Chapter 1.1

Policies and Institutions Underpinning Country Innovation: Results from the Innovation Capacity Index

Augusto López-Claros,
EFD-Global Consulting Network
Yasmina N. Mata, Consultant

The ingenuity and inventiveness of the Chinese, which have given so much to mankind—silk, tea, porcelain, paper, printing, and more—would no doubt have enriched China further and probably brought it to the threshold of modern industry, had it not been for this stifling state control. It is the State that kills technological progress in China. Not only in the sense that it nips in the bud anything that goes against or seems to go against its interests, but also by the customs implanted inexorably by the raison d'État. The atmosphere of routine, of traditionalism, and of immobility, which makes any innovation suspect, any initiative that is not commanded and sanctioned in advance, is unfavourable to the spirit of free inquiry.

—Etienne Balazs (1968)[1]

Introduction

Our understanding of what drives national prosperity has evolved over time. Natural resources, population growth, industrialization, geography, climate, and military might have all played a role in the past. We also know that the relative importance of these drivers has shifted over time, and that in recent decades, more importance has been given to the coherence and quality of policies and the development of supporting institutions. A relative newcomer to this debate—identified as perhaps one of the most important modern engines of productivity and growth—has been the innovation excellence of a country; that is, its industries, researchers, developers, creative thinkers, enlightened politicians, managers, and clusters.

This chapter discusses the role of innovation in promoting economic and social development. In particular, it features the Innovation Capacity Index (ICI), a tool for assessing the extent to which nations have succeeded in developing a climate that will nourish the potential for innovation. The Index allows policymakers and entrepreneurs around the world to examine the broad range of country-specific factors which underlie innovation capacity, creating a quantified framework for formulating and implementing better policies for the creation of an environment supportive of innovation.

This chapter builds on "The Innovation Capacity Index: Factors, Policies and Institutions Driving Country Innovation," chapter 1.1 in *The Innovation for Development Report 2009–2010*, which introduced the ICI for the first time. Section 1 presents some thoughts on the role of innovation in economic and social development, with particular emphasis

[1] Balazs, 1968, quoted in Landes (1998), p. 57.

on its role in boosting factor productivity. In Section 2, we examine briefly some of the factors which are essential for the creation of an environment that will encourage innovation and the types of initiatives that will contribute in some way to boosting productivity and, hence, economic growth. Chapter 1.1 in last year's Report provided a fairly comprehensive analysis of the role of these factors and, hence, our discussion here is mainly intended to provide a summary, while noting the importance of a few additional factors not covered in 2009. The identification of these factors draws on insights in economic theory and practice accumulated during the past half century which have played a central role in determining the major building blocks of the Innovation Capacity Index. Section 3 presents a brief overview of international benchmarking as a means of enhancing analysis and policy dialogue in a number of important areas. Section 4 presents the Innovation Capacity Index, highlighting briefly some of its key features. Section 5 presents the main results of the ICI for 2010, with particular reference to a handful of countries: Korea, Brazil, China, Israel, and Spain, which are seen as exhibiting some especially interesting features, or as suggesting patterns that may be of broader interest. In Section 6, we present our main conclusions. For those familiar with the contents of Chapter 1.1 in the 2009 *Report*, we recommend that readers skip directly to Section 5, the presentation of this year's results and the analysis contained therein for the five new countries featured in 2010.

1. A brief overview of innovation

There have been some attempts to define "innovation." For the OECD, for instance, innovation is "the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations" (OECD and European Communities, 2005, p. 46). Onadera and Kim (2008, p. 112) think that innovation "is about the successful exploitation of new ideas and the invention, development and commercialization of new technologies, services, business models and operational methods. Innovation is thus related to a process connecting knowledge and technology with the exploitation of market opportunities for new or improved products, services and business processes compared to those already available on the market." We are broadly sympathetic to the view that any definition is likely to be constraining and is unlikely to apply and be meaningful when seen in the context of several thousand years of recorded history and a long and varied chain of innovations. In the context of this study, we think of innovation as the creative use of knowledge to allow individuals—and, by extension, corporations and nation-states—"to go farther, faster, deeper and cheaper" (Friedman, 1999). In most instances, innovation will involve a rise in factor productivity and, hence, other things being equal, living standards.

In last year's chapter, several examples were given of scientific innovation in Europe of the Middle Ages which contributed to substantially enhancing labor productivity. As noted by Landes (1998) eyeglasses, for instance, were seen to have significantly lengthened the working life of skilled workers, by perhaps as much as 20 years, thereby greatly boosting the productivity of toolmakers, weavers, metalworkers, scribes, and others who depended on their eyesight to do fine work. Eyeglasses not only prolonged the productive working life of large numbers of people, but also encouraged the invention of new precision instruments such as gauges and micrometers, which could not have been invented otherwise had workers not been able to see well. Adam Smith himself had noted the connection between innovation and productivity in his *Wealth of Nations*. "This great increase in the quantity of work, which, in consequence of the division of labor, the same number of people are capable of performing, is owing to three different circumstances; first, to the increase of dexterity in every particular workman; secondly, to the saving of the time which is commonly lost in passing from one species of work to another; and lastly, to the invention of the great number of machines which facilitate and abridge labor, and enable one man to do the work of many" (p. 7).

The mechanical clock is another instance of ingenuity having a major impact on productivity. Landes notes that "the very notion of productivity is a by-product of the clock: once one can relate performance to uniform time units, work is never the same" (p. 49–50). It was the invention of the me-

chanical clock which in turn led to one of Adam Smith's seminal insights: wealth and prosperity depend directly—to use Smith's language—on the "productive powers of labor."[2]

Printing was a Chinese invention in the 9th century, but it did not take off in a major way until it made its way to Europe several centuries later. In China, however, the widespread use of the technology was discouraged by an overly conservative Confucian mandarinate. In Europe, however, written manuscripts had been much in demand for centuries before Gutenberg printed the first Bible and in Italy alone, more than 2 million books were printed before 1501. Muslim countries found the idea of a printed Koran unacceptable, leaving the operation of printing presses in Istanbul to Jews and Christians, but not Muslims. Indians, likewise, did not adopt the new technology until the early 19th century when the first printing presses made their appearance. In sharp contrast, in Europe, not even the Church was able to restrain the new technology and all its uses. In all of these examples, one sees innovations spreading gradually, sometimes over several decades, "diffusing across countries and regions as people moved up learning curves and gained efficiency through practicing and improving the new techniques" (Goldstone, 1996).

An interesting question—to which we shall turn our attention more fully in the next section—concerns the factors that may help create an environment that nurtures the capacity for innovation. Two cultures that showed great promise of playing a leading role in advancing the cause of scientific discovery and innovation were those of Islam and China. There seems to be little doubt that in the 400-year period leading up to 1100, as noted by Landes, "Islamic science and technology far surpassed those of Europe, which needed to recover its heritage and do so to some extent through contacts with Muslims in such frontier areas as Spain. Islam was Europe's teacher."[3] An early example of Islamic innovation is provided by Sells (1999, p. 7): "At the time Muhammad was reciting the first Qur'anic revelations to a skeptical audience in the town of Mecca, several developments were leading to a transformation of Arabia's place in the world. One was a technological revolution. Sometime around the period of Muhammad's life, the Bedouin developed a new kind of camel saddle that allowed their camels to carry previously unimagined weight. Camels, which had been used largely for milk and transport of individuals and small loads, became the center of a transportation revolution. Within a hundred years, the Hellenistic and Roman worlds of transport and commerce, based on donkey carts and the upkeep of roads, were replaced by camel caravans. And the Bedouin in Arabia, who had been traders with and raiders of the established civilizations, were to control the vehicle of trade and commerce in the Western world: the dromedary camel."

Gradually, after the year 1100, Islamic science came to a standstill as the faith was taken over by zealots, and the emphasis within the community shifted to one of conformity and obedience to its rulers, itself facilitated by the non-separation of church and state. Not surprisingly, "native springs of invention seem to have dried up."[4]

The case of China is equally fascinating because, at a time when Europe was a backwater of scientific enquiry, Chinese inventions—printing, paper, the compass, gunpowder, porcelain, silk, the use of coal and coke for smelting iron—suggested the existence of great technological potential. Why China failed to realize this potential and in the next several centuries fell hopelessly behind Europe is an intriguing question. Several explanations have been put forward by sinologists, among which the role of the state figures prominently. At one level, the lack of a well-defined framework for property rights and the absence of a free market seem to have been lethal. "The Chinese state was always interfering with private enterprise—taking over lucrative activities, prohibiting others, manipulating prices, exacting bribes, curtailing private enrichment."[5] During the Ming dynasty (1368–1644), serious attempts were made to shut down all trade with the outside world, efforts which in turn led to the proliferation of smuggling, rent-seeking, corruption, and violence.

At least one author, Jack Goldstone (1996), has suggested that an additional factor in explaining the abortive nature of China's technological potential stemmed from the confinement of women to the home, which severely restricted the employment of women outside of the household and limited the supply of workers to labor-intensive industries, such as textiles. He further states: "In northwest Europe, with its pattern of late marriages and nuclear families, there existed a

[2] Smith, 1994, p. 5.
[3] Landes, p. 54.
[4] Ibid., p. 55.
[5] Ibid., p. 56.

stage in the life course of most women—between puberty in their early teens and marriage in their mid-twenties—when they were available for labor and routinely performed work for wages outside their natal households. *No such stage existed in the life course of Chinese women, at least from the Ming through the end of the Imperial era (to 1911)* (emphasis in original). This would have posed a great obstacle to the creation of textile factories along the lines of their development in Europe and North America at any time in China's late Imperial history" (p. 3).

