: "(…) while the rest of the world moves toward the knowledge economy –in which a software patent is worth millions of tons of raw materials– and high value-added exports, most Latin American countries remain stuck in their reliance on exports of oil, soybeans and other primary products (…)".

Currently, as Peru is immersed in an electoral debate, the incoming new government must consider the benefits derived from increasing the current global stock of knowledge to accelerate growth. According to the World Bank (2003), it is important an explicit, efficient, and sustained policy to move the private sector to the frontier, and the need for a concerted, rapid build-up of national human capital. For a country like Peru, policies aiming towards increasing quality and efficiency of secondary and tertiary education, increasing linkage between research institutions and the private sector and actively promoting Foreign Direct Investment (FDI), should be priorities.

Given the preceding situation, the following questions arise: How far is Peru from a Knowledge Economy? Can a small and open economy such as Peru be integrated itself into a Knowledge Economy? What are the challenges and opportunities that Peru confronts? How ready is Peru to make a successful transition to a Knowledge Economy? At what stage of that transition is Peru now? Answering these questions is the main goal of this article.

This paper will address the Knowledge Economy framework defined as an economy in which knowledge is created, acquired, transmitted and used more effectively by entrepreneurs, organizations, individuals and communities to reach higher levels of economic and social development. Given this definition, the goal of this article is to assess Peru's conditions to integrate itself into such an economy. To do this, the assessment looks, from a general perspective, at Peru's performance on elements such as investments in education, innovation capability, levels of

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1 According to the 2004 World Bank classification.

2 On Sunday, April 30, 2006. The Oppenheimer Report.

information infrastructure, and economic and institutional environment. These elements have been defined by the World Bank as the four pillars of the Knowledge Economy and together they constitute the Knowledge Economy framework.

The article is structured into four parts. Following this introduction, there is a general description of the Knowledge Economy framework including its definition and the relation between economic growth and Knowledge Economy pillars. The third section deals with an overview on the Peruvian Knowledge Economy from the perspective of the four pillars of the Knowledge Economy. A final section presents some conclusions and future challenges that may be drawn from this assessment.

II.- The Knowledge Economy (KE) framework

Definition and transition to the KE

Knowledge is considered a resource that can create wealth and enhance quality of life. It can be defined as information that is used to make better decisions, which leads to rational actions. Moreover, knowledge can be in the form of documents, procedures, processes and skills that are directly linked to core needs and problems and that have a critical and beneficial impact.[3]

The Organization for Economic Cooperation and Development (OECD, 1996) defined Knowledge Economy as an economy that is directly based on the production, distribution and use of knowledge and information. Furthermore, a knowledge economy can be defined as one in which the production, distribution and use of knowledge are the main drivers of growth, wealth creation and employment across all industries (United Nations, 2005).

In that sense, Aubert and Reiffers (2003) point out that the concrete application of knowledge in the form of new and improved technologies has always been the driving force behind the development of societies. However, these have taken a

[3] The economics literature on Industrial Organization usually defines computer software and entertainment products stored in digital form, such as music, as information goods. Moreover, information goods have a feature that sets them apart from ordinary private goods. They are public goods, i.e. the use by one person does not preclude the use by any other person and does not cost additional resources, except the small cost of distributing them. That is, the use of such a good is non rival. Furthermore, it is difficult to exclude unauthorized users from using such a product once it exists. Intellectual property rights, usually copyrights, are the means by which society tries to create a workable market in information goods. According to Scotchmer (2004), knowledge has the same property. Once there is a known technique for efficiently coding information in microwaves or it is known that DNA is a double helix, then everyone can use that knowledge simultaneously without incurring additional costs of discovery. Then, knowledge and information goods share the same property of nonrivalness. The difference between private goods and knowledge is illustrated by a controversy that arose in the eighteenth century, recounted entertainingly by Sobel (1995).

quantitative jump over the past decade in the wake of the "explosion" of information and telecommunication technologies, the globalization process, and dramatic advances in the life, materials, and energy sciences. These developments have led to new industries and new services, as well as to the renewal of established ones. Countries' competitiveness and welfare depend more than ever on their ability to create and use knowledge throughout the economy.

In the same line, Neef (1998) explains that the basic thesis behind the emergence of a knowledge economy is that since the beginning of the 90's there has been a unique combination of focused market incentives that have led to an immense technical progress in the areas of computing, biotechnology, telecommunications, and transportation (to name only a few) and which have begun to foster dramatic changes in the way in which economies, organizations, and governments will function in the future.

That transition can be explained by the changing nature of the workplace in all major developed economies. According to the same author, during the past several years there has been a marked shift from goods-based production to high-skill, high-technology, and service-based growth. Knowledge in the form of complex problem solving, technological innovation, creative exploitation of new markets, and the development of new product or service offerings is central to success in these areas.

Another important indicator of this knowledge economy transition, Neef says, is the increasing globalization of firms. As the emphasis on computing technology in the past fifteen years has shifted from accounting to high-speed communications, convergent developments –particularly in transport, computing, and telecommunications capabilities– have created a potentially unbounded economic framework in which both a global market and a global labor pool are emerging. In many instances, this electronic corporate globalization is already occurring. More than 100 American firms, for example, outsource their software to sites in India[4], where the work is completed and returned electronically overnight by highly skilled programmers at only a fraction of the labor costs demanded in the US.

The KE and growth

A group of Chicago school economists, namely, T. W. Schultz, Gary Becker, and particularly Robert E. Lucas and Paul M. Romer, technically incorporated more

[4] See in Dahlman and Utz (2005) the potential that India is facing in the Knowledge Economy thanks to key ingredients, such as: (i) critical mass of skilled, (ii) English-speaking workers, especially in the sciences, (iii) a well-functioning democracy, (iv) one of the world's largest domestic market, (v) macroeconomic stability, (vi) a dynamic private sector, (vii) institutions of a free market economy, (viii) a well-developed financial sector, and (ix) a broad and diversified science and technology infrastructure.

direct knowledge into their theories and models, and promoted the research domain of growth theory to the frontier.

Romer (1994) has argued that the neoclassical growth model developed by Solow (1956) only captured the facts that (i) there are many firms in a market economy, (ii) discoveries differ from other inputs in the sense that many people can use them at the same time, and (iii) it is possible to replicate physical activities. For both Romer's model (1986) and Lucas' model (1988), they consider the fact that technological advances come from things that people do and that technology is endogenously provided. In effect, based upon their conceptual nuances, explanations for sources of sustained growth in the new growth literature can be primarily divided into two strands: technological spillovers and human capital spillovers (or normally termed knowledge spillovers). Thus, both authors were the primary developers of the new growth theory. Their work has not only had a tremendous influence on mainstream literature but has also been extolled by the media (Chiang Lin, 2005).

In the same way, endogenous growth models, such as those of Romer (1990), Grossman and Helpman (1991), and Aghion and Howitt (1992), attempt to explain productivity growth by the introduction of a research and development (R&D) sector, with human capital or skilled labor as an input[5]. These models show that the steady-state growth rate of output per worker depends positively on the level of available resources for R&D in the economy, such as the stock of human capital or endowment of skilled labor. Hence, an increase in the average educational attainment of the labor force, for example, will lead to a permanent increase in the long-term growth rate of per capita income.

Subsequent studies such as those of Jones (1995), Kortum (1997) and Segerstrom (1998) develop models in which the growth rate of per capita income depends only on parameters that are usually taken as exogenous, such as the population growth rate and no longer depends on the level of R&D resources in the economy. In such models, levels of human capital and other R&D resources affect only the long-run level of per capita income, but not the growth rate. Finally, Chen and Looi (2005) develop a theoretical model of endogenous growth in which knowledge (technology and human capital) is the main engine of economic development. They find that the growth rate of per capita income hinges on the growth rate of human capital.

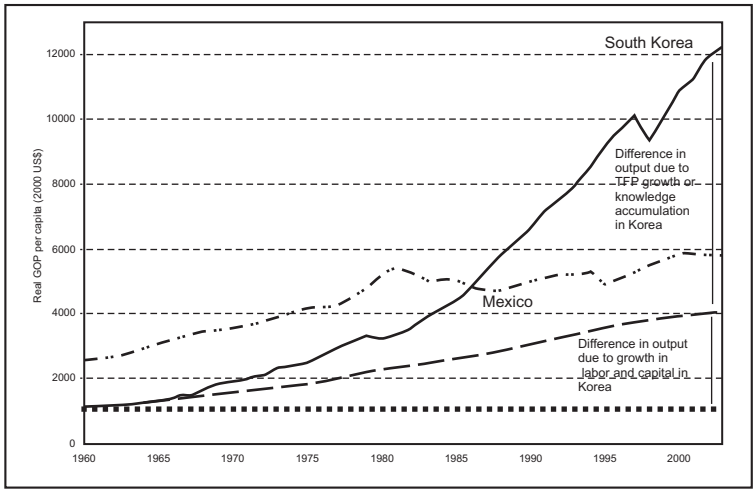
Consequently, the formulation and application by economies of strategies that involve the sustained use and creation of knowledge at the core of a development process will determine sustained economic growth. As Chen and Dahlman (2006) point out, at lower levels of development, which typically imply lower levels of science and technology capability, knowledge strategies typically involve the tapping of existing global knowledge and the adoption of such foreign technologies to local conditions in order to enhance domestic productivity. At higher levels

[5] Many of the subsequent R&D-based models in the new growth literature cited Joseph Schumpeter as an inspiration.

of development, which typically imply higher levels of science and technology capability, knowledge strategies also hinge critically on domestic innovative effort and emphasize the move to produce products and services that have added higher value in order to be consistent with the high wages that are characteristic of these economies.

An example that highlights the contribution of knowledge (represented by the total factor productivity - TFP)[6] to the economic growth is presented in Figure 1, which decomposes South Korea's economic growth over the past four decades. Korea's real GDP per capita, around US$1,110 in 1960, increased eleven-fold to US$12,200 by 2003. In contrast, Mexico's real GDP per capita experienced a slightly more than twofold increase, from US$2,560 to US$5,800 over the same period. It is interesting to see that without the contribution of knowledge, Korea's real GDP per capita in 2003 would still be below that of Mexico (Chen and Dahlman, 2006).

FIGURE 1
SOUTH KOREA: KNOWLEDGE AND GDP PER CAPITA



Source: Chen and Dahlman (2006).

6 Romer (1986, 1990) and Lucas (1988) argued that TFP levels depend on the stock of knowledge or human capital. Grossman and Helpman (1991) postulated that imported goods embodied foreign technology and hence imports would lead to increases in TFP. Similarly, Coe and Helpman (1995) found that for a sample of developed countries both domestic and foreign R&D had significant impact on TFP.

The pillars of the KE[7]

It has been found that a successful transition to a Knowledge Economy typically involves elements such as long-term investments in education, developing innovation capability, modernizing the information infrastructure, and having an economic environment that is conducive to market transactions. These elements have been termed by the World Bank as pillars of the Knowledge Economy and together they constitute the Knowledge Economy Framework.

(i) A conducive economic and institutional regime

The economic and institutional regime of an economy needs to be such that economic agents have incentives for the efficient use and creation of knowledge, and thus should have well-grounded and transparent macroeconomic, competition and regulatory policies.

A "knowledge-conducive" economic regime should be in general one that has the minimal number of price distortions. For example, it should be open to international trade and be free from various protectionist policies in order to foster competition, which in turn will encourage entrepreneurship (Sachs and Warner, 1995; Bosworth and Collins, 2003). Government expenditures and budget deficits should be sustainable, and inflation should be stable and low (Barro, 1991). Domestic prices should also be largely free from controls and the exchange rate should be stable and reflect the true value of the currency. The financial system should be one that is able to allocate resources to sound investment opportunities and redeploy assets from failed enterprises to more promising ones (Levine et al., 2000).

Features of a conducive institutional regime include an effective, accountable and corrupt-free government and a legal system that supports and enforces the basic rules of commerce and protects property rights. Intellectual property rights should also be protected and strongly enforced. If intellectual property rights are not adequately protected and enforced, then researchers/scientists will have less incentive to create new technological knowledge and even in the event that knowledge is created, the lack of intellectual property rights protection will greatly hamper dissemination of such new knowledge (Knack and Keefer, 1995; Kaufmann et al., 2002 and 2003).

(ii) Educated and skilled labor force

A well-educated and skilled population is essential to the efficient creation, acquisition, dissemination and utilization of relevant knowledge, which tends

[7] This section is based on Chen and Dahlman (2006).

to increase total factor productivity and hence economic growth.