Potential innovators in Europe were considerably less subject to such constraints. What was more important: Europe had entered an era of free enterprise. "Innovation worked and paid, and rulers and vested interests were limited in their ability to prevent or discourage innovation. Success bred imitation and emulation."[6] It led to the establishment of scientific societies and formal programs of scientific enquiry and, in time, created a culture of innovation and research which saw the progress of science and technology as powerful engines of economic and social development.[7]

2. Factors, policies, and institutions fostering innovation

Over the past quarter century there has been an intense debate among professional economists and policymakers about the relative importance of various factors in creating the conditions for sustainable growth. From an early emphasis on macroeconomic stability, the debate has broadened substantially to include the role of institutions, education, the quality of governance, of public administration, the presence of economic opportunities, and the increasingly crucial role of technology and innovation in enhancing the efficiency of the development process. Indeed, this debate has intensified in the past couple of years as a result of the international financial crisis and the soul-searching it has precipitated about the sustainability of the present economic system. Robert Shiller (2009), a leading observer of financial markets, who issued repeated warnings about the real estate bubble in the United States, thinks that "capitalist economies, left to their own devices, without the balancing of governments, are essentially unstable." Nobel Laureate Amartya Sen (2009) recently wrote that "the question that arises most forcefully now is not so much about the end of capitalism as about the nature of capitalism and the need for change."

An increasingly important factor in explaining rising prosperity and economic efficiency concerns the agility with which an economy adopts existing technologies to enhance the productivity of its industries. As countries have made considerable progress in improving their institutional and macroeconomic framework, attention turned to other drivers of productivity, with technology and innovation emerging as central to the whole development process; economic output is no longer mainly a function of capital and labor but, increasingly, of knowledge and the acquisition of *new* knowledge.

These issues were seen as critical because technological differences have been shown to explain much of the variation in productivity between countries. As progress in the dissemination of knowledge and the increasing use of information and communications technologies (ICT) have become increasingly widespread, we have seen strong productivity growth linked to the improved performance of industries which have used the latest technologies intensively to transform key elements of their operations. High-tech producers such as Microsoft, with well-established traditions of heavy spending in research and development, are enabling those sectors of the economy using the latest information technologies to improve their productivity performance and thus contributing to an overall boost to productivity growth.

These considerations lead us to pose a couple of central questions: What are the factors, policies and institutions which are conducive to the creation of an economic and social environment that boosts the capacity for innovation? What is their relative importance? How do they interact with each other? How successful have countries been in identifying and adopting them? Let us now consider some high-priority areas.

Education and human capital

According to Amartya Sen (1999), education and good pub-

[6] Landes, p. 59.

[7] The examples provided in this section have mainly dealt with technology innovations. The Middle Ages in Europe also saw a fertile period of innovation in the use of new financial instruments. See Ferguson, (2008) for an excellent overview, from the early days of money lending in Venice in the 14th century, through the gradual emergence of credit and currency markets under the Medici, to the appearance of bond, insurance, and real estate markets elsewhere in Europe.

lic health allow for more effective participation in the economic and political life of the nation. Illiteracy, for instance, can be a major barrier to participation in economic activities and the use of, and access to, technological innovations. Lack of such basic skills severely limits the possibilities of citizens to participate in the development process, to be gainfully employed, to be well-informed judges of government policies and politicians, and to avoid falling prey to the manipulations of demagogues. From a business perspective, as noted by Porter (1990),

> achieving more sophisticated competitive advantages and competing in advanced segments and new industries demands human resources with improving skills and abilities. The quality of human resources must be steadily rising if a nation's economy is to upgrade. Not only does achieving higher productivity require more skilled managers and employees, but improving human resources in other nations sets a rising standard even to maintain current competitive positions … Education and training constitute perhaps the single greatest long-term leverage point available to all levels of government in upgrading industry. Improving the general education system is an essential priority of government and a matter of economic and not just social policy. [8]

Education and training are indeed emerging as key drivers of productivity growth. As the global economy has become more complex, it is now evident that in order to compete and maintain a presence in global markets, it is essential to boost the human capital endowments of the labor force, whose members must have access to new knowledge, be continually trained in new processes, and in the operation of the latest technologies. Porter provides useful insights in his discussion of the role of education in contributing to an upgrading of an economy's productive apparatus. Worth highlighting are the emphasis he places on high educational standards—which typically require some form of state involvement in the setting of norms—as well as the need for students to receive education and training that has a strong practical orientation. He also notes that when teaching is perceived to be a prestigious job—hence, adequately compensated—it can have a measurable impact on the quality of the teaching staff and, more generally, the excellence of the education system. Porter highlights the importance of close collaboration between the educational institutions and potential employers, with universities and other institutions of higher education called upon to adapt to the changing needs of industry. Not to be neglected as well is the need for firms to "invest heavily in ongoing in-house training through industry associations or individually." He also praises the role of technical and vocational education, and highlights the benefits of inward migration policies that allow the movement of workers with specialized skills.[9]

Higher education, in particular, would appear to be particularly important, given the gains made in recent decades in expanding the coverage of primary and secondary education. Countries which have invested heavily in creating a well-developed infrastructure for tertiary education have reaped enormous benefits in terms of growth. Education has been a particularly important driver in the development of the capacity for technological innovation, as the experience of Japan, Finland, Sweden, Korea, Taiwan, and Israel clearly shows.

Governance and corruption

Corruption undermines the investment climate, discourages private-sector development and innovation, and encourages various forms of inefficiency; the more widespread, the more damaging its effects. Budding entrepreneurs with bright plans and ideas will be intimidated by the bureaucratic obstacles, financial costs, and psychological burdens of starting new business ventures—including dealing with corrupt officials to obtain permits and licenses—and will either opt to take their ideas to some other less corrupt country, if they can afford to do so, or, more likely, may desist altogether, or opt for early departure from the market, quickly shutting down newly created companies. So, corruption is either a barrier to entry into the market or a factor in precipitating early departure; in either case, economic growth is adversely affected. The high incidence of corruption will imply an additional financial burden on businesses, imposing heavy costs on them, thereby undermining their international competitiveness. Unlike a tax, which is known and predictable and can be built into the cost structure of the enterprise in an orderly fashion, bribes are necessarily unpredictable and random, and will undermine cost control, reduce profits and undermine the efficiency of

[8] Porter, 1990, p. 628.
[9] Ibid., 1990, pp. 628–30.

those who must pay them to stay in business. Paulo Mauro (1995) used some indices of corruption and institutional efficiency to show that corruption lowers investment and, hence, economic growth. He offers the following example: "If Bangladesh were to improve the integrity and efficiency of its bureaucracy to the level of that of Uruguay (corresponding to a one-standard deviation increase in the bureaucratic efficiency index), its investment rate would rise by almost five percentage points, and its yearly GDP growth rate would rise by over half a percentage point" (p. 705).

Corruption is particularly devastating for small and medium-sized enterprises—often the engines of economic growth and job creation in the developing world—which may not have the clout of big companies to protect themselves from a proliferation of requests for bribes. Corruption also contributes to a misallocation of human resources. To sustain a system of corruption, officials and those who pay them will have to invest time and effort in the development of certain skills, nurture certain relationships, and build up a range of supporting institutions and opaque systems, such as off-the-books transactions, secret bank accounts, and the like. But these "assets" will not be easily transferable to the non-corrupt part of the economy later on, since, by its very nature, corruption is not about boosting productivity and the country's potential wealth; it is fundamentally about the redistribution of rents which, of course, do not add to economic growth. Surveys have shown that the greater the incidence of corruption in a country, the greater the share of time that management has to allocate to dealing with ensuring compliance with regulations, avoiding penalties, and dealing with the bribery system that underpins them, activities that draw attention and resources away from production, strategic planning, and so on. And, of course, the more the time is spent by officials either building up systems to control corruption—or, in the case of corrupt officials, ensuring that the bribery machinery in place remains operational, appropriately flexible and secret—the less time is devoted to governing and adding value, without doubt a net reduction in the government's administrative capacity.

Corruption undermines government revenue and, therefore, limits the ability of the government to invest in productivity-enhancing areas, such as education, infrastructure and health. Not surprisingly, where corruption is endemic, individuals and citizens will view paying taxes as a questionable business proposition, often a way to indulge the government in some of its worst excesses. There is always a delicate tension between the government in its role as tax collector and the business community and individuals in their roles as tax payers. The system works reasonably well and the budget becomes an important mechanism of distribution when those who pay taxes feel that there is a good chance that they will see a future payoff, in terms of improvements in the country's infrastructure, enhanced services, better schools, and a better-trained and healthier workforce, and so on. Corruption sabotages this implicit contract. When government officials allow corruption to flourish they contribute to the creation of an environment in which those who pay taxes are either morally outraged at having to do so or, more likely, feel entirely justified in finding creative ways to avoid paying them or, worse, become bribers themselves. In some cases, lobbying and influence-peddling become relatively attractive alternatives to paying all taxes due, a natural response to the signal sent to the private sector by government bureaucrats or legislators that "we are for sale."

To the extent that corruption undermines revenue, it adversely affects government efforts to reduce poverty. According to the World Bank (2009), in 2005 (the latest year for which figures are available), there were 1.4 billion people living on less than US$1.25/day, the definition of extreme poverty. There were 2.6 billion living on less than US$2.00/day, equivalent to 47 percent of the population of the developing countries. Monies that leak out of the budget because of corruption are monies that will not be available to lighten the burden of the poor; bribery thus interferes with the fulfilment of basic human needs. Of course, corruption also undermines the case of those who argue that foreign aid can be an important element in the fight against global poverty; for why should taxpayers in the rich countries be asked to support the lavish lifestyles of the kleptocrats in failing states?

Corruption, as we shall see below, distorts public investment and boosts overall spending, leading, other things being equal, to a larger government deficit than would otherwise be the case. A larger deficit will generally mean a larger accu-

mulation of public debt, higher debt-service payments, and, inevitably, constraints on other areas of expenditure which could more directly contribute to improved productivity and growth. So, by undermining revenue, increasing the effective tax burden, and boosting expenditure, corruption is highly damaging to the public finances. Or, to put it in another way: when corruption depresses revenues, governments will be forced—to sustain a given level of expenditure—to increase tax rates and/or to forego the benefits of programs which cannot be financed because of lack of resources. Often, because they are easy to collect, governments will opt for increasing consumption taxes, which tend to be regressive, disproportionately affecting the lower-income groups. To give another example: in Russia the minimum pension—received by some 37 million people—fell by 70 percent in real terms between 1991 and 1996 because the government had "lost" several billion dollars in annual budget revenue, through tax exemptions extended to cronies and favored companies.

Johnson, Kaufmann, and Zoido-Lobatón (1998) used cross-country data to establish that the higher the level of corruption in a country, the larger the share of its economic activity that will go underground, and, hence, will be beyond the reach of the tax authorities. Not surprisingly, studies have shown that corruption also undermines foreign direct investment since it acts in ways that are indistinguishable from a tax; other things being equal, investors will always prefer to establish themselves in less corrupt countries. Wei (1997, p. 24) reviewed foreign direct investment (FDI) data from 14 source countries to 45 host countries, and concluded that: "an increase in the corruption level from that of Singapore to that of Mexico is equivalent to raising the tax rate by 21–24 percentage points."

Macroeconomic management

Having a stable macroeconomic environment has come to be accepted as an essential ingredient for the successful implementation of broad-based reforms aimed at encouraging the development of the private sector. There are no known instances of countries that have managed to grow in a sustainable way, while pursuing imprudent fiscal policies which have fuelled inflation and exchange rate instability, and have contributed to the emergence of various macroeconomic imbalances. Prudent fiscal and monetary policies that contribute to low inflation rates and a more stable domestic environment have been shown to contribute strongly to business confidence and the willingness of domestic and foreign investors to undertake investment projects.

The latest global financial crisis has highlighted the crucial importance of sound public finances. The problem with high public indebtedness is that it creates a terrible dilemma for governments. Scarce public resources which could be allocated to education, public health or to improve countries' infrastructure—all areas that help to improve competitiveness—have to be increasingly dedicated to debt service. The primary aims of economic policy are subverted. Instead of worrying about reforms aimed at boosting productivity, governments increasingly have to worry about keeping the markets happy, making sure that debt rollovers take place smoothly and so on—i.e., day-to-day cash management. In contrast, countries that have managed to sustain prudent levels of debt have typically been able to allocate adequate resources to productivity-enhancing areas of public expenditure. They have also been more successful in persuading the business community and civil society to pay their taxes on time.

The question of a country's integration with the global economy has also acquired growing importance over the past decade, particularly in the context of discussion about the interactions between the process of globalization and economic development. In an increasingly interdependent world economy, a more outward-looking orientation has become an essential element of successful economic reforms. In addition to the well-known gains from international trade, it is clear that relative openness and strong links with the world economy impose on domestic producers the valuable discipline of international competition, and provide opportunities for new exports. An open orientation can also attract much needed capital and expertise, thus enhancing the prospects for growth through increased efficiency and productivity. Greater integration with the world economy also serves as an important channel for absorbing technological advances from abroad, including improvements in management practice and positive effects on the buildup of human capital that derive

from being able to tap into global systems of knowledge, as is evident from the experience of many outward-oriented economies that have developed strong export sectors based on new manufacturing industries.

The regulatory framework

The World Bank's *Doing Business Report* (DBR) is an excellent compendium of business regulation in 183 countries. The picture that emerges from that study for a large number of countries is a fairly disquieting one.[10] In 2009, the scope of the DBR expanded significantly, such that now, in addition to the usual indicators on opening a new business (number of procedures needed, time taken, and cost) one can also obtain answers to such questions as: Which countries make it easy to pay taxes or get licenses? Where is it easier or more difficult to enforce contracts? Who regulates property registration most closely? Where are investors provided the greatest protection? Which countries have the most restrictive labor legislation, making it very difficult, for instance, to adjust the size of the payroll?

The data in Table 1 eloquently highlight the extent to which many countries discourage the development of entrepreneurship and, hence, the capacity for innovation of their own private sectors. And it is clear from the data that these are problems existing not only in developing countries.

A key lesson that emerges from the DBR is that those countries with the greatest need for entrepreneurship and private sector development are those that generally create the greatest obstacles for the creation of new enterprises, or that otherwise intervene in ways that retard the emergence of entrepreneurial capacities which are so central to the development of an enabling environment for innovation. To the extent that red tape, excessive regulation, and bureaucracy are self-imposed evils, there would appear to be ample scope for government action aimed at their speedy elimination.

Gender equity

A number of studies have shown that there is a close connection between national economic performance and the degree to which societies have succeeded in integrating women into the economy and have allowed them to increasingly participate in decisionmaking, particularly in the case of representa-

Table 1. *Doing Business Report*: An international perspective on regulation

	Singapore	Argentina	India	Korea	South Africa	Spain	United States
Ease of doing business*	1	118	133	19	34	62	4
Starting a business*	4	138	169	53	67	146	8
Number of procedures	3	15	13	8	6	10	6
Time (days)	3	27	30	14	22	47	6
Dealing with construction permits*	2	169	175	23	52	53	25
Employing workers*	1	101	104	150	102	157	1
Registering property*	16	115	93	71	90	48	12
Time (days)	5	52	44	11	24	18	12
Protecting investors*	2	109	41	73	10	93	5
Paying taxes*	5	142	169	49	23	78	61
Enforcing contracts*	13	46	182	5	85	52	8
Time (days)	150	590	1420	230	600	515	300
Closing a business*	2	86	138	12	76	19	15
Time (years)	0.8	2.8	7	1.5	2	1	1.5

* Rank from 181 countries

Source: World Bank, 2010.

[10] The *Doing Business Report* is available free of charge, at: http://www.worldbank.org

tion in parliaments, cabinets, and other executive bodies, and have made it possible for them to avail themselves of opportunities for education and building up of human capital.

International competitiveness and productivity have much to do with the efficient allocation of resources, including, of course, human resources. The efficient operation of our increasingly knowledge-based economy is not only a function of adequate levels of available finance, a reasonably open trade regime for goods and services, but is also more and more dependent on our ability to tap into a society's reservoir of talents and skills. When, because of tradition, a misunderstanding of the purpose of religion, social taboos or outright prejudice, half of the world's population is prevented from making its contribution to the life of a nation, the economy will suffer. The skill-set which the private sector can tap will be necessarily narrower and shallower, and productivity, the engine of sustainable growth, will be impaired. Indeed, it is no surprise that the most competitive countries in the world, those that have been better able to operate on the boundaries of the technology frontier, are also those in which women have been given the greatest opportunities to be equal partners with men. Thus, gender equality has not only an ethical or moral dimension, but is, in fact, an issue of economic efficiency and, thus, may be at the very basis of creating a more prosperous world.

There are important other factors

The list of other factors which contribute to create an enabling environment for innovation is long. Among them:

- What is the legal basis for secure property (including intellectual) and contract rights?
- What are the patterns of income distribution in the country? Are levels of inequality so high that they feed political instability?
- Do timely and accurate accounting and reporting provide adequate information about the financial position of public and private enterprises?
- Is the financial sector deep enough to allow reasonably free access to finance and the emergence of venture capital?
- Is the trade regime unduly restrictive, or it is reasonably open, encouraging competition and gains in efficiency? Does the legal framework encourage foreign direct investment, or is there undue protection of "strategic" sectors?
- What are the levels of spending in education, both in absolute terms (percent of GDP) and in relative terms (as percent of total government expenditure)?
- Is there an adequate safety net to provide workers with some degree of financial security in times of economic stress?
- Is regulation of the labor market appropriate, or does it provide perverse incentives for both employers and workers?
- What is the level of expenditure in research and development?
- What is level of expenditure in information and communication technologies? Does the government take a leadership role in the adoption of the latest technologies?
- Does the educational system encourage enrollment in science and engineering?
- How widespread is the knowledge of English?
- What are the penetration rates of the latest technologies?
- How effective is the government in providing information and public services for the people through electronic platforms?
- Are public procurement policies and systems open and transparent, and do they encourage the adoption of new technologies and reward innovation?
- What is the degree of collaboration between industry and the universities? Is the university system delivering to the business community adequately trained graduates, or do these have to be "reeducated"?
- Where they exist, are government tax incentives well-targeted, limited in duration, and applied transparently, or do they distort the incentives system?
- Do government immigration policies encourage the arrival of skilled workers and other highly qualified professionals?
- Is there public funding for long-term research?