Basic education is necessary to increase peoples' capacity to learn and to use information. On the other hand, secondary education, and higher education in engineering and scientific areas is necessary for technological innovation. For example, in industrial economies, university research accounts for a large share of domestic R&D. Technical secondary-level education is also required for the process of technological adaptation of foreign technologies for use in domestic production processes. Such training is necessary to monitor technological trends, assess what is relevant for the firm or economy, and assimilate new technologies. A more educated population also tends to be relatively more technologically sophisticated. This generates local quality sensitive demand for advanced goods, which in turns tends to stimulate local firms to innovate and design technologically sophisticated goods and production techniques.

Most empirical cross-country studies of long-run growth now include some measure of human capital and recent studies of international differences in output per worker (Temple, 1999; Krueger and Lindahl, 2000) and economic growth rates have focused on the role of human capital in economic development (Mankiw et al., 1992; Benhabib and Spiegel, 1994; Hall and Jones, 1999). Regardless of the underlying model, it is a fairly robust finding that a country's human capital is almost always identified as an essential ingredient for achieving growth. Hanushek and Kimko (2000) take an alternative approach by focusing on the effects of educational quality on economic growth. Using international test scores as a proxy for the quality of educational systems, they find that educational quality does exert positive effects on economic growth.

(iii) An effective innovation system

Economic theory indicates that technical progress is a major source of productivity growth and an effective innovation system is the key for such technical advancement (Solow, 1956; Romer, 1986 and 1990). An innovation system refers to the network of institutions, rules and procedures that influence the way by which a country acquires, creates, disseminates and uses knowledge. Institutions in the innovation system include universities, public and private research centers and policy think tanks. Non-governmental organizations and the government are also part of the innovation system to the extent that they also produce new knowledge. An effective innovation system is one that provides an environment that nurtures research and development (R&D), which results in new goods, new processes and new knowledge, hence being a major source of technical progress.

There have been a number of studies that show that innovation or the generation of technical knowledge has substantial positive effects on economic growth or productivity growth. For example, Lederman and Maloney (2003), using

regressions with panel data of five-year averages between 1975 and 2000 over 53 countries, find that an increase of one percentage point in the ratio of total R&D expenditure to GDP increases the growth rate of GDP by 0.78 percentage point. Guellec and van Pottelsberghe (2001) investigated the long-term effects of various types of R&D on multifactor productivity growth using panel data for the OECD over the period 1980-1998. They find that business, public and foreign R&D all have statistically significant positive effects on productivity growth. Adams (1990), using the number count of academic scientific papers of various scientific fields to proxy for the stock of knowledge, finds that technical knowledge contributed significantly to the total factor productivity growth of U.S. manufacturing industries for the period 1953-1980.

(iv) An adequate information infrastructure

Information and communications technologies (ICT) infrastructure in an economy refers to the accessibility, reliability and efficiency of computers, phones, television and radio sets, and the various networks that link them.

One of the most obvious benefits associated with ICT usage is the increased flow of information and knowledge. Because ICTs allow information to be transmitted relatively inexpensively and efficiently (in terms of cost), ICT usage tends to reduce uncertainty and transactions costs of participating in economic transactions. This, in turn, tends to lead to an increase in the volume of transactions leading to a higher level of output and productivity. Moreover, with the increased flow of information; technologies can be acquired and adapted more easily again leading to increased innovation and productivity. Various studies have produced empirical evidence suggesting that substantial productivity gains have been obtained from ICT usage. For instance, Whelan (2000), Oliner and Sichel (2000) and Jorgenson and Stiroh (2000) point to the use of ICT as an important factor in improved Total Factor Productivity growth.

Apart from increasing the supply of information and knowledge, ICTs are able to overcome geographic boundaries. Therefore, international buyers and sellers are increasingly able to share information, reduce uncertainty, reduce transaction costs, and increase competitiveness across borders, all of which result in a more efficient global marketplace. Also, production processes can be outsourced, based on comparative advantage, across national boundaries resulting in further global efficiency gains. Market access and coverage also tend to expand, along with increased access to global supply chains.

The KE framework describing the four pillars has been presented so far, together with their corresponding contribution to promoting economic performance and growth. It is important to note that simultaneous actions and balanced investments

in all four pillars are necessary, as good performance in one pillar often is a precondition for a good performance in the other pillars. A minimum level in human capital is thus required in order for an economy to develop an efficient research and innovation system or to reap the productivity gains from investments in an up-to-date information technology infrastructure. Likewise, if good governance and economic incentives structures are not in place, it is difficult to develop sustained economic growth.

III.- Peru in the four pillars of the Knowledge Economy

Figure 2 shows the KAM Knowledge Economy Index, which is an aggregate index that summarizes performance over the four KE pillars and is constructed based on 12 knowledge indicators.[8-9] The countries that appear in the KEI scatter plot can be loosely grouped into three broad categories in terms of their development towards the knowledge economy. Firstly, located near the top-right corner of the scatter plot, are a group of countries that are in the advanced stages of development in terms of the knowledge economy. These are mostly the economies of the OECD and those of the East Asian Newly Industrialized Economies. Next, around the center of the scatter plot are a group of countries that are midway through the transition to the knowledge economy. The majority of the middle income countries from Europe and Central Asia, Middle East and North Africa, and Latin America are in this category. Lastly, countries that have just embarked on the path to becoming a knowledge economy appear around the bottom-left portion of the scatter plot, and these typically include the low-income economies from Africa and South Asia.

Peru is at the top of the category of countries that have just embarked on the path to becoming a KE, over the 45 degrees line between the 30th and 50th percentile for

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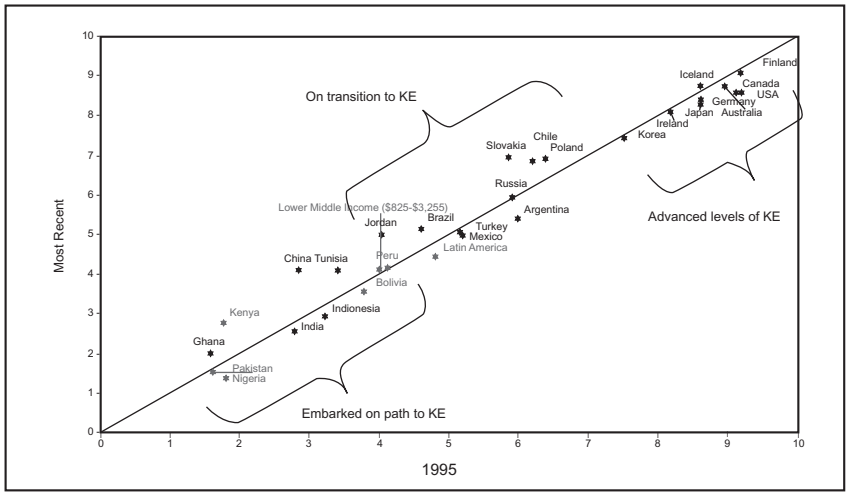
8 The Knowledge Assessment Methodology (KAM) is an interactive benchmarking tool created by the Knowledge for Development Program of the World Bank Institute to help countries identify the challenges and opportunities they face in making the transition to the knowledge economy. The KAM consist of 80 structural and qualitative variables to measure countries' performance on the four KE pillars. Each of the 80 variables in the KAM is normalized on a scale from 0 to 10 against all countries in the comparison group. The default comparison group is "all countries". See more details on this methodology, as well as the variables used, at www.worldbank.org/kam.

9 The 12 knowledge indicators are: (1) Economic and Institutional Regime: (i) Tariff & Non-Tariff Barriers, (ii) Rule of Law, and (iii) Regulatory Quality; (2) Education: (i) Adult Literacy Rate, (ii) Secondary Enrollment, and (iii) Tertiary Enrollment; (3) Innovation: (i) Researchers in R&D per million population, (ii) Patents Granted by USPTO per million population, and (iii) Scientific and Technical Publication per million population; (4) Information Infrastructure: (i) Telephones per 1,000 people, (ii) Computers per 1,000 people, and (iii) Internet Users per 1,000 people.

FIGURE 2[10-11]
GLOBAL VIEW: KNOWLEDGE ECONOMY INDEX



Source: World Bank, "Knowledge Assessment Methodology – KAM".

both 1995 and the most recent year, which means that in the last decade the country has made no progress on the KEI index in a relative sense. As a comparison, notice the higher position of other middle income countries such as Chile, Slovakia and Poland, between the 50th and 70th percentile, at the top of the group of countries that are midway the transition to the KE. These countries not only have progressed but also are closer to the group of countries in advanced stages of development in terms of the knowledge economy.

In this section, an assessment on the four pillars, based on a benchmarking analysis and from a general perspective, will identify the strengths and weaknesses,

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10 The values on the axis are the normalized scores (from 0 to 10) calculated from the available data on the 80 variables, being 10 the top score for top performers and 0 the worst for the laggards. The top 10% of performers get a normalized score between 9 and 10, the second best 10% gets allocated normalized scores between 8 and 9 and so on. More than one country may be allocated either the top or worst normalized scores. The 0 – 10 scales describes the performance of each country on each variable, relatively to the performance of the rest of the country sample.

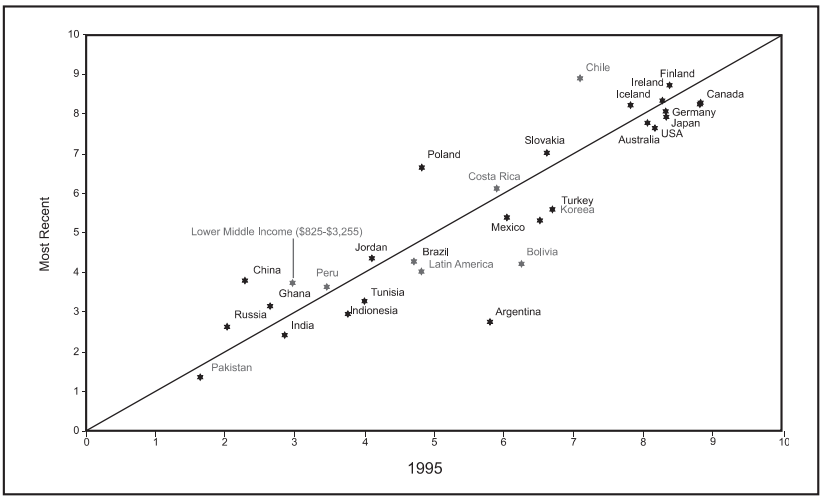
11 The following interpretation applies: the horizontal axis plots countries' and regions' performance in the KEI in 1995, while the vertical axis plots countries' and regions' performance in the KEI for the most recent year, currently 2005. The diagonal line represents the locus of points where the KEI values in 1995 and in the most recent year are equal. As such, countries that appear above the diagonal line have made an improvement in the KEI since 1995, and countries that appear below the diagonal line have experienced deterioration in terms of the KEI.

and also provide information that can help build the capacity of Peru to access and use knowledge to enhance its competitiveness in the global economy and increase its social well-being.

III.1.- Economic and institutional regime

Figure 3 benchmarks Peru's relative global position in the Economic and Institutional Regime based on the Knowledge Assessment Methodology (KAM). It shows that Peru has improved its relative position in the last decade but is so far from Chile's and Costa Rica's positions, the former, in this case, at the top with the group of countries that are in advanced stages of development in terms of this pillar.

FIGURE 3[12]
GLOBAL VIEW: ECONOMIC AND INSTITUTIONAL REGIME

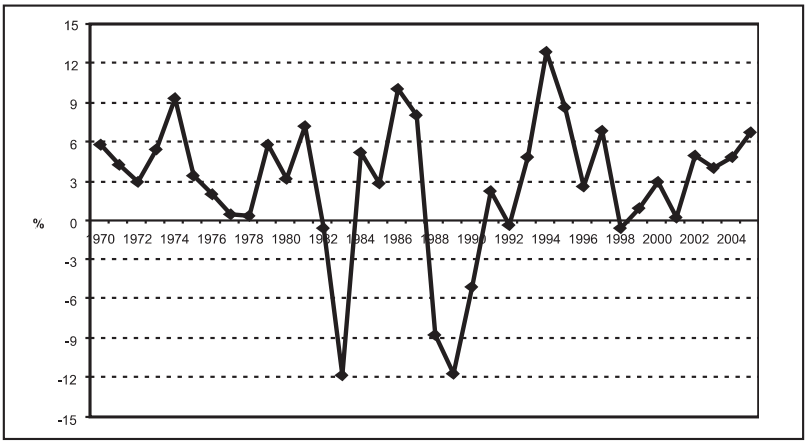


Source: World Bank, "Knowledge Assessment Methodology - KAM".

[12] For Figures 3, 12, 19 and 25 the following interpretation applies: the 0 – 10 scale describe the performance of each country. The horizontal axis plots countries' and regions' performance in a specific pillar (or variable in analysis) in 1995, while the vertical axis plots countries' and regions' performance in the same pillar (or variable in analysis) for the most recent year, currently 2005. The diagonal line represents the locus of points where the pillar (or variable in analysis) values in 1995 and in the most recent year are equal. As such, countries that appear above the diagonal line have made an improvement in the pillar (or variable in analysis) since 1995, and countries that appear below the diagonal line have experienced deterioration in terms of the pillar (or variable in analysis), in a relative sense.