3. Composite indicators and the measurement of innovation

There seems to be broad consensus that composite indicators will be more credible if their construction is underpinned by a sound theoretical framework that enlightens in a plausible way the choice of variables and the ways in which these are combined. There has been wide debate with respect to the usefulness of these types of measures. The debate has been limited not only to technical aspects and methodological questions, but also to subjective perceptions of the public at large and, more specifically, to whether their advantages outweigh their potential disadvantages. It is not our intention to enter into this debate. Suffice it to say that the past couple of decades has seen a remarkable increase in the number of credible organizations that have opted for the development of composite indicators, scoring mechanisms, and associated rankings.

The *Handbook on Constructing Composite Indicators* by the OECD and the European Commission Joint Research Centre (EC JRC) lists some of their main advantages and disadvantages (Table 2). Some of the functionalities implied are: i) support for decisionmakers, since such indicators may allow more considered judgements as to various policy options available; ii) the ability to assess progress over time and to make meaningful international comparisons; and iii) contribute to public debate and the promotion of greater accountability. According to the *Handbook*, the two main criteria for evaluating composite indicators are ease of interpretation and the transparency of the methodology used. Ease of interpretation is important because the intent of building a composite indicator is to cast light on a given subject—readers and users must be able to see at a glance what is being measured. Transparency is key for credibility, particularly when the indicators touch upon some critical variable, with broad penetration in the public domain. In view of the disadvantages listed in Table 2, perhaps one of the main conclusions of this analysis is that composite indicators must be used with caution and as useful complements to other information and analysis, including well-informed judgements and common sense.

As a source of information, composite indicators can influence policymaking from a variety of perspectives. For instance, composite indicators can be useful for quantifying and outlining numerical goals and benchmarks. International benchmarking as a means of providing incentives for "changing behavior" has a well established record. For example, the United Nations Development Program's *Human Development Index* (HDI) rankings have encouraged development specialists to see economic development in a broader dimension, involving

Table 2. Advantages and disadvantages of composite indicators

Advantages	Disadvantages
• Can summarize complex, multidimensional realities with a view to supporting decisionmakers; • Are easier to interpret than a battery of many separate indicators; • Can assess progress of countries over time; • Reduce the visible size of a set of indicators without dropping the underlying information base, thus making it possible to include more information within the existing size limit; • Place issues of country performance and progress at the center of the policy arena; • Facilitate communication with general public (i.e., citizens, media) and promote accountability; • Help to construct/underpin narratives for lay and literate audiences; • Enable users to compare complex dimensions effectively.	• May send misleading policy messages if poorly constructed or misinterpreted; • May invite simplistic policy conclusions; • May be misused, e.g., to support a desired policy, if the construction process is not transparent and/or lacks sound statistical or conceptual principles; • The selection of indicators and weights could be the subject of political dispute; • May disguise serious failings in some dimensions and increase the difficulty of identifying proper remedial action, if the construction process is not transparent; • May lead to inappropriate policies if dimensions of performance that are difficult to measure are ignored.

Source: OECD and European Community Joint Research Centre, *Handbook on constructing composite indicators: Methodology and user guide*, 2008.

aspects of well-being not captured by conventional measures of GDP. The HDI has also led many countries to invest in preparing better and more updated statistical series capturing social dimensions of development. The practice of synthesizing large volumes of information into a scoring system which can be translated into an index and an associated set of rankings can provide considerable value-added, particularly where efforts have been made to identify the critical factors deemed to affect the dependent variable. For instance, Transparency International (TI) has been associated with the *Corruption Perceptions Index* (CPI) since 1993. That corruption existed everywhere was a well-known fact. What TI showed was that some countries had been more successful than others in curtailing it and that it was possible to build a simple index that would attach a corruption score to each country. The work of TI, including the formulation of anticorruption initiatives in such areas as public procurement, conflict of interest, and freedom of information laws, as well as the formation of an extended network of national chapters in more than a hundred countries, helped greatly to focus public attention on the issue of corruption. Many governments disliked the CPI and severely criticized it, a sure sign of its effectiveness. We believe TI contributed to legitimizing public discourse on issues of corruption and thus eased the transition by the World Bank and, to a lesser extent, the IMF into doing the same.

Composite indicators can also contribute to developing a common discourse and values when framing a problem in the light of public debate. Indexes and the associated rankings are useful benchmarking tools to focus public attention on a particular set of policy issues. When supported by detailed data, they can provide valuable information about underlying strengths and weaknesses, which can then become a catalyst for enhanced policy debate and efforts to improve particular areas of deficiency. For instance, the *Human Development Index* is an alternative measure of human welfare that captures a social dimension not existing in conventional GDP measures. The United Nations Development Program also publishes gender related indices which attempt to assess the extent to which countries have succeeded in empowering women and reducing gender disparities.[11]

Finally, they can also help to highlight priority areas for policy reform and existing areas of achievement. For instance, the World Bank has developed the *Country Policy and Institutional Assessments*, a rating system that captures a broad array of factors affecting the policy environment in a large number of developing countries. The CPIA encompass such concepts as the quality of public sector management, the extent to which authorities have improved the policy framework through various structural policies aimed at enhancing resource use, as well as various elements of social policy, including aspects of social protection and poverty reduction, among others. According to the World Bank "The CPIA consists of a set of criteria representing the different policy and institutional dimensions of an effective poverty reduction and growth strategy. The criteria have evolved over time, reflecting lessons learned and mirroring the evolution of the development paradigm. In 1998, the criteria were substantially revised and coverage was expanded to include governance and social policies. The number of criteria was set at 20 (where it remained until 2004), and the ratings scale was changed from a 5- to a 6-point scale. To strengthen the comparability of country scores, specifically across regions, the ratings process was revised to include the benchmarking step."[12]

The Innovation Capacity Index was built against the background of this large body of work which sees indexes—with all their limitations—as working tools to generate debate on key policy issues, and to track progress over time in the evolution of those factors which help explain national performance. A well-designed composite indicator could thus provide a useful frame of reference for evaluation, the effectiveness of which will be enhanced if greater attention is placed on ways to improve national performance than on the relative rankings themselves.

4. The Innovation Capacity Index

It is worthwhile mentioning at least three areas in which the work underlying the construction of the ICI makes this a novel and, in our view, far-reaching policy instrument.

A. Overwhelming use of hard data

The ICI makes overwhelming use of hard data indicators. A full 90 percent of the variables used in the construction of

[11] See, for instance, the UNDP's Gender Empowerment Measure (GEM) and the Gender-related Development Index (GDI), both available at: http://www.undp.org

[12] World Bank, 2005, available at: http://www.worldbank.org

the Index can be regarded as hard, that is, measuring directly some underlying factor (e.g., the budget deficit, expenditure in education, research and development intensity, etc.), and, therefore, not dependent on some survey instrument capturing (typically), business or civil society *perceptions*. This is not to suggest that there is no place for surveys in the construction of indexes. However, over the past decade or so, we have seen considerable improvement in the ability of various international organizations to develop indicators for a large number of countries that capture factors that had previously not been easily measured. An excellent example of this is the work done at the World Bank on business regulation and obstacles to the creation of new enterprises. Most of the concepts captured in the *Doing Business Report* published by the World Bank were in the past "measured" only through some opinion survey, such as the one carried out annually by the World Economic Forum. Many of these concepts, however, are now available through the comprehensive field work done by the Bank to examine the actual—as opposed to *perceived*—obstacles faced by the business community in a large number of countries. While this may perhaps be the best example, it is by no means the only one. In recent years, the International Telecommunications Union has broadened the scope of the variables which they track that attempt to capture various indicators of the breadth and use of the latest technologies. The IMF has compiled a measure of trade openness, and the World Bank has put together at least two impressive scoring mechanisms: one is the Worldwide Governance Indicators which capture a large number of governance and rule-of-law measures; the second is the Country Policy and Institutional Assessment (CPIA), which examines various elements of a country's policy environment, such as the quality of public administration, the efficiency of the financial sector, and so on. All of these have been used in the construction of the ICI.

B. Use of a "stages-of-development" theoretical framework

The construction of the Index explicitly incorporates the notion that while there are many factors which will have a bearing on countries' innovation capacity, the relative importance of these will vary depending on their stage of development and the particular political regime against which policies are being implemented. As regards the stages of development, our work is close in spirit to that done by Porter (1990), who divides countries and their respective industries into three broad categories: factor-driven, investment-driven, and innovation-driven. These categories, in turn, are highly correlated with rising economic prosperity, as captured by the growth of per capita income. Porter highlights some of the features of each of these stages and it will be useful to provide here a brief summary.

Factor-driven

Countries are in this stage when they derive advantages from basic factors of production, such as natural resources, plentiful and inexpensive labor, and, in some cases, a benign climate which may create favorable conditions for agriculture. These factors may impose some constraints on the kinds of industries that can develop and, thus, may limit a country's presence in the global economy. At the factor-driven stage, countries will compete on the basis of price advantage, and technologies will usually be adopted from other countries, as opposed to created from within. Typically, human capital resources will not be particularly well developed, a feature that will constrain a country's ability to innovate and to see sustained productivity growth. Because countries will be largely price-takers in international markets, they will be vulnerable to business cycle fluctuations, exchange rate movements, or other external shocks that may lead to sharp changes in the terms of trade. At this stage, countries will have institutions in the early stages of development and one may see high levels of corruption, weaknesses in the legal framework and the rule of law, relatively low levels in the quality of the public administration and, as a result, a poor macroeconomic situation, characterized, for instance, by high inflation or loose public finances. In light of these observations, for nations in the factor-driven stage, the focus of policies should be the achievement of macroeconomic stability and the establishment and improvement of the basic institutions underpinning the modern market economy. To the extent that policies are not geared to these ends, nations may get stuck at this stage for decades, if not, in fact, much longer.

Investment-driven

At this stage, we witness heavy investment aimed at modernizing the economy's infrastructure. According to Porter, firms will invest to "construct modern, efficient, and often large-scale facilities equipped with the best technology available on global markets."[13] Technologies and processes discovered or developed elsewhere will not simply be adopted, but may also be improved upon. The range of technologies imported from abroad may also widen to include not only basic ones, but also the most sophisticated. The main underlying theme of this stage is the willingness of firms to invest to upgrade factors to enhance productivity growth. This may include improvements in education and training, which create a pool of skilled workers who are able to assimilate and improve upon imported technologies or, in any case, adapt them to local conditions. Cost factors are still important and economies operating at this level are not immune from shifts in the global business cycle (or the exchange rate). But at this stage, investment aimed at a more efficient use of resources will often bring about a diversification in the economy's sources of wealth creation and, thus, the emergence of a greater degree of resilience to changes in the terms of trade. As a result of the above, one may also see a fairly sustained increase in wages and labor costs. At this stage, the focus of policies broadens somewhat. While macrostability and institutional development are still important, these policies must be supplemented by policies aimed at further structural reforms, increasingly formulated in a medium-term framework. At this stage, for instance, governments may focus on fiscal sustainability issues and may implement pension reform to establish a sounder financial basis for the social security system, may aim to significantly improve the infrastructure for higher education, and find ways to change the nature of public administration so that it plays a more supportive role for private sector development.

Innovation-driven

Consumers in countries operating at this stage of development have high levels of income per capita, sophisticated and demanding tastes, and, on average, higher levels of education than at the factor-driven or investment-driven stages, all of which create a demand for improvement and innovation. At this stage, firms may continue to use and improve existing technologies, but, increasingly, they create them. "Favorable demand conditions, a supplier base, specialized factors, and the presence of related industries in the nation allow firms to innovate and to sustain innovation."[14] This stage may also see countries essentially ceding to nations in earlier stages of development those industries that are less-sophisticated, or where demand is highly price-sensitive. Firms operating in innovation-driven countries will have their own marketing and supply networks and will have, in many cases, established recognizable brands. They will also become important investors abroad and become truly global players, not only in terms of markets for sale and sources of inputs, but also in terms of sources of funding, labor supply and the location of production. This stage also sees a further upgrade in the training of the labor force and the emergence of highly-skilled workers with specialized know-how and able to command high wages.

The role of public policy at the innovation stage is more subdued than at the previous two stages. Governments—overwhelmingly in the context of democratic institutions and processes—are called upon to preserve the gains made over the previous decades in terms of macro management and institutional development. Above all, governments are expected to do no harm to the policy environment, and the prospect that they can always be voted out of office generally tends to explain a certain level of policy stability. In these countries "the impetus to innovate, the skills to do so, and the signals that guide its directions must come largely from the private sector."[15] Porter (1990, p. 555) also identifies a "wealth-driven" stage which, in essence, is one of decline, where "the motivations of investors, managers, and individuals shift in ways that undermine sustained investment and innovation, and hence upgrading…and where malaise and an eroding sense of purpose may set in." It is conceivable that countries may enter periods of decline, and it is certainly the case that industries may also do so, partly through the failure of managers to anticipate technological change. But there is nothing to suggest that the entire collectivity of nations will go through a period of decadence and decline. The more likely scenario would appear to be one where nations gradually progress

[13] Porter, 1990, p. 548.
[14] Ibid., p. 554.
[15] For an application of Porter's stages-of-development approach to the measurement of competitiveness, see Sala-i-Martin and Artadi, 2004.

through the three stages identified above. Although some may remain in a given stage for a very long time—perhaps lasting even many decades, if not longer—a few may see temporary regression (e.g., Argentina and many of the poorest nations in Africa which can degrade to failed states). But the majority find themselves in a path of gradual forward, though at times uneven, progress).

The above stages are not meant to be interpreted in a rigid way. It may be possible, for instance, for a country to be in the factor-driven stage, while some of its industries, in specialized niche sectors, may be operating at a higher stage of development. Neither should countries be seen as steadily and gradually progressing from the factor-driven to the innovation-driven stage. Korea, Singapore, and Taiwan are examples of economies that have made the transition to the innovation stage in a relatively short span of time; indeed, Taiwan has made the transition from an agricultural economy with low income per capita to a prosperous global industrial ICT powerhouse in less than 40 years, an impressive achievement. Regrettably, regression is also possible, and the last 50 years provide many examples of countries that have failed to deliver their potential, that have stagnated on a relative basis with respect to countries at broadly similar stages of development, or that have joined the ranks of failed states.

In all cases, as should be evident, the role of policy matters enormously for how quickly and efficiently countries are able to make the transition through these three stages. Table 3 presents World Bank data on average income per capita for 2008, on the basis of which countries are classified as being high-income, upper-middle and lower-middle-income, and low-income. One may apply Porter's stages-of-development framework to suggest that low-income countries are at the factor-driven stage, middle-income countries would have moved to the investment-driven stage, and high-income countries would have entered the innovation-driven stage. While there will be exceptions to this categorization (e.g., a rich oil exporter in the Gulf region), we find that, in general, countries broadly possess the characteristics identified by Porter for each of the levels of income. A further sobering feature of this table is the relatively huge income gaps across the various categories: for instance, from an average of US$6,942 for upper-middle-income to US$37,787 for high-income, or from US$2,286 for lower-middle-income to US$567 for low-income, displaying well known, large, and growing, income disparities.

C. The nature of a country's political regime matters for innovation

The above theoretical (and practical) considerations, as explained further below, have had a direct bearing on the choice

Table 3. Average GNI per capita, current US dollars, 2008 (World Bank Atlas Method)

High-income	GNI per capita > $11,906		Average: $37,787
Full democracies	Flawed democracies	Hybrid regimes	Authoritarian regimes
$42,615	$18,270	$33,090	$43,650
Upper-middle-income	GNI per capita: $3,856–$11,905		Average: $6,942
Full democracies	Flawed democracies	Hybrid regimes	Authoritarian regimes
$6,907	$6,982	$7,810	$5,260
Lower-middle-income	GNI per capita: $976–$3,855		Average: $2,334
Full democracies	Flawed democracies	Hybrid regimes	Authoritarian regimes
–	$2,165	$2,524	$2,449
Low-income	GNI per capita < $975		Average: $567
Full democracies	Flawed democracies	Hybrid regimes	Authoritarian regimes
–	–	$555	$583

Source: World Bank, 2010a; International Monetary Fund, 2010; The Economist Intelligence Unit Democracy Index.

of weights for the various factors which have been used to construct the Innovative Capacity Index. In addition to the embedding of a formal stages-of-development framework into the determination of key elements of the Index structure, we have also seen the benefits of establishing a further distinguishing criterion for nations: namely the type of political regime under which policies are implemented. For these purposes we have used the four categories developed in The Economist's Democracy Index: *full democracies, flawed democracies, hybrid regimes,* and *authoritarian regimes.* There is ample empirical evidence suggesting that democracies are much better at creating the sorts of conditions in a country that are conducive to the nurturing of creativity and independence of thought that are so essential for innovation. Therefore, our work attaches to the nature of a country's political regime a significance that is not captured by purely looking at the level of income per capita as a proxy for the country's stage of development.

The question of the relationship between democracy and development has been amply debated in the economics and political science literature. Without entering into this debate—which is outside the scope of this paper—there is overwhelming empirical support for the thesis that, for instance, poor democracies do much better than poor autocracies, arguably the most relevant comparison to cast light on this subject.[16] Siegle, Weinstein, and Halperin (2004) look at annual data drawn from the World Bank's World Development Indicators for the period 1960–2003 to show that the median per capita growth rates of poor democracies have been 50 percent higher than those of autocracies.[17] Citizens in poor democracies live, on average, nine years longer than in low-income autocracies, have a 40 percent higher chance of attending secondary school, will enjoy higher levels of agricultural productivity and much lower infant mortality rates.