It can be said that Peru would be in a better position if the Institutional Regime had the same positive trend as the Economic Regime. In effect, the country has shown a solid economical performance, when the country has grown continuously. The GDP increased 6.67% in 2005 (Figure 4), the highest rate in the last 8 years, following significant adjustment and structural reforms between 1993 and 1997[13].

FIGURE 4
GROSS DOMESTIC PRODUCT: 1970 - 2005
(Annual growth)



Source: World Development Indicators, World Bank 2006.

Internal and external factors determined this positive performance. The former are controlled fiscal deficit (graph on the top left side, Figure 5), monetary (controlled inflation) policies (graph on the top right side, Figure 5), increasing foreign currency reserves (at US$14,470 millions on April 2006[14]) (graph on the bottom, Figure 5), commercial policy (e.g. the signing of the Andean Trade Promotion and Drug Eradication Act– ATPDEA), and Foreign Direct Investment returning to Peru (approximately, US$2,518.8 millions[15] in 2005, Figure 6). The latter are high commodity prices, and increases in Chinese and United States consumption of Peruvian products. In fact, Peru's economic performance in comparison to other Latin American countries is not inferior (Figure 7).

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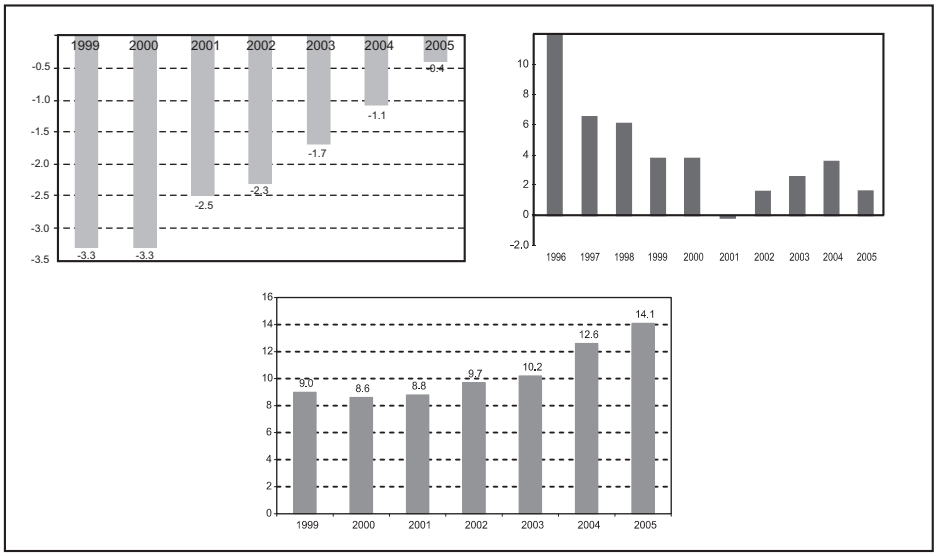
13 Between 1998 and 2000 the GDP suffered a slow down, with rates of only about one percent. Although the economy achieved 4% growth in 2002, one of the highest in the region, this recovery fits the fluctuating pattern that has historically characterized Peru's economy (World Bank, 2004).

14 "El Comercio" Newspaper. May 1, 2006.

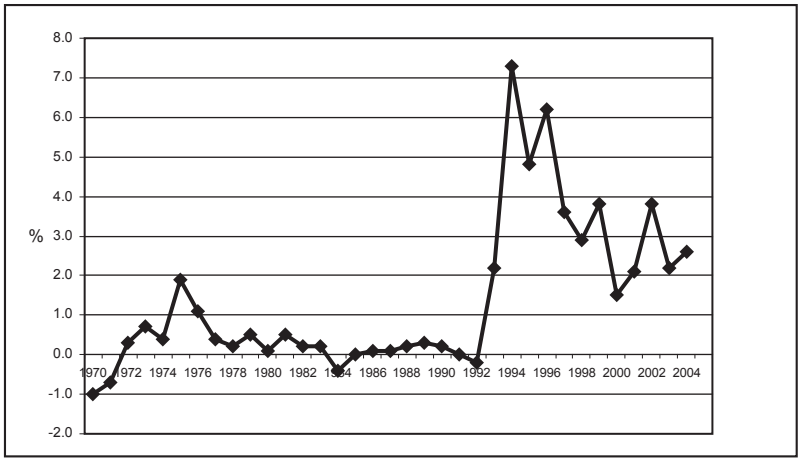
15 ECLAC (2006)

FIGURE 5
PERU: FISCAL DEFICIT [1], INFLATION RATE [2] AND INTERNATIONAL RESERVES [3]



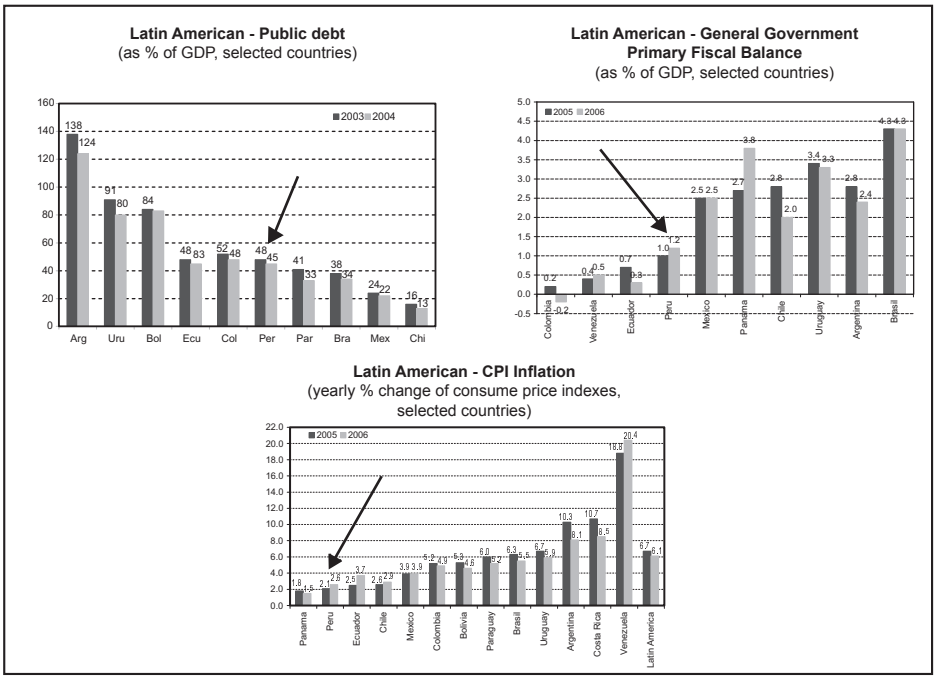
(1) % of GDP; (2) %; (3) US$ billions.
Source: Central Reserve Bank of Peru.

FIGURE 6
FOREIGN DIRECT INVESTMENT, NET INFLOWS: 1970 - 2005
(% of GDP)



Source: World Development Indicators, World Bank 2006.

FIGURE 7
LATIN AMERICA: PUBLIC DEBT (1), FISCAL BALANCE (2) AND INFLATION (3)



Source: Peruvian Institute of Economics (IPE): (1) BCRP[16], ECLAC[17]; (2) Credit Suisse, First Boston; (3) Latin American Consensus Forecasts – April 2005.

However, is this performance sustainable? According to Seminario (2006), institutional reform is one of the outstanding themes (as well as education, institutional reform and infrastructure) that many adverse situations are confronting and unless nothing is done, will remain in time and affect the current economic progress.

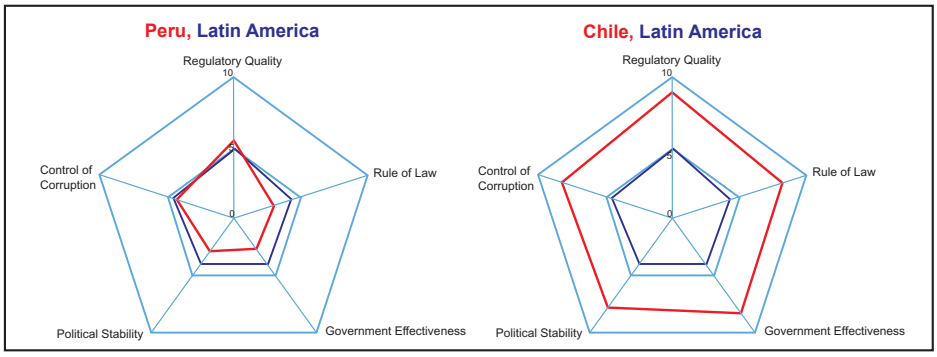
According to the Knowledge Assessment Methodology, Figure 8 shows that Peru, in comparison to the Latin American Region, is not very strong in terms of Institutional Regime variables such as control of corruption, political stability, government effectiveness and rule of law, and a limited regulatory quality that do not exceed the 50th percentile. In effect, regulatory unpredictability remains a big concern, and the perception of corruption pushes down the region's rule of law. The same figure depicts Chile as far out-performing Peru. Indeed, the strength of Chile's

16 Central Reserve Bank of Peru

17 Economic Commission for Latin America and the Caribbean - ECLAC.

political and economic institutions is considered one of the key drivers of its recent economic success.[18]

FIGURE 8
QUALITY OF GOVERNANCE[19]



Source: World Bank, "Knowledge Assessment Methodology – KAM".

Figure 9 displays Peru's ranking in the institutional regime for three selected variables (Judicial Independence, Property Rights and Public Trust of Politicians) published by The Latin America Competitiveness Review 2006 (WEF). In general, Peru's relative position is closer to that of Nicaragua, Venezuela and Ecuador (countries with the lowest scores in the selected variables) and very far from that of Chile and Uruguay (countries with the best position in the ranking). This fact suggests that Peru has to improve its actual system of rules, which shapes incentives and defines the way economic agents interact in the economy.

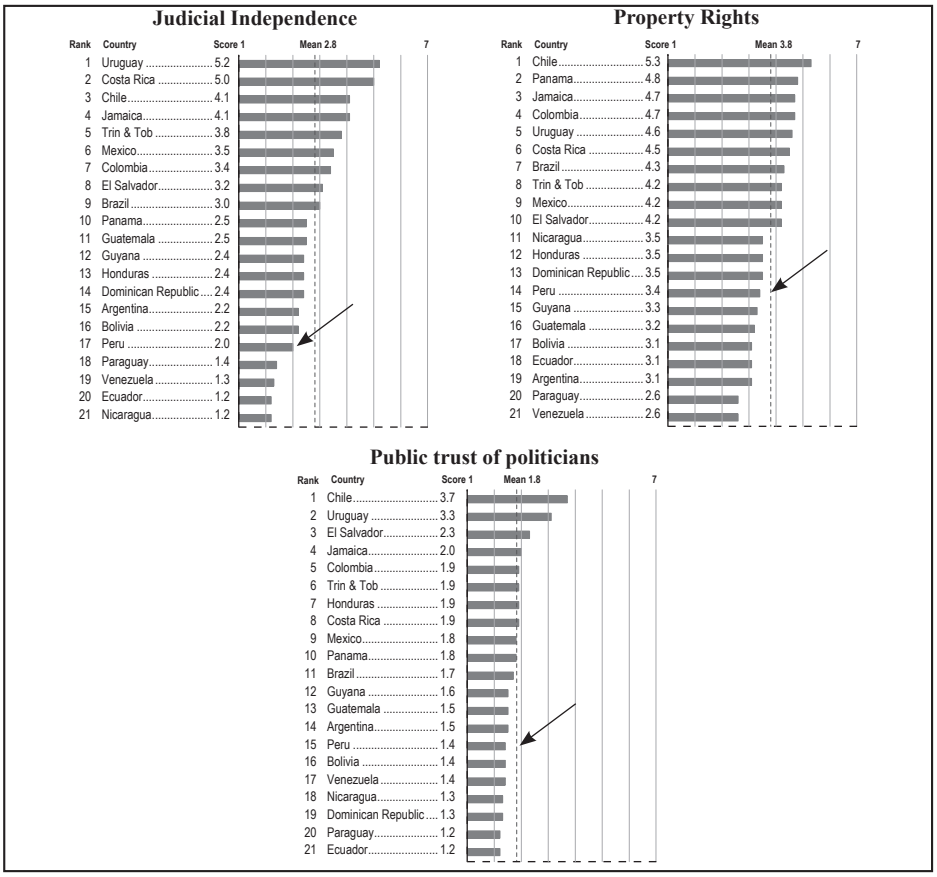
In the first graph (left side), Peru's judicial system is in need of much improvement given its relative position (17th) that suggests the existence of an ineffective system. In the next graph, Peru's position is a little bit higher but behind the first half of the group of Latin American and the Caribbean (LAC) countries (14th). When property rights are inadequately defined, investment and business

18 Contrary to many other countries in the region, Chile's recent history was characterized by a fairly stable and orderly transition to democracy. This enabled the country to consolidate its democratic institutions early on, and provided a good basis for successive governments to generate and implement sound policies (WEF, 2006).