The latter statistic is particularly relevant as it reflects, in turn, better prenatal care for pregnant women, higher levels of nutrition, higher quality drinking water, and more opportunities for the education of girls. It turns out that poor democracies are also far better than poor autocracies in avoiding severe economic contractions—annual drops of 10 percent or higher in real GDP. "Seventy percent of autocracies have experienced at least one such episode since 1980, whereas only 5 of the 80 worst examples of economic contraction over the last 40 years have occurred in democracies."[18] In a nutshell: "poor democracies outperform authoritarian countries because their institutions enable power to be shared and because they encourage openness and adaptability. … An integral virtue of democracies, therefore, is that they provide a sphere of private space, which, protected by law, nurtures inventiveness, independent action, and civic activity. …Democracies are open: they spur the flow of information. …The free flow of ideas, every bit as much as the flow of goods, fosters efficient, customized, and effective policies."[19]

Index structure and formulation

In constructing the Index, we have tried to strike a balance between reasonably broad coverage of those factors which affect the capacity for innovation, on the one hand, and a certain degree of economy, on the other, as there is, in principle, a potentially large number of variables which could conceivably have a bearing on a nation's ability to innovate. Once these factors had been identified, an early priority was to organize them in a sensible way, bringing similar variables—for instance, those pertaining to a country's human capital endowment—under one category or pillar. Obviously, there is no unique way to do this, nor is there a "magic" number of pillars that may be used. We feel comfortable with the following formulation which identifies five pillars:

1. Institutional environment
2. Human capital, training and social inclusion
3. Regulatory and legal framework
4. Research and development
5. Adoption and use of information and communication technologies

A more detailed representation can be seen in Figure 1 and in Box 1.

The choice of pillars and variables is based on the theoretical and empirical considerations discussed in detail in Section 2. It is worthwhile at this point to make several additional remarks to cast some light on some methodological issues which arose in the construction of the ICI.

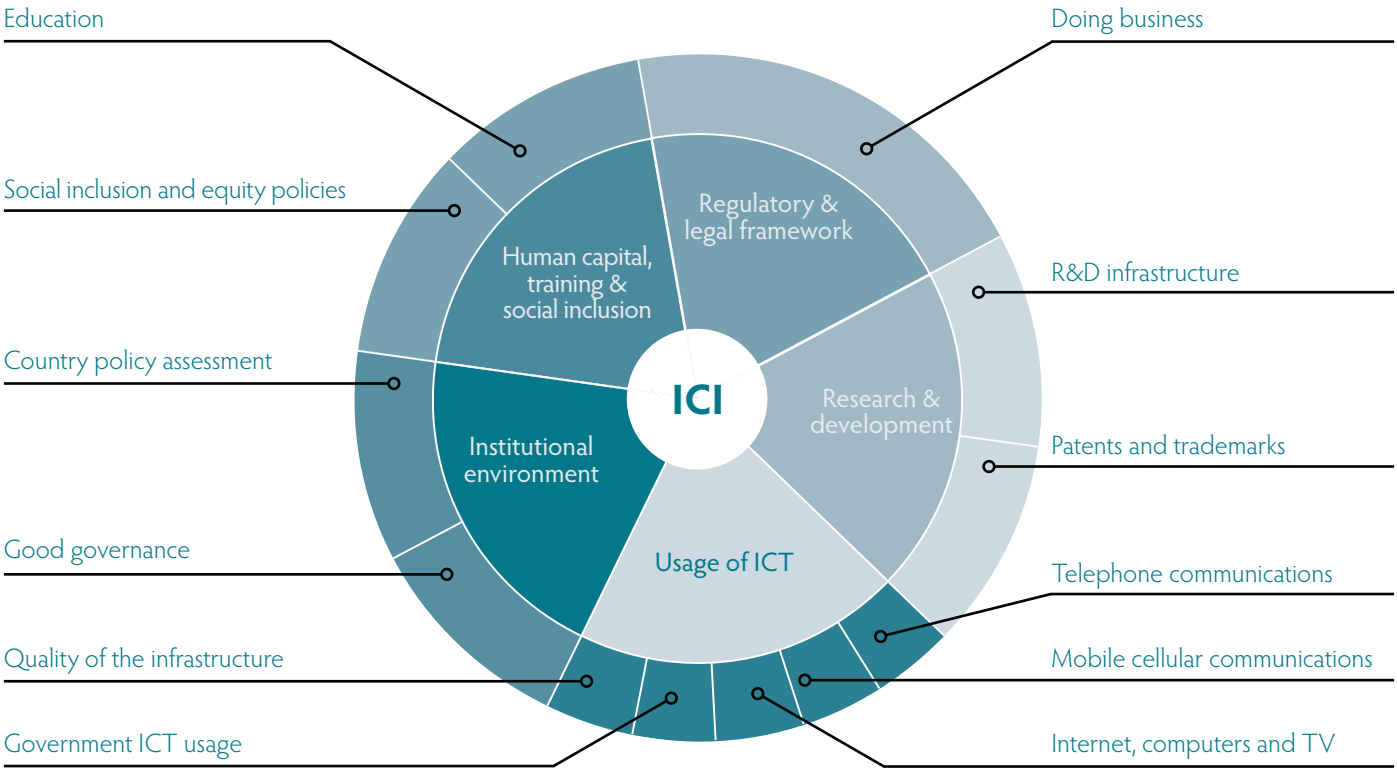
[16] To compare like with like: for instance, it makes no sense to compare high-income democracies with poor autocracies.

[17] Indeed, the true gap is probably larger, because the data excludes figures for Cuba, North Korea, and Somalia, among the worst-performing authoritarian regimes.

[18] Siegle et al., 2004, p. 60.

[19] Ibid., pp. 63–64.

Figure 1. **The Innovation Capacity Index**



Missing variables

One constraint faced by researchers in the construction of such indexes is the lack of reliable or internationally comparable data. The absence of data may prevent the inclusion of some variables which, a priori, theoretical, or empirical considerations might suggest are relevant. This was the case, for instance, with knowledge of the English language. English being the most widely used language of science and technology, global finance, and the Internet, common sense would suggest that, other things being equal, knowledge of English would have a tangible impact on boosting a nation's capacity to innovate. But there appear to be no data on English literacy for the large number of countries that figure in this study. However, since these omissions were mostly exceptional, we were not greatly hampered by lack of data, a fact partly to be attributed to the progress that has been made over the past decade in quantifying a growing number of previously "soft" variables.

Data sources

Because a key virtue of an index is its ability to make meaningful international comparisons, we have gone to sources which compile the data on a comparable basis, using a common methodology. These include: the International Telecommunication Union, which provides the most up-to-date and complete database of ICT and telecommunication statistics;[20] the World Bank's *World Development Indicators* (WDI), which makes available data on some 800 indicators covering different dimensions of economic and social development;[21] the World Bank/International Finance Corporation's *Doing Business Report* (DBR), which contains objective measures of business regulations and their enforcement across 181 economies;[22] the United Nations Development Programme's *Human Development Report* (HDR), with its ample database on critical issues for human development worldwide;[23] and the World Economic Outlook (WEO), the main instrument for the IMF's global surveillance activities,[24] among others.

[20] International Telecommunication Union (ITU), available at: http://www.itu.int
[21] World Bank, 2009, available at: http://www.worldbank.org
[22] World Bank, 2010a, available at: http://www.doingbusiness.org
[23] United Nations Development Programme (UNDP), available at: http://www.undp.org
[24] International Monetary Fund (IMF), 2010, available at: http://www.imf.org

Box 1. Structure of the Innovation Capacity Index (ICI)

The ICI is built upon five pillars composed of a total of 61 variables. For synthetic purposes only, the variables are grouped into conceptual subsections, which may be thought of as subindexes. The ICI ranks countries according to their overall performance and also provides scores by pillars and subindexes which give a general idea of performance in those areas. Variable definitions are presented in the Appendix.

1st Pillar: Institutional environment

A. Good governance
- 1.01 Voice and accountability
- 1.02 Political stability
- 1.03 Government effectiveness
- 1.04 Rule of law
- 1.05 Property rights framework
- 1.06 Transparency and judicial independence
- 1.07 *Corruption Perceptions Index* (TI)

B. Country policy assessment

1. Public sector management
   - 1.08 Quality of budgetary and financial management
   - 1.09 Quality of public administration
2. Structural policies
   - 1.10 Financial sector efficiency
   - 1.11 Trade openness
   - 1.12 Foreign direct investment gross inflows (as % of GDP)
3. Macroeconomy
   - 1.13 Debt levels
   - 1.14 Fiscal balance
   - 1.15 Macro stability

2nd Pillar: Human capital, training and social inclusion

A. Education
- 2.01 Adult literacy rate (% aged 15 and older)
- 2.02 Secondary gross enrolment ratio (%)
- 2.03 Tertiary gross enrolment ratio (%)
- 2.04 Expenditure in education (as % of GDP)

B. Social inclusion and equity policies
- 2.05 Gender equity
- 2.06 Environmental sustainability
- 2.07 Health worker density
- 2.08 Inequality measure: ratio of richest 20% to poorest 20%

3rd Pillar: Regulatory and legal framework

A. Doing business

1. Starting a business
   - 3.01 Number of procedures
   - 3.02 Time (days)
   - 3.03 Cost (as % of income per capita)
2. Ease of employing workers
   - 3.04 Ease of employing workers
3. Paying taxes
   - 3.05 Paying taxes
4. Protecting investors
   - 3.06 Strength of investor protection
5. Registering property
   - 3.07 Number of procedures
   - 3.08 Time (days)
   - 3.09 Cost (as % of property value)