19 The center of the chart denotes the minimum normalized value of 0, while the outer perimeter of the chart denotes the maximum normalized value of 10. Thus, a "bigger" or "fuller" spider chart implies that the country or region is better positioned in terms of the variable in analysis. The actual values of the variables for the most recent year are provided in parenthesis. The KAM basic scorecard provides the option of displaying the actual, normalized or no values in the chart. See: www.worldbank.org/kam.

activity can be severely restricted (De Soto, 2000). Indeed, this is a real problem that Peru is currently dealing with and which needs to be resolved, considering that the MIF (2003) found that in large parts of Latin America and the Caribbean, due to insufficiently defined or poorly enforced property rights, 70 percent of the population is excluded from using their property for business activity. Property rights ensure that the interests of investors and corporations as well as their returns are protected. Finally, the third graph, shows a deterioration of the public trust in Peruvian politicians (a score of 1.4, far from Chile's, 3.7, and below the mean, 1.8). This result could be portraying the frustration of the population seeing that their standard of living does not increase. When people and businesses do not trust their governments, they are not likely to support their development programs and strategies, thus undermining their success (WEF, 2006).

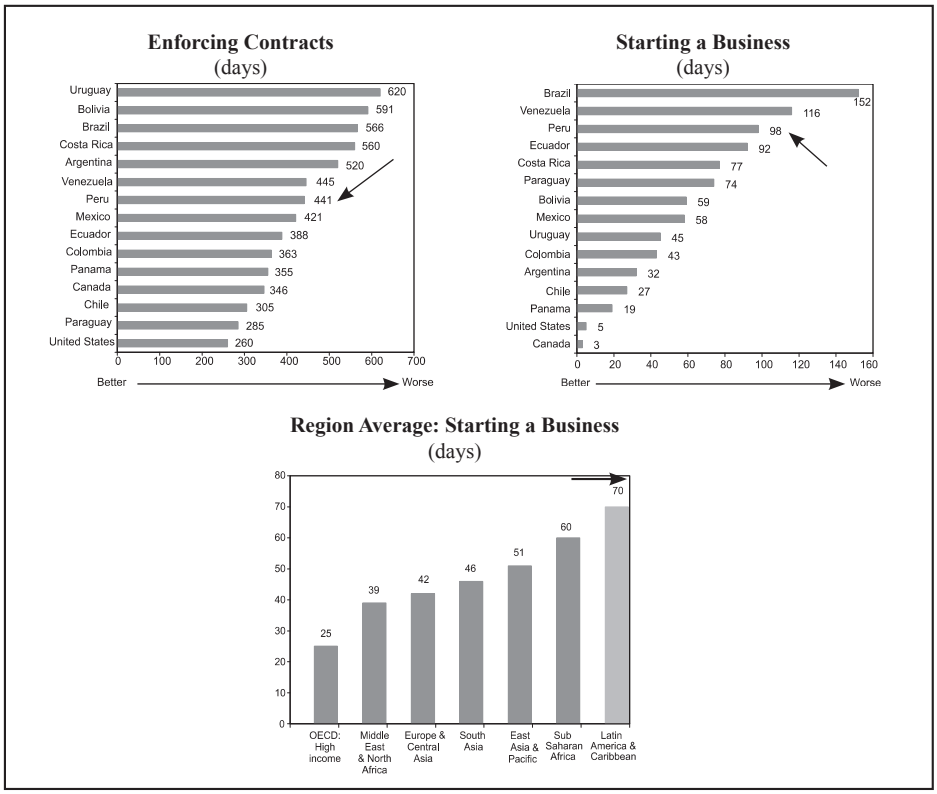
FIGURE 9
PERU'S INSTITUTIONAL PERFORMANCE IN LATIN AMERICAN



Source: WEF (2006). Executive Opinion Survey, 2005.

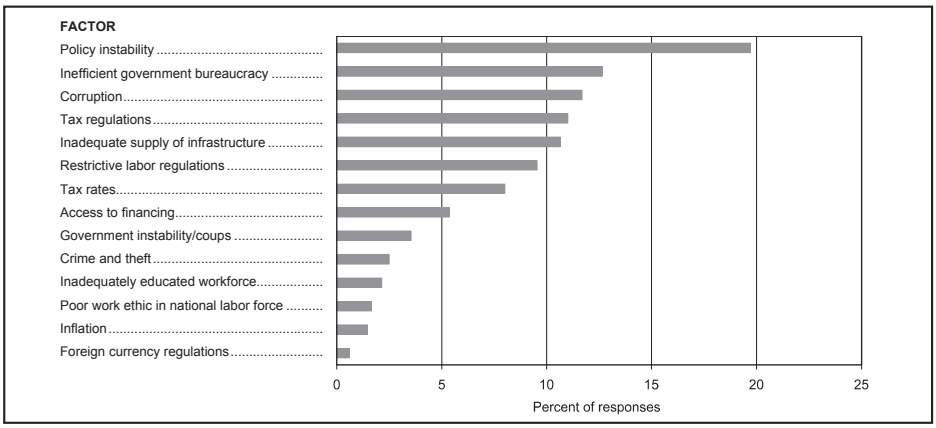
Finally, the institutional performance described above affect the time that takes enforcing contracts and starting a business. If the rules are not clear or not respected, Peru will attract less investment from abroad and from its own citizens. Fewer transactions will occur, fewer firms will be born (as more die) and less growth will occur. Informality, another institutional challenge in Peru (65% of total workers in Lima, according to the National Survey of Households 2004 – INEI), is associated with lower investment, lower growth and lower productivity. The following two figures show that (i) enforcing contracts and starting a business in Peru take 441 (more than a year) and 98 days, respectively. The latter time is above the Latin America and Caribbean average of 70 days; and (ii) the policy instability, inefficient government bureaucracy and corruption remain the most problematic factors for doing business.

FIGURE 10
PERU: DOING BUSINESS, 2005



Source: Doing Business (2005), World Bank.

FIGURE 11
PERU: THE MOST PROBLEMATIC FACTORS FOR DOING BUSINESS

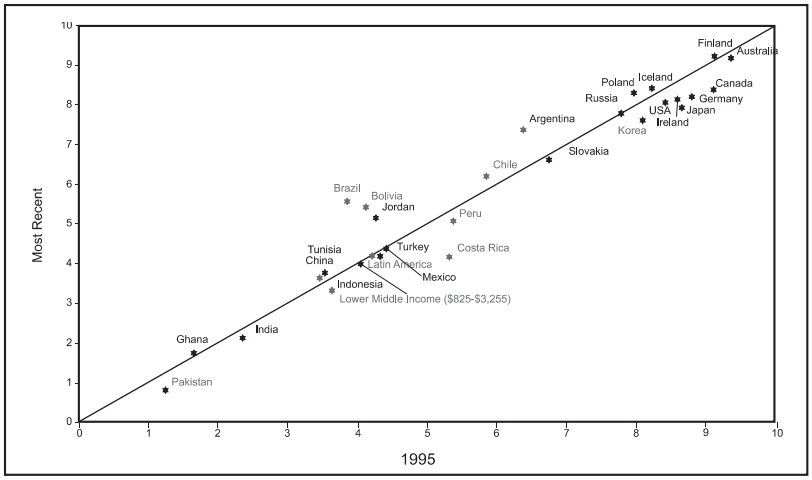


Source: World Bank, Doing Business in 2006: Creating Jobs, WEF (2006). Executive Opinion Survey, 2005.

III.2.- Education system

Figure 12 benchmarks Peru's relative position in Education based on the KAM. It shows that Peru has not improved its relative position in the last decade and is so far behind Chile and Argentina, countries that in the last decade have improved on this pillar.

FIGURE 12
GLOBAL VIEW: EDUCATION



Source: World Bank, "Knowledge Assessment Methodology – KAM".

What explains this situation? Table 1 shows that Peru is not very strong in terms of adult literacy (less than 90%). For the sake of comparison, literacy rates in some other Latin American nations are: Mexico (90.3%,), Chile (95.7%), Argentina (97.2%) and Cuba (99.8%).[20] The same table shows that the public spending as a percent of the GDP does not reach 3%, considered low in comparison to other countries. Indeed, the increase in Peru's public finance of education between 1990 and 2002 has been marginal, against the increments registered during the same period, in countries such as Chile, Mexico, Guyana, and also Bolivia[21] (Figure 13).

TABLE 1
PERU: PUBLIC SPENDING IN EDUCATION AND LITERACY RATE
(%)

Variable	1981	1993	1999	2000	2001	2003	2002	2003
Public Spending in Education / GDP(1)	n.a.	n.a.	2.8	2.8	2.8	n.a	2.8	2.9
Adult literacy rate(2)	81.9	87.2	n.a	n.a	87.9	87.7	n.a	n.a

Source: (1) Minister of Economy and Finance – Central Bank of Reserve of Peru (BCRP); (2) INEI, National Census 1981, 1993. National Survey of Households 2001, 2003.

Figure 14 shows that the gross enrollment rate in basic (pre-primary) education[22] has increased in the period 1990 – 2002, from 30% to 58%, reaching similar levels to those of US and Finland (Figure 15). That is a good sign since basic education is essential to the efficient creation, acquisition, dissemination and utilization of relevant knowledge.

Regarding primary education[23], the enrollment rate has increased since 1990 and reached similar levels to those registered for OECD countries (e.g. Japan, Spain, Finland, US, Korea and Ireland) (Figure 16 in Annex 1). However, even though

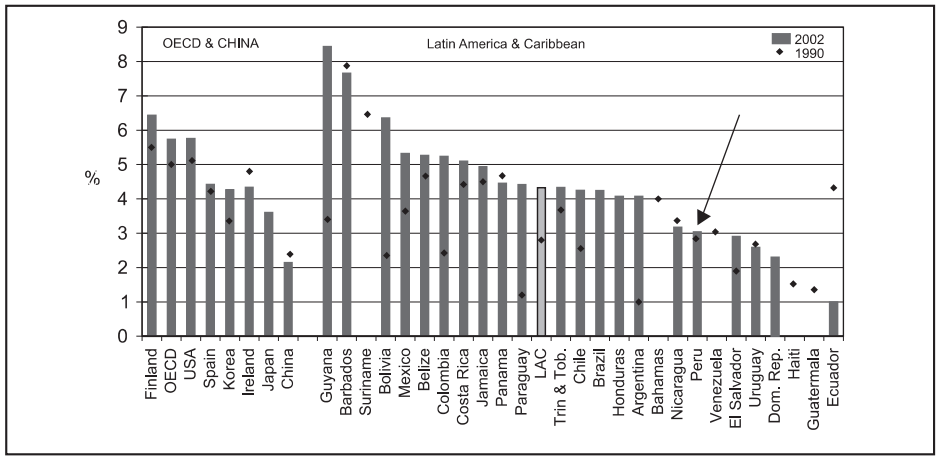
20 World Bank (2005).

21 Perhaps state support to education in Bolivia has allowed this country improve its position in the last decade in the Education Pillar (Figure 12).

22 Gross enrollment rate in pre-primary education is the number of pupils enrolled in pre-primary, regardless of age, expressed as a percentage of the population in the theoretical age group for pre-primary education (UNESCO Institute for Statistics).

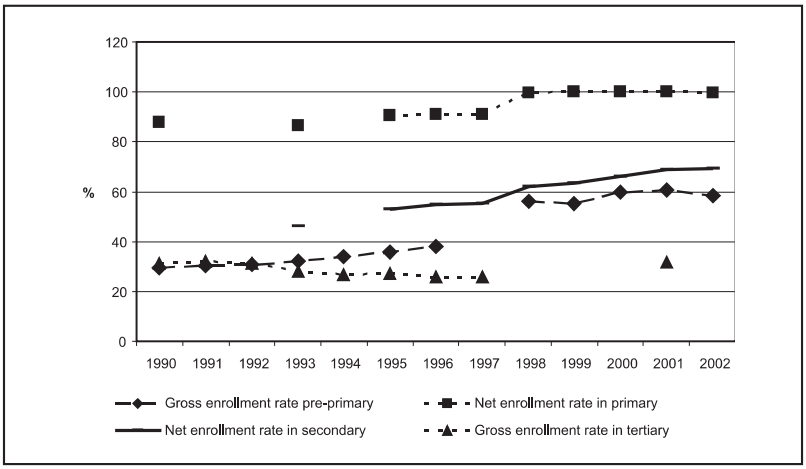
23 Net enrollment rate in primary education is the number of pupils in the theoretical age group for primary education enrolled in primary education expressed as a percentage of the total population in that age group (UNESCO Institute for Statistics).

FIGURE 13
PUBLIC SPENDING ON EDUCATION AS A PERCENTAGE OF GDP (1990 and 2002)



Note: Data for the United States, Ecuador, Brazil, Japan, China and Honduras are for 2001. Figures for China and Honduras are for 1999 and 1998, respectively.
Source: IADB (2006). World Bank Development Indicators Database, data from UNESCO Institute for Statistics.

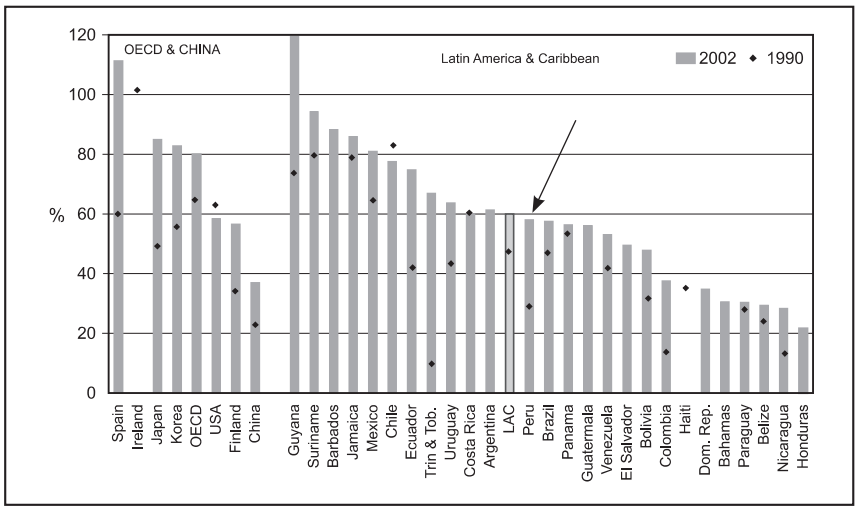
FIGURE 14
PERU: PRE-PRIMARY, PRIMARY, SECONDARY AND TERTIARY ENROLLMENT RATES



Source: World Bank internal databases (DDP and Edstats).

enrollment rates in secondary and tertiary education[24] have shown a small increase between 1998 and 2002 (according to available information), they are behind the same OECD countries' levels. The same happens with Argentina, Chile and Brazil (Figure 16). This picture agrees with Mingat and Tan (1996) who found that higher education is most important in high-income countries, while primary education is a significant driver of growth in low-income countries. In addition, IADB (2005) points out that in the area of education for high-level science and technology human resources, postgraduate education in Peru in 1999 was centered on the humanities (35% of students), whereas enrollment for engineering, natural sciences, medicine and agriculture was lower: 32%, 12%, 18% and 3%, respectively. In consequence, the number of new doctoral graduates in Peru is extremely low compared to other countries in the region. This is due in part to a shortage of mechanisms for financing doctoral studies in universities abroad.

FIGURE 15
LATIN AMERICA & CARIBBEAN AND OECD & CHINA: GROSS ENROLLMENT RATES IN PRE-PRIMARY EDUCATION



Source: World Bank internal databases (DDP and Edstats).

[24] Net enrollment rate in secondary education is the number of pupils in the theoretical group for secondary education enrolled in secondary education expressed as a percentage of the total population in that age group. Gross enrollment rate in tertiary education is the number of pupils enrolled in tertiary, regardless of age, expressed as a percentage of the population of the five-year age group following on from the secondary school leaving age (UNESCO, Institute for Statistics).

In general, although the coverage has shown a modest improvement compared to the regional average, the quality is still deficient. The following table reports that in reading comprehension and math (according to the evaluation delivered by Peru's Ministry of Education), less than 16% and 10% of students have the required ability, respectively. Note that the results in math show alarming deficits in primary (second and sixth year) and secondary (third and fifth year) education. Furthermore, the information in the Table 2 describes the higher differences in quality between public and non public schools, where the percentages of students in public schools with the required ability do not reach 9% and 5% in reading comprehension and math, respectively[25]. At the same time, problems in equality can be inferred from these results, since the Peruvian Education System cannot compensate social, cultural and regional differences.

TABLE 2
PERU: QUALITY OF PRIMARY AND SECONDARY EDUCATION, 2004
(% of students with required ability)

Topic	Primary				Secondary Peru	
	2nd year	6th year				
	Peru	Peru	Non public school	Public school	3rd year	5th year
Reading comprehension	15.1	12.1	35.8	8.2	15.1	9.8
Math	9.6	7.9	29.9	4.4	6	2.9

Source: Benavides and Rodríguez (2006). Unit of Measure of Education Quality (2005) – Peru's Ministry of Education .

Benavides and Rodríguez (2006) point out diverse reasons that explain these differences in education[26]. Mainly, the location (rural and urban schools), the institutional characteristics (public or non public management) and the characteristics of students (e.g. socio-economics conditions, repetition incidence and malnutrition) explain those differences in a high degree in both math and communication. In a low degree, the differences are explained by equipment (access to education resources) and the educative process (e.g. curriculum contents and teaching methods).

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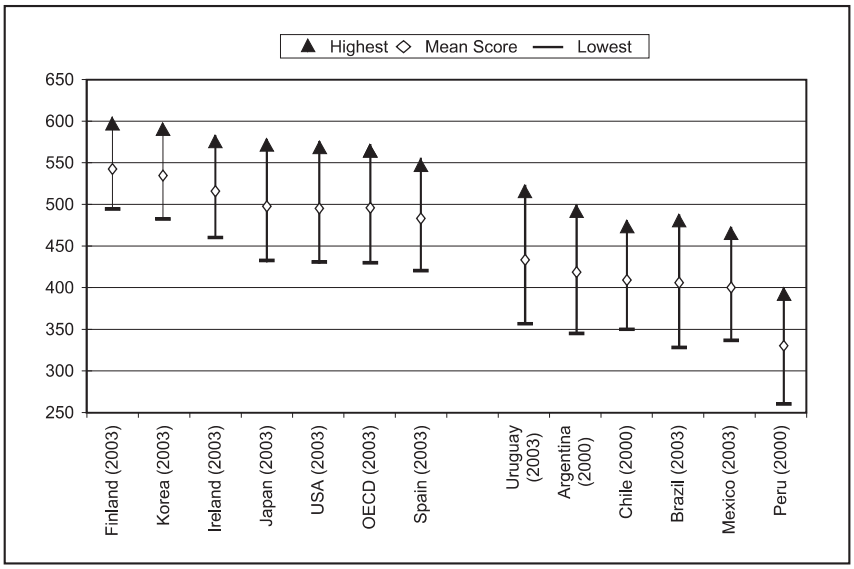
25 According to Benavides and Rodríguez (2006) these results are similar to those from PISA (Programme for International Students Assessment) evaluations.

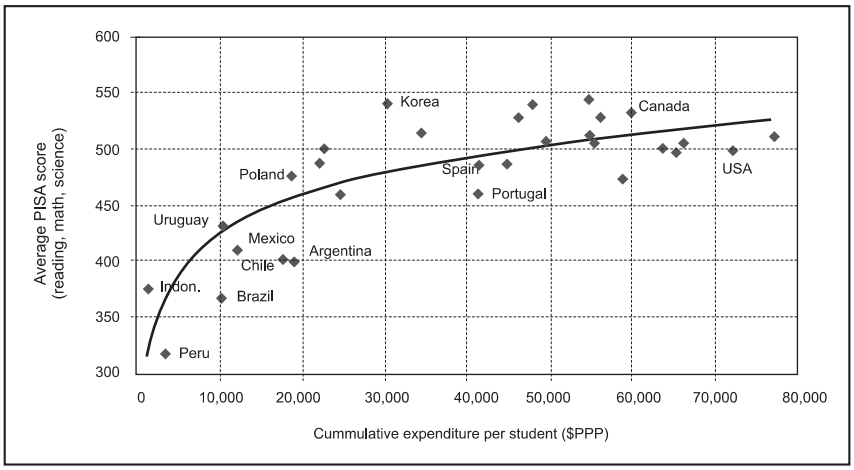
26 The authors based their arguments in diverse studies: Cueto (2005), Chávez (2002), Valdivia (2003) and Aguero and Cueto (2004).

FIGURE 17
PISA SCORES FOR READING: 2000 AND 2003



Source: IADB (2006). OECD/PISA database.

FIGURE 18
RELATIONSHIP BETWEEN EXPENDITURE PER STUDENT AND AVERAGE COMBINED PISA SCORE FOR READING, MATH AND SCIENCE (2000)



Source: IADB (2006). OECD/UNESCO-UIS.

Regarding the low results in math and communication evaluations, the same authors say[27] that it is important to analyze the education process in dynamic rather than static terms. In effect, the future learning-school performance depends on the past learning-school performance. Therefore, the transition from primary to secondary school is important, since bad performances in the former will affect future performances in the latter. In addition, the authors explain that other reasons[28] are related to the school management, such as lack of supervision mechanisms by the school director and incentives policies for teachers' salaries, and an erratic curricular policy (in primary and tertiary levels); yet another reason is related to quality of teaching such as lack of impact analysis on teachers' training programs, and inefficient pedagogic methodology by teachers.

Finally, in an international context, IADB's report on Education, Science and Technology in Latin America and the Caribbean for 2006 alerts two points: (i) Peru is not in a favorable position in terms of quality of education, measured by PISA scores for reading[29] (Figure 17), and (ii) the efficiency and effectiveness education in Peru is the lowest in comparison to other countries when cumulative per student spending is plotted against PISA scores, meaning that the learning in Peru is lower than what would have been expected given its level of investment (Figure 18).

III.3.- Innovation system

Figure 19 benchmarks Peru's relative global position in innovation, based on the KAM. It shows that Peru has not improved its relative position in the last decade, and also its disadvantage has gotten stronger when it is compared to other Latin America countries (such as Argentina, Costa Rica, and Chile), and even more so when compared to some innovator countries (such as South Korea, Ireland, Finland, Israel, Singapore, and Sweden).

The first step to analyze these lags is to look inside Peru's National Innovation System (NIS), which consists of universities, research institutes and enterprises that invest in technological innovation and government agencies involved in this area, such as the Ministry of Production and the National Science and Technology Council (CONCYTEC[30]) under the President of the Council of Ministers (the cabinet). At

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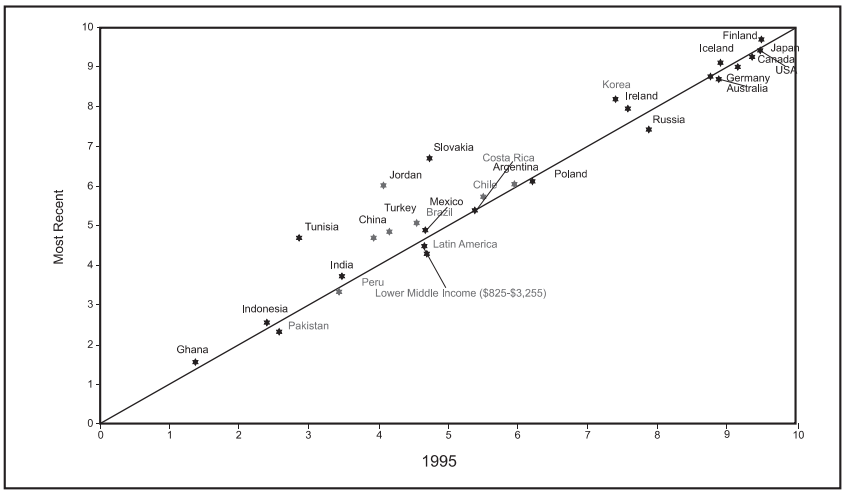
27 Based on Cueto (2004) and Aguero and Cueto (2004).

28 Based on Alcazar and Cieza (2002), GRADE (2004) and Eguren et al. (2003).

29 Unfortunately, the same report does not show Peru's performance in math scores.

30 CONCYTEC is a key player in science and technology. Its chief objective is to promote scientific and technological development in the country and contribute to policy-making. CONCYTEC funds R&D projects, although the volume of resources invested is small compared to those invested by universities and other institutions. It has spearheaded actions to promote science and technology in recent years, such as working on a Science and Technology.