4th Pillar: Research and development

A. R&D infrastructure
- 4.01 Research and development expenditure (as % of GDP)
- 4.02 Information and communication technology expenditure (as % of GDP)
- 4.03 R&D worker density
- 4.04 Students in science and engineering (as % of tertiary students)
- 4.05 Scientific and technical journal articles (per million people)
- 4.06 Schools connected to the internet (%)

B. Patents and trademarks
- 4.07 Patents granted to residents (per million people)
- 4.08 Trademark applications filed by residents (per million people)
- 4.09 Receipts of royalty and license fees (US$ per person)
- 4.10 Payments of royalty and license fees (US$ per person)

5th Pillar: Adoption and use of information and communication technologies

A. Telephone communications
- 5.01 Main (fixed) telephone lines per 100 inhabitants
- 5.02 Waiting list for main (fixed) lines per 1000 inhabitants
- 5.03 Business connection charge (as % of GDP/capita)
- 5.04 Business monthly subscription (as % of GDP/capita)
- 5.05 Residential connection charge (as % of GDP/capita)
- 5.06 Residential monthly subscription (as % of GDP/capita)

B. Mobile cellular communications
- 5.07 Subscribers per 100 inhabitants
- 5.08 Prepaid subscribers per 100 inhabitants
- 5.09 Population coverage (%)
- 5.10 Connection charge (as % of GDP/capita)

C. Internet, computers and TV
- 5.11 Total fixed internet subscribers per 100 inhabitants
- 5.12 Total fixed broadband subscribers per 100 inhabitants
- 5.13 Internet users per 100 inhabitants
- 5.14 Personal computers per 100 inhabitants
- 5.15 Television receivers per 100 inhabitants

D. Government ICT usage
- 5.16 E-government readiness index

E. Quality of the infrastructure
- 5.17 Electrification rate (%)
- 5.18 Electric power transmission and distribution losses (as % of output)
- 5.19 Roads paved (as % of total roads)

Country categories

For operational and analytical purposes, countries were divided into two different categories by income level and political system, according to the following criteria:

Income levels: Gross National Income (GNI) per capita based on the World Bank 2008 country classifications:[25]
High-income: GNI per capita > US$11,906
Upper-middle-income: GNI per capita: US$3,856 – 11,905
Lower-middle-income: GNI per capita: US$976 – 3,855
Low-income: GNI per capita < US$975

Average incomes per capita for each country grouping are shown in Table 3.

Political systems: The Economist Intelligence Unit's *Index of Democracy* 2008[26] analyzes electoral process and pluralism, prevalence of civil liberties, the functioning of government, issues of political participation, and political culture, and classifies countries as:
Full democracies: scores 8–10
Flawed democracies: scores 6–7.9
Hybrid regimes: scores 4–5.9
Authoritarian regimes: scores < 4

The 131 countries included in the ICI may thus be presented as shown in Table 4.

Weights

We have given considerable thought to the issue of how to weight the five pillars of the Index across the 131 countries. In choosing the weights, our starting point has been the theoretical considerations put forward by Rostow (1960) and Porter (1990, as highlighted in the section above), which we find intuitively appealing and in conformity with extensive empirical observation over the post World War II period, particularly in the context of the work carried out by organizations such as the World Bank and the International Monetary Fund. Such work suggests that the relative importance of factors affecting innovation will be a function of a country's stage of development. Countries in earlier stages—as in Porter, we may think of them as countries with relatively underdeveloped institutions and human capital, which act as constraints on the level of attainable output per capita—will need to prioritize those areas which are essential prerequisites for the next stage. Thus, before it can join the group of nations doing innovation, a low-income country in sub-Saharan Africa will need to focus reform efforts and resources in developing the institutional infrastructure and in building up its human resource endowments. At the other end of the development spectrum, an innovator such as Sweden—already endowed with efficiently working institutions and with a highly skilled labor force—will have to focus its energies on improving those factors which more directly sustain and further boost an established capacity for innovation, for example, ensuring that the system of higher education is able to provide training immediately relevant for industry, or ensuring that the government makes further improvements in the regulatory environment and provides the incentives that underpin the creation of new businesses. An alternative way to see this is to say that those pillars which more fundamentally have to do with people, institutions, and social networks (pillars 1 and 2) are seen as the foundations for the pillars which deal with means and other enabling factors (pillars 3, 4, and 5). Innovation would be the last frontier, provided that the foundations of governance and human resources are well on their way to being broadly secured.

These theoretical considerations have been further complemented by extensive data analysis. Nevertheless, it is useful to provide here the gist of that analysis, which largely corroborates the above observations derived from the work of Rostow and Porter. A first step was to determine the influence of the three country categories chosen (income levels, type of political regime, and geographical location) on the raw index scores. (The choice of geographic location was not induced by any sense of geographic determinism, that is, the notion, as discussed by Diamond (1999), that differences across countries and cultures are largely determined by climate, fauna, and flora. Rather, the idea was in keeping with Diamond's sensible observation that "all human societies contain inventive people. It's just that some environments provide more starting materials, and more favorable conditions for utilizing

[25] Available at: http://www.worldbank.org
[26] The Economist Intelligence Unit's Index of Democracy, available at: http://www.eiu.com

Table 4. ICI Country clusters according to income level and political regime

High-income: GNI per capita > US$11,906			
Full democracies	Flawed democracies	Hybrid regimes	Authoritarian regimes
Australia Austria Belgium Canada Czech Republic Denmark Finland France Germany Greece Iceland Ireland Italy Japan Korea, Republic of Luxembourg Malta Netherlands New Zealand Norway Portugal Slovenia, Republic of Spain Sweden Switzerland United Kingdom United States	Croatia, Republic of Cyprus Estonia, Republic of Hungary Israel Slovak Republic Taiwan Trinidad and Tobago	Hong Kong SAR Singapore	Bahrain, Kingdom of Kuwait Oman Qatar Saudi Arabia United Arab Emirates

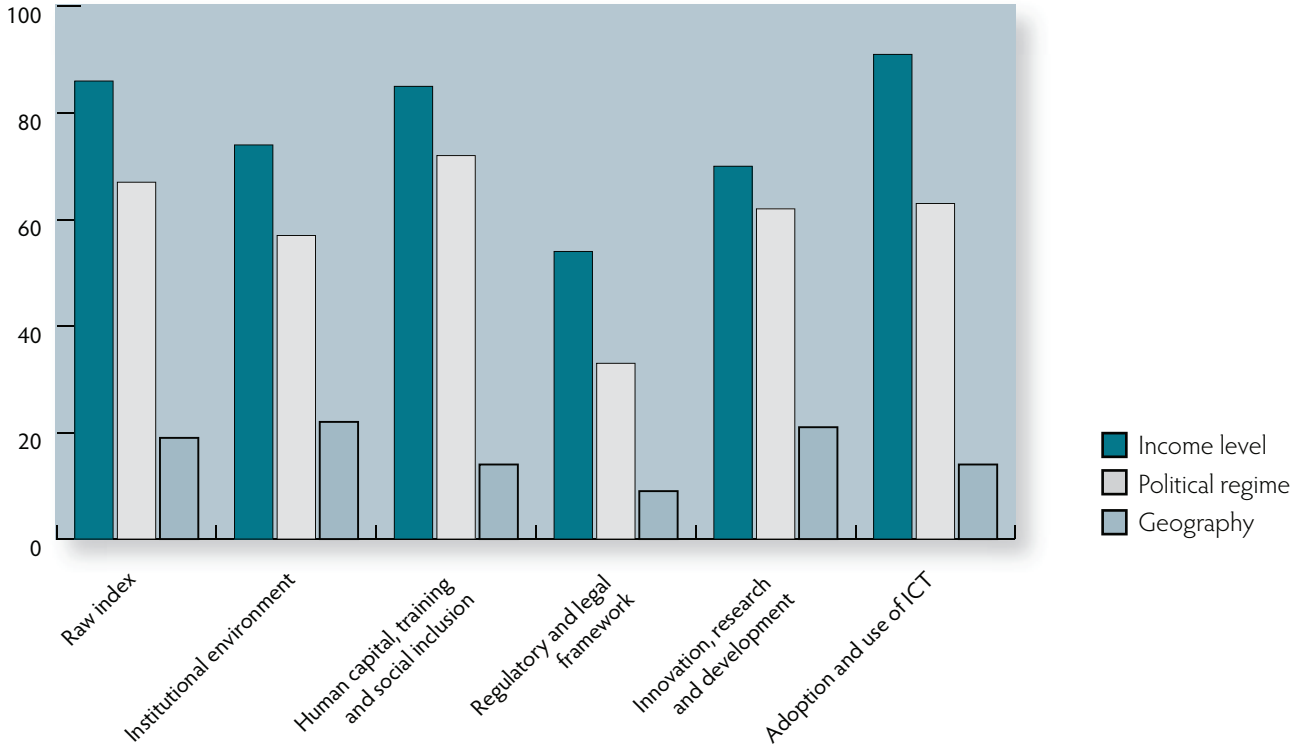
Upper-middle-income: GNI per capita: US$3,856–US$11,905			
Full democracies	Flawed democracies	Hybrid regimes	Authoritarian regimes
Costa Rica Mauritius Uruguay	Argentina Botswana Brazil Bulgaria Chile Colombia Dominican Republic Jamaica Latvia, Republic of Lithuania, Republic of Macedonia, FYR Malaysia Mexico Namibia Panama Peru Poland Romania South Africa Suriname	Bosnia and Herzegovina Lebanon Russian Federation Turkey Venezuela	Algeria Kazakhstan, Republic of