FIGURE 19
GLOBAL VIEW: INNOVATION



Source: World Bank, "Knowledge Assessment Methodology – KAM".

the same time, several public and private institutions provide innovation services. These include specialized technology institutes catering to the needs of specific sectors, but not very inclined to coordinate with private or academic sectors. There are also the CITESs (Technological Development Centers), and various public and private enterprises providing quality control services, environmental impact studies, and certification of sanitary conditions, whose customer base is limited to a few medium-sized and large export-oriented businesses. Lastly, there is the National Institute to Defend Competition and Protect Intellectual Property (INDECOPI), which manages the national patent system and is responsible for guaranteeing intellectual property rights.

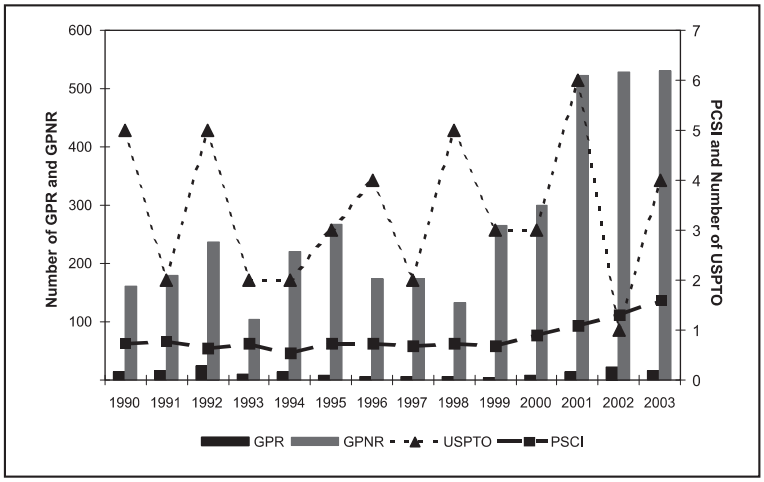
From Mullin (2002), Kuramoto and Torero (2004), Espinoza (2004) and IADB (2005), it can be concluded that Peru's NIS is weak. One of the main obstacles for developing science and technology in Peru is the weak linkage between system stakeholders and function. According to IADB, despite recent efforts by CONCYTEC and the Ministry of Production, the functions of science and technology policy-making and the building of links among the stakeholders remain weak. Public resource allocation has little connection to sector priorities.

Law (Framework Law 28303), establishing the Innovation and Decentralization Forum to identify opportunities and strategic partnerships to promote innovation in the local arena. It has also developed strong ties with the scientific and academic community.

There is little cooperation and joint work between research and development (R&D) institutions and the productive sector. Mullin (2002) and IADB consider that some of the challenges and technological needs confronting companies are: (i) no tradition to develop and continually improve products and processes, (ii) chronic scarcity of funds for technological innovation; (iii) unawareness of the challenges, needs and technological opportunities of an open market, (iv) no tradition to seek advice and work with universities and technological centers, and (v) lack of technological management know-how.

Secondly, following Lederman and Maloney (2003), the performance of Peru's innovation effort can be analyzed –that is, determining its weak relative position– looking at Peru's "innovation outputs" and "innovation inputs". Regarding the former, the fundamental measure of innovation success is the rate of growth of per capita incomes and hence the well-being of Peru's population. However, Peru's success in intermediate innovation outcomes across time can be tracked by following two common measures: the number of granted patents (in Peru and by the US) and the number of scientific publications.

FIGURE 20
PERU'S INNOVATION OUTPUTS: GRANTED PATENTS AND PUBLICATION IN SCI RESEARCH

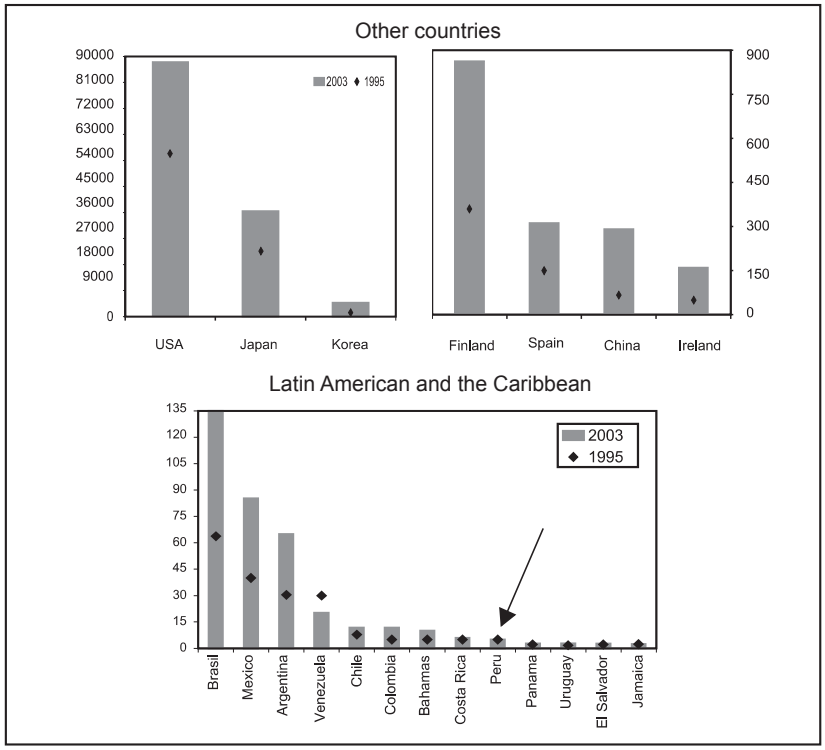


GPR = Granted Patent Residents
GPNR = Granted Patent not Residents
USPTO = Patents Granted by US to Peru
PSCI=Publication in SCI Research (per 100,000 inhabitants)
Source: Red de Indicadores de Ciencia y Tecnología (RICYT). United States Patent and Trade Office (USTPO)

The previous figure shows that the patenting performance -measured by the patent granted to residents and patents granted by the US- has had an erratic evolution from 1990 to 2003 (at levels below 25 and 7, respectively). This performance locates Peru on a weak position in relation to Latin American countries such as Brazil, Mexico and Argentina, and far behind innovator countries such as Finland, Japan and Korea (Figure 21). The deficiency in local productivity is evident when we observe, furthermore, that during the same period of time, the indicator for patents granted to non residents grows (Figure 20). On the other hand, with respect to the indicator of papers published by Peruvian researchers, even though it shows a positive trend since 2000, its position is still the weakest in comparison to the Latin American average, and mainly, Chile and Argentina's (Figure 22).

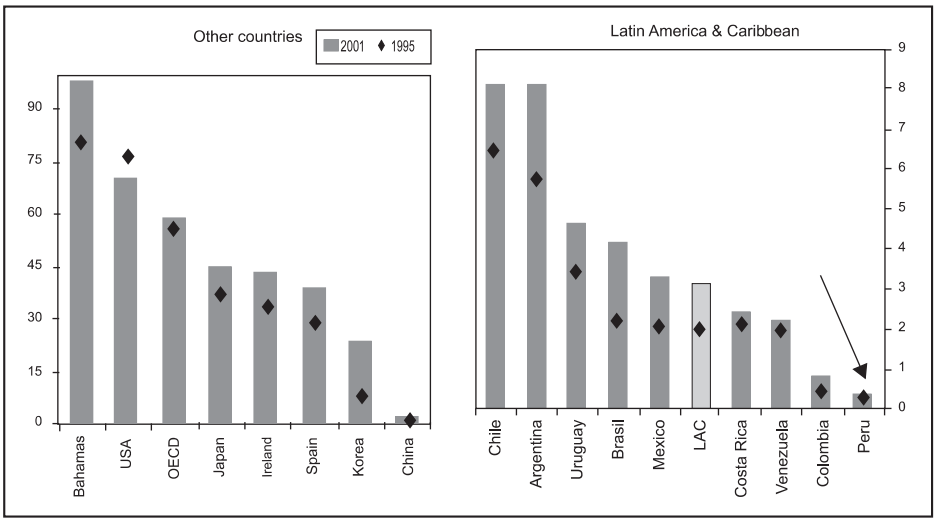
Regarding Peru's innovation inputs, similar benchmarking can be done with two indicators: investment in research and development (R&D) and science and

FIGURE 21
PATENTS GRANTED BY USPTO
(1995 and 2003)



Source: IADB (2006). World Bank Indicators.

FIGURE 22
SCIENTIFIC AND TECHNICAL JOURNAL ARTICLES PER 100,000 INHABITANTS
(1995 and 2001)



Source: IADB (2006). World Bank Indicators.

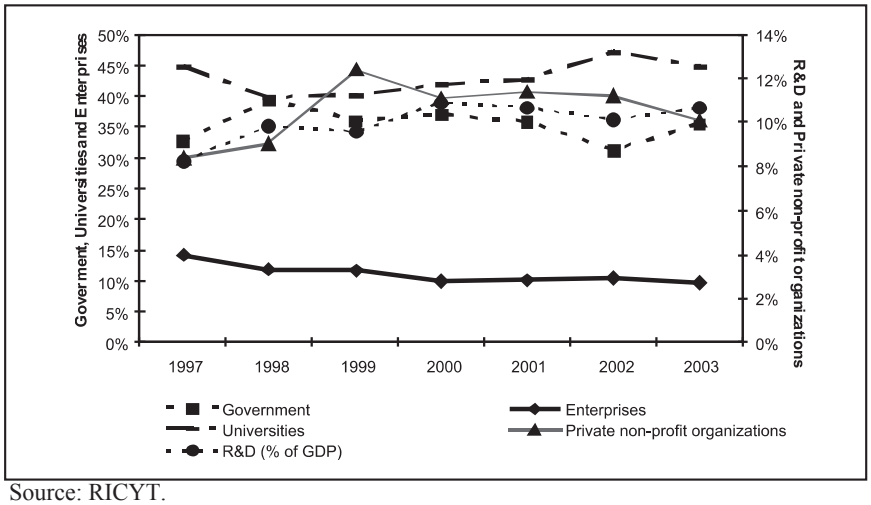
technology personnel. Unfortunately, there is no available information for the latter, but it is possible to infer that there are insufficient human resources in science and technology since, as seen in the education pillar, local productivity is, in reality, low in areas such as number of patents and articles published in international journals.

Figure 23 shows that the innovation effort, measured by expenditures on R&D as a percentage of Peru's GDP, has been around 0.11% in the 1997 – 2003 period, similar to those recorded by Paraguay and Trinidad & Tobago, but at lower values in comparison to those registered by Chile, Brazil and Argentina, and even further behind innovator countries such as the United States, Finland and Korea (see top graph of Figure 24).

On the other hand, Figure 23 also shows that the main sources of financing R&D in Peru are the government (between 30% and 37%) and higher education (between 40% and 47%) in contrast to the level of effort for R&D displayed by the private sector (between 10% and 14%) between 1997 and 2003. It is interesting to note that this pattern of financing is common in Latin American countries (see bottom graph of Figure 24). In effect, whereas some 70% of R&D expenditure is financed by private companies in those countries which are leaders in innovation, such as Korea, US, Finland and Ireland, the situation is the reverse in Central and South American countries, where on average, less than 30% of R&D is financed by the private sector, with the bulk being financed by the government, universities, and

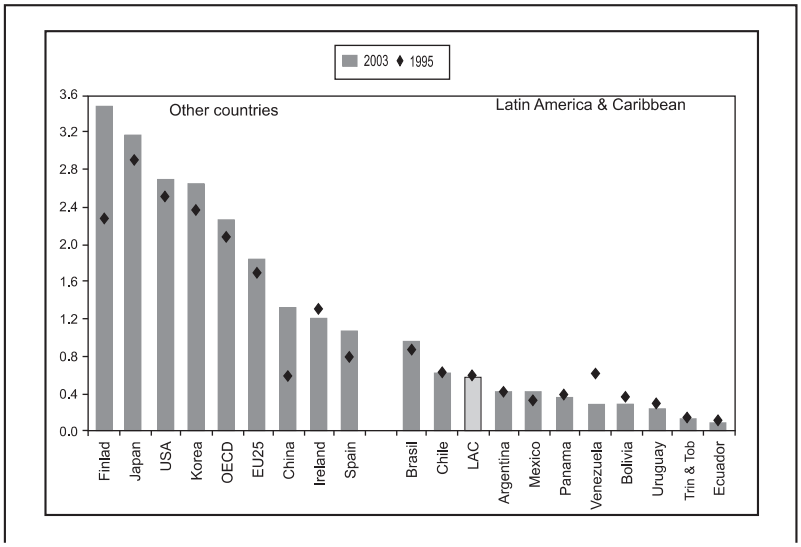
non-profit agencies. According to WEF (2006), this pattern is a legacy of the policy of import substitution, which the subsequent market-based shift in the public R&D strategy failed to fully reverse.

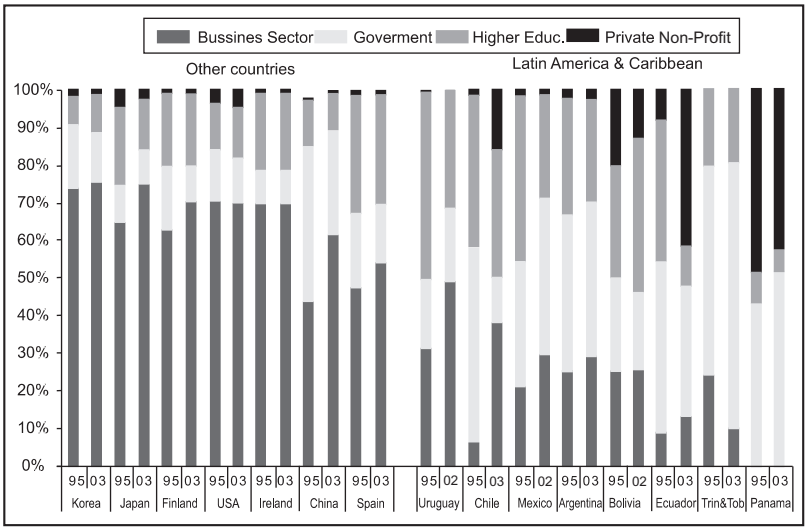
FIGURE 23
PERU'S INNOVATION INPUTS: EXPENDITURE OF R&D AND SOURCE OF FINANCING



Source: RICYT.

FIGURE 24
R&D EXPENDITURE BY COUNTRIES AND SECTORS





Source: IADB (2006), RICYT and OECD.

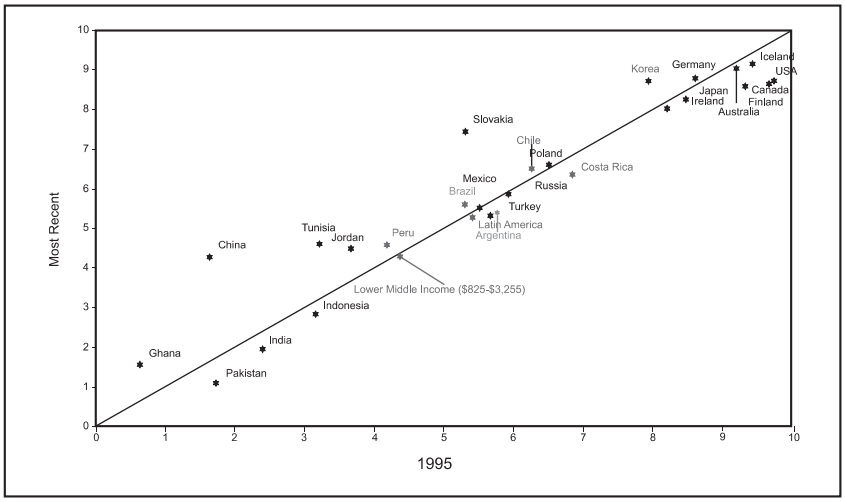
III.4.- Information infrastructure

Figure 25 benchmarks Peru's relative position in the ICT pillar based on the KAM. It shows that Peru has improved its relative position in the last decade and, even though it is in a better position than other lower middle income countries (e.g. Tunisia and Jordan), it is far behind some Latin American countries (e.g. Brazil and Chile) and other upper middle income countries (e.g. Slovak Republic and Poland). However, is that improvement enough to say that ICT development in Peru is conducive?

This improvement is the result of the reforms implemented since the beginning of the nineties. These reforms began with a privatization programme that sold almost 200 enterprises in a number of areas, such as mining, energy, banking, manufacturing and telecommunications, rendering revenues of almost US$ 8 billion. In particular, the increase in the economic efficiency in telecommunications has been quite significant since the rise from 56 (in 1993) to 271 (in 1999) in 2001. There have also been some positive distributive effects produced by reforms in the telecommunications density, which went from 3.1 in 1993 to 13.7 in 2001 (Tavera, 2001).

Thus, as a result of the reforms implemented, the usage in Peru of fixed and mobile telephones, personal computers and internet users has shown a positive trend in the last 5 years (Figure 26). However, when Peru's performance in the

FIGURE 25
GLOBAL VIEW: INFORMATION AND COMMUNICATION



Source: World Bank, "Knowledge Assessment Methodology – KAM"

ICT's pillar is compared to some innovator and other Latin America countries it becomes evident that the country still displays lagged values for ICT penetration, as shown by the low levels of personal computers, internet users, and cellular and fixed telephones (Figure 27).

Finally, the Network Readiness Index (NRI)[31] describes that Peru, amongst 104 and 115 countries in 2004 and 2005, is ranked 90 and 85, respectively and its score is poor (negative) when compared to Chile (ranked 35 and 29, respectively) and some innovators countries such as the US, Finland and Korea (which ranked in the highest positions in both years) (Table 3). Therefore, all the above suggests that the improvement registered by Peru in this Pillar during the last decade has not been sufficient, but also shows that the overall capability and readiness to employ the potential of ICT is weak, particularly when compared to other economies.

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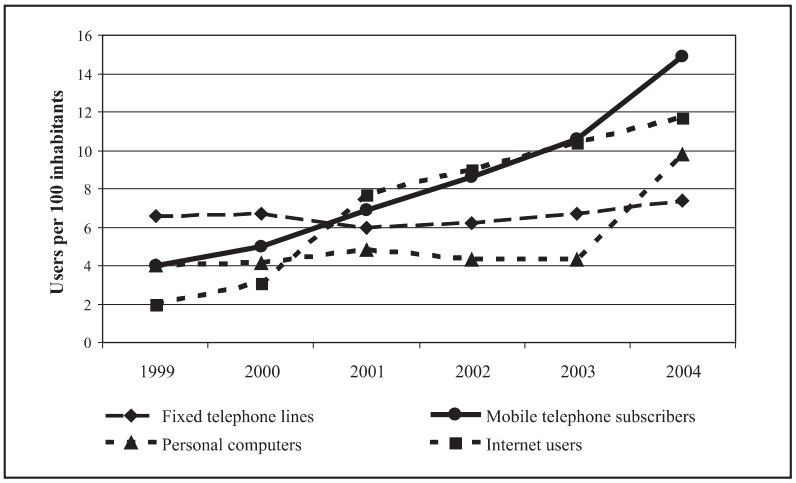
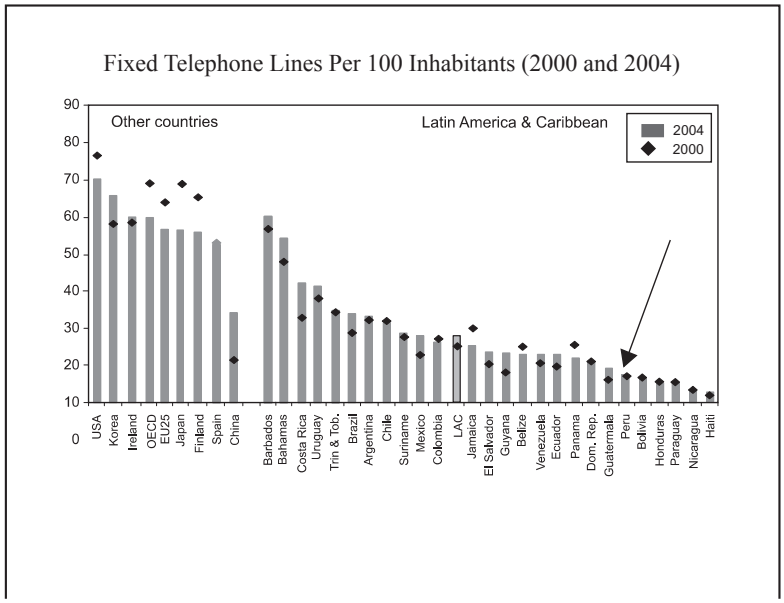
31 Developed by World Economic Forum in The Global Information Technology Report, the NRI is defined as "the degree of preparation of a nation or community to participate in and benefit from ICT developments"; it is an index composed by three components: (i) the Environment for ICT (measured by three sub indexes: market, political/regulatory situation, and infrastructure), (ii) Readiness (measured by three sub indexes: individual readiness, business readiness, government readiness), and (iii) Usage (measured by three sub indexes: individual usage, business usage and government usage).

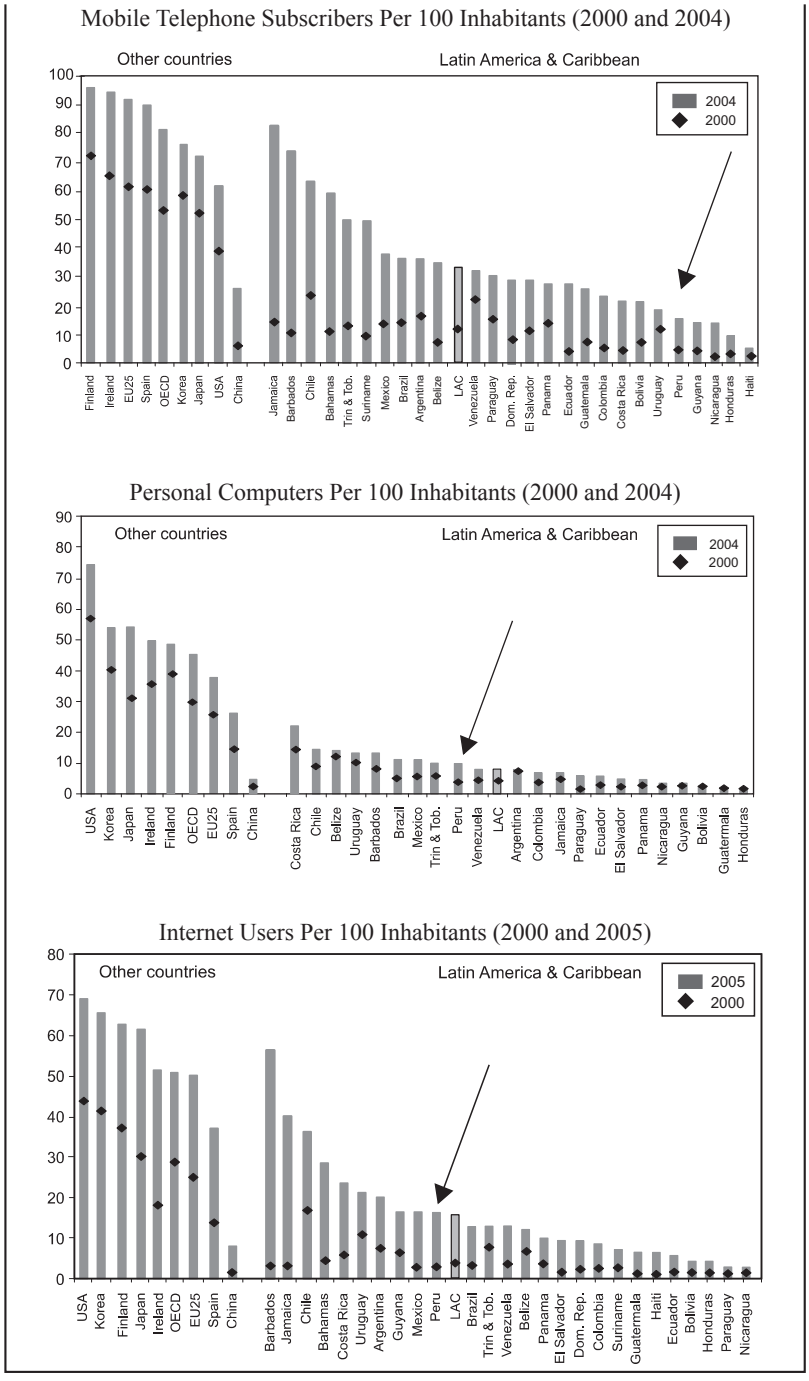
FIGURE 26
MAIN PERU'S ICT INDICATORS
(Penetration)



Source: IADB (2006), International Telecommunication Union.

FIGURE 27
ICT INDICATORS (PENETRATION) IN PERU AND OTHER COUNTRIES





Source: IADB (2006), International Telecommunication Union.

TABLE 3
NETWORK READINESS INDEX
RANKING (SCORE[32])

Country	2001	2002	2003	2004	2005
United States	1 (6.05)	2	1 (5.50)	5	1 (2.02)
Singapore	8	3	2	1 (1.58)	2
Finland	3	1 (5.92)	3	3	5
Korea	20	14	20	24	14
Chile	34 (4.00)	35 (4.14)	32 (3.94)	35 (0.29)	29 (0.52)
Jordan	49	51	46	44	47
China	64	43	51	41	50
Brazil	38	29	39	46	52
Mexico	44	47	44	60	55
Costa Rica	45	49	49	61	69
Argentina	32	45	50	76	71
Peru	52 (3.38)	67 (3.10)	70 (3.09)	90 (-0.91)	85 (-0.70)
Bolivia	67	78	90	99	109
Paraguay	63	76	91	98	113
Total Countries	**75**	**82**	**102**	**104**	**115**

Source: Global Information Technology Reports 2001, 2002, 2003, 2004 and 2005.
World Economic Forum.

IV.- Conclusions and challenges ahead

The main conclusion is that Peru is very far from what a knowledge economy is supposed to be. The incoming new government should implement different policies in order to create a culture of innovation and technological development and to take on the path towards a knowledge society.

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32 The content in parenthesis represents the score obtained by each country and determines its relative position or ranking. For example, in 2005, the United States, with a score of 2.02, was in the first position of Network Readiness Index, and Peru, with a negative score, is in the 85th position.

First, given the poor performance on "governance" and "doing business" indicators, Peru is an economy without a solid institutional regime. A challenge ahead is to implement policies on judicial independence, property rights and transparency matters. The legal and regulatory framework establishes the rules of the game and how they change. If the rules are not clear or not respected, Peru will attract less investment from abroad and from its own citizens. Empirical evidence shows that uncertainty in the legal and regulatory framework leads to significantly lower investment, less training and lower profitability (World Bank, 2004).

A big step and challenge ahead is the recent launch of "The Real Property Rights Consolidation Project" (US$ 25 million[33]) approved by the World Bank on March 14th, 2006 in order to consolidate the decentralization and sustainability of a quality real property rights system, to facilitate access for the Peruvian population. The project aims to enhance the welfare of real property owners, and to facilitate access to economic opportunities. It has 5 components. The comprehensive real property rights policies component will strengthen the policy-making process on property rights, ensuring stronger legal, regulatory and institutional reforms, and also ensuring that further policy reforms will lead to equitable and sustainable socio-economic outcomes. The second component, decentralized formalization and cadastre services provision, will establish the cadastre services in urban and peri-urban areas among the participating municipalities, through technical assistance provided by COFOPRI[34], in adapting the needs of informal owners, justifying the cost-benefit terms, and, providing capacity-building for provincial and district municipalities. The modern real property registry system component will support the integration of real property data, and the establishment of the national cadastre system, to improve the quality of, and access to real property registry services. The communications and Information component seeks to formalize benefits, by fostering real property-related economic activity. Finally, the fifth component will support project management activities, namely monitoring and evaluation, project coordination, and the assessment and accountability frameworks.

Second, it is important to keep the positive trend of foreign direct investment. Even though FDI has recovered its trajectory in the last year, more should be encouraged in order to improve the adoption and generation of new technologies.[35] In effect, the role of FDI is particularly important. It generates new financial, managerial, and technological resources that push forward the production possibility frontier (PPF) of the economy, and not only generates new private firms in the

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33 Plus US$10 millions by the Peruvian government.

34 Comisión de Formalización de la Propiedad Informal.

35 INDECOPI (2005), paper elaborated by Santiago Roca and Luis Simabuko, points out that Peru's balance of knowledge, based on the trade of goods, showed a deficit of US$427 millions in 2004. That means that Peru has a serious problem in generating technology.

economy, but through linkage effects and other transactions, may also transfer know-how and technology to public and domestic private firms.

The policies implemented to attract investments should also consider promoting investment in knowledge and innovation through research and development of new products and processes. The United Nations Conference on Trade and Development (UNCTAD, 2005) has developed an "innovation capability" index[36], which gives an indication of a country's capacity to attract FDI in R&D. Table 4 (Annex 2) shows that Peru's capability (position 63; index 0.425) is below that for Latin American countries such as Argentina, Chile, Brazil, and Costa Rica. The same source reports the tendency of transnational enterprises to internationalize and locate their R&D businesses in developing countries. China and India are the principal Asian beneficiaries of R&D investments, and Brazil is the largest Latin American recipient. Thus, the investment policies to be considered should at least be abreast of this trend and, where possible, try to capitalize on the opportunities arising in this area.

Third, there are limitations in Peru's human capital not only from the inequality and low quality of education (low result in national and international evaluations) but also from the poor performance in the innovation pillar (underperformed innovation inputs and outputs). In effect, what the preceding paragraph suggests will not be possible if the population does not have the required abilities to absorb, apply and use the knowledge, as well as, and more importantly, whether Peru's NIS is weak or maybe inexistent.

Thus, the application of policies is necessary to increase the quality (improving also the efficient use of public resources) and to increase the equality (ensuring expanded access to education). It is important to make the education system as a whole more responsive to market needs. Improvement in the quality of the education system also requires enhancing the quality of primary and secondary education, including tackling issues related to teacher remuneration policy, vacancies and absenteeism, reversing high dropout rates, and correcting inadequate teaching and learning materials and uneven levels of learning achievement. Furthermore, the curriculum of tertiary education institutions that include skills and competencies for the KE (e.g. communication skills, problem-solving skills, creativity) that also meet the needs of the private sector have to be considered. This leads to increased university-industry partnership to ensure consistency between research and the needs of the economy.

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[36] It is built on two indicators: one measuring technological activity (which takes number of research staff, patents granted and scientific publications as proxies, all deflated by the number of inhabitants); and the other measuring human capital (whose proxies are the literacy rate and enrolment in secondary and tertiary education).

Fourth, the outlook in the innovation system pillar is worrisome. There is much to do in order to improve the innovation outputs and inputs. For instance, it is important to revert the low levels of public spending in R&D and its quality, exacerbated by the low levels of private expenditures in R&D and hence, low levels of technological adaptation. It is important to develop and identify clusters, encouraging investment in science and technology by private firms providing incentives, and link the local scientific community to the international one (mainly to developed or innovating countries).

With the recent passing of the Science, Technology and Innovation Act in 2004, Peru has taken major steps towards defining technological innovation as one of the cornerstones of its development strategy. By the National Competitiveness Council[37], the dialogue among the public sector, the private sector, and academics pointed out the factors affecting the country's business competitiveness, one of which is technology innovation. The Council has been given the task of developing and implementing a National Competitiveness Plan to help improve Peru's capacity to compete in international markets, and defined three main tenets for the National Competitiveness Strategy, which are developing a culture of innovation, promoting research, seeking specialization and transferring technology.

Fortunately, Peru's Ministry of Production has promoted the creation of Technological Development Centers (CITEs in Spanish) associated with production chains such as footwear, leather, wood and furniture, among others, to increase value-added exports, and exports of products with a competitive edge (IADB, 2005). These CITEs are an important first step towards improving the business technological services market. These actions have enabled the Ministry of Production to establish strong ties with the business sector.

As another big challenge ahead, Peru is currently implementing a competitiveness reform program with the Inter-American Development Bank's (IADB) support for an amount of US$36 million. The program aims to counteract the prevailing disincentive to invest in technological innovation, where the uncertainty of the outcome makes it difficult to secure loans by private financial institutions. The program involves a continuous process validated by innovation, with financing being made available for a broad range of activities, from non-applied research to technical innovation projects by companies clearly focused on generating new products or processes. The objective of this five-year science and technology program is to improve the country's competitiveness by strengthening technological innovation and research capabilities. Its specific objectives include: (i) strengthening the national innovation system (NIS); (ii) expanding the capacity to generate scientific and technological knowledge; (iii) promoting business innovation and greater private-sector participation in science and technological

[37] See: http://www.perucompite.gob.pe

activities, to help boost the competitiveness of Peru's leading productive sectors; and (iv) encouraging research in science and technology so that they can make a meaningful contribution to improving business competitiveness by promoting links and cooperation between the scientific/academic and productive sectors.

Finally, the country is in a relatively modest position compared to the Latin American region in terms of the initial phases of the adoption of new information technologies. However, some factor for increasing the adoption and utilization of new information and communication technologies should be applied, such as the development of a legal framework and policies that promote investment in ICTs; a government commitment to use such technologies (use of e-government, which also will help improve transparency); and promotion of competition in both the ICT delivery markets and the telecommunications and information technology services market.

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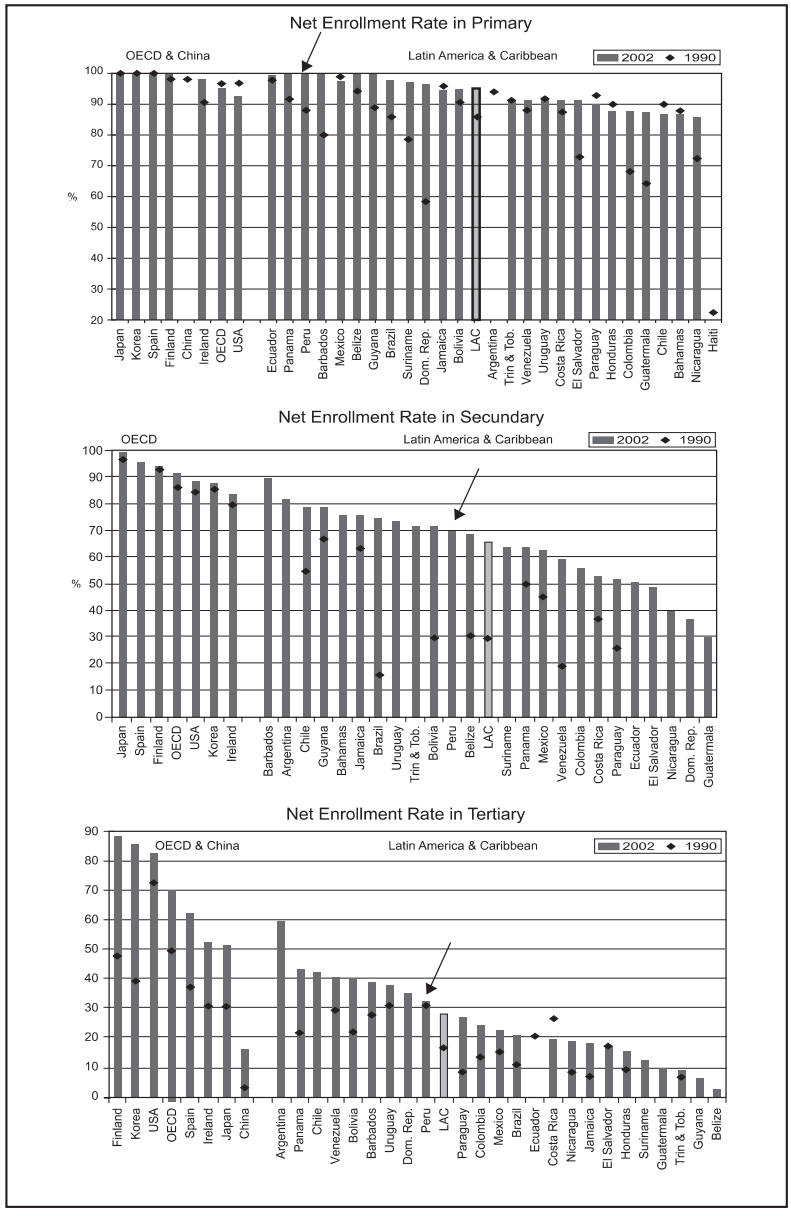
ANNEX 1

FIGURE 16
ENROLLMENT RATES: LATIN AMERICA & CARIBBEAN AND OECD & CHINA



Source: IADB (2006).

ANNEX 2

TABLE 4
UNCTAD INNOVATION CAPABILITY INDEX, 2001

	Innovation capability		Technological activity		Human capital	
	Position	**Index**	**Position**	**Index**	**Position**	**Index**
Sweden	1	0.979	1	0.976	2	0.982
Japan	11	0.885	5	0.935	21	0.835
Ireland	21	0.814	22	0.781	18	0.848
Hungary	32	0.725	28	0.692	35	0.758
Czech Republic	36	0.69	30	0.68	38	0.701
Argentina	37	0.685	37	0.603	33	0.767
Chile	42	0.576	47	0.544	47	0.609
Brazil	49	0.529	52	0.478	52	0.579
Uruguay	52	0.506	71	0.298	37	0.715
Costa Rica	58	0.472	49	0.526	71	0.419
Mexico	59	0.469	54	0.461	65	0.477
Venezuela (Bolivarian Republic of)	62	0.46	56	0.468	64	0.482
Peru	63	0.425	74	0.289	57	0.561
Jamaica	67	0.395	68	0.315	67	0.475
Colombia	68	0.393	70	0.311	66	0.476
Ecuador	78	0.319	83	0.235	74	0.404
El Salvador	84	0.279	88	0.204	82	0.354
Paraguay	93	0.213	106	0.075	83	0.351
Guatemala	101	0.135	109	0.055	96	0.215
Angola	117 (last)	0.019	117	0	118	0.025

Source: ECLAC (2006), UCNTAD (2005).