Lower-middle-income: GNI per capita: US$976–US$3,855			
Full democracies	Flawed democracies	Hybrid regimes	Authoritarian regimes
	Belize Bolivia El Salvador Guatemala Honduras India Indonesia Nicaragua Papua New Guinea Paraguay Philippines Sri Lanka Thailand Ukraine	Ecuador Georgia Iraq Pakistan	Angola Azerbaijan, Republic of Cameroon China, People's Republic of Congo, Republic of Côte d'Ivoire Egypt, Arab Republic of Iran, Islamic Republic of Jordan Morocco Nigeria Sudan Syrian Arab Republic Tunisia

Low-income: GNI per capita < US$975			
Full democracies	Flawed democracies	Hybrid regimes	Authoritarian regimes
		Bangladesh Cambodia Ethiopia Ghana Haiti Kenya Madagascar Malawi Mali Mozambique, Republic of Nepal Senegal Tanzania Uganda Zambia	Afghanistan, Islamic Republic of Chad Guinea Lao PDR Mauritania Niger Rwanda Togo Vietnam Yemen, Republic of Zimbabwe

inventions, than do other environments" (p. 408)). This was achieved in two stages: first, we obtained a set of raw pillar and index scores without imposing any prior organizational principle on the data with respect to a country's level of income, its political regime, or its geographical location; second, we used statistical techniques developed by Pavlidis and Noble (2001) to create a template for a correlation analysis with respect to numerical values assigned to each category;[27] that is, income levels were given a number from 1 to 4, from lowest to highest income, and political regimes from 1 to 4, from least democratic to most democratic, and so on, thus generating three category data sets. In this way the raw index and pillar scores were used as templates and compared with the category data, in order to find if there was a correlation between the different categories and scores. Only those correlations with p-values equal to or lower than 0.05 were deemed significant.[28] According to these tests (see Figure 2), the two main categories with the greatest influence on the index and pillar scores were income levels followed by political regime. In the age of globalization, geographic location appears to play a role of declining importance. This created 16 possible country clusters based on four income categories and four different types of political regime (Table 4). The final weight allocation is shown in Table 5.

Figure 2. Correlation coefficients (R in %) of the different country category groups with respect to raw index and pillar scores*



*Pillars 2, 3 and 5 with respect to geography showed p-values above 0.05. These were 0.10, 0.30 and 0.11 respectively.

[27] Pavlidis and Noble, 2001. In this paper, the authors demonstrated the ease and feasibility of using this type of correlation analysis when dealing with large data sets, and applied in their case to array expression patterns of DNA. They note that the advantages of *template matching* (that is, using a set of data as a pattern in order to find correlations with other data sets) are that this feature-selection method is simple, can be used to differentiate between any number of categories, and permits rankings according to different levels of differentiation. In fact, the large data set generated by our study was managed and analyzed with the aid of a free, open-source DNA microarray analysis suite, the Multiexperiment Viewer, developed at the Institute for Genomic Research (TIGR) in California. For more information, see: Saeed et al., 2003, available at: http://www.tm4.org/mev.html

[28] The p-value determines to what extent the different correlations obtained were due to chance. It is a probability value that varies from 0 to 1. A significance level of 0.05 indicates that the there is only a 5 percent probability that the correlation value was determined purely by chance.

Table 5. Weighting of pillars in the Innovation Capacity Index

	High-income: GNI per capita > US$11,906			
	Full democracies	Flawed democracies	Hybrid regimes	Authoritarian regimes
Institutional environment	10%	15%	20%	20%
Human capital, training and social inclusion	10%	15%	20%	20%
Regulatory and legal framework	20%	20%	20%	20%
Research and development	30%	25%	20%	20%
Adoption and use of ICT	30%	25%	20%	20%
Total	100%	100%	100%	100%

	Upper-middle-income: GNI per capita: US$3,856–US$11,905			
	Full democracies	Flawed democracies	Hybrid regimes	Authoritarian regimes
Institutional environment	25%	25%	25%	25%
Human capital, training and social inclusion	25%	25%	25%	25%
Regulatory and legal framework	20%	20%	20%	20%
Research and development	15%	15%	15%	15%
Adoption and use of ICT	15%	15%	15%	15%
Total	100%	100%	100%	100%

	Lower-middle-income: GNI per capita: US$976–US$3,855			
	Full democracies	Flawed democracies	Hybrid regimes	Authoritarian regimes
Institutional environment	25%	25%	25%	25%
Human capital, training and social inclusion	25%	25%	25%	25%
Regulatory and legal framework	20%	20%	20%	20%
Research and development	15%	15%	15%	15%
Adoption and use of ICT	15%	15%	15%	15%
Total	100%	100%	100%	100%

	Low-income: GNI per capita < US$975			
	Full democracies	Flawed democracies	Hybrid regimes	Authoritarian regimes
Institutional environment	-	30%	30%	30%
Human capital, training and social inclusion	-	30%	30%	30%
Regulatory and legal framework	-	20%	20%	20%
Research and development	-	10%	10%	10%
Adoption and use of ICT	-	10%	10%	10%
Total	-	100%	100%	100%

5. Innovation Capacity Index Rankings 2010–2011

The results for this year's rankings for the 131 countries covered by the Innovation Capacity Index are presented in Table 6. Table 7 presents a more detailed version of the results, identifying individual pillar scores and ranks and the corresponding scores and ranks for the subindexes that make up the various pillar components, such as "good governance" and "country policy assessment" for pillar 1, on a country's institutional environment. Table 8, on the other hand, presents Index ranks and scores for the various country clusters, depending on each country's income per capita (e.g., stage of development) and political regime. This Table is useful, as it addresses the occasional criticism against rankings involving a relatively large number of countries, namely, that they force comparisons between markedly different sets of countries, possibly at very different stages of development or having other important structural differences. From this Table, one can see, for instance, that although Thailand has a rank of 45 in the ICI, it is first among lower-middle-income flawed democracies, ahead of Ukraine, Indonesia and the Philippines. Ghana's rank of 76 among all 131 countries highlights a large number of weaknesses across all the pillars of the ICI, but the country does much better when the comparator group includes only low-income countries with either a hybrid or an authoritarian regime.

While these tables offer a good overview of the main results, we direct the attention of the reader to the Innovation Profiles contained in Part 3 of the Report, which provide additional information on individual country performance. Part 3 includes profiles for a total of 70 countries, with the remaining 62 innovation profiles available at: http://www.innovationfordevelopmentreport.org

To highlight the type of analysis which is made possible through the Innovation Capacity Index, we now discuss this year's results for Korea, Brazil, China, Israel, and Spain. These countries are interesting for a variety of reasons: Korea, because it has a top-10 rank and, like Sweden last year, provides an impressive benchmark against which to assess other countries' performance. Korea's rapid transformation from a low-income, largely agricultural economy in the early 1960s to a high-technology power four decades later is an impressive achievement, highlighting the extent to which sound, outward-oriented, policies can contribute not only to the development of a remarkable level of innovation capacity, but also to high levels of income per capita. Despite being a rising emerging market power, Brazil faces a number of challenges which must be addressed before it can fulfill its innovation potential. Much progress needs to be made in improving the efficiency of spending—vast resources are allocated to financing the pensions of public workers, while not enough is spent in providing better educational opportunities to its young population and investing in research and development. The country suffers from an ingrained culture of heavy bureaucracy and red tape and, consequently, has some of the worst rankings in the World Bank's Doing Business Report. China has dazzled the world with its quick ascent to the position of the world's second largest economy. Its ability to pull hundreds of millions of people out of poverty is surely an important achievement. But the country is still saddled with a difficult business environment, by mediocre human capital indicators and relatively low rates of penetration for the latest technologies, all of which are constraining its innovation capacity. Israel, like Korea, is a major player in the high-technology markets. Heavy investment in education and the judicious use of investment incentives and other active public policies to encourage innovation are worthy of examination for the lessons they offer other countries aspiring to establish a footprint in the ICT world. Finally Spain, a rich industrial country with well-developed institutions and infrastructure, has an ICI ranking that is mediocre for its stage of development. A dysfunctional labor market with perverse incentives and an unreformed establishment for higher education are significant drags on Spanish innovation capacity.

Table 6. Innovation Capacity Index rankings 2010–2011*

Country	ICI rank	ICI score
Sweden	1	80.3
Switzerland	2	78.1
Singapore	3	76.7
Finland	4	76.1
United States	5	74.8
Denmark	6	74.3
Canada	7	73.6
Netherlands	8	72.8
Taiwan	9	72.5
Luxembourg	10	72.2
Korea, Republic of	11	72.1
Norway	12	72.0
Hong Kong SAR	13	71.4
New Zealand	14	71.3
United Kingdom	14	71.3
Japan	16	70.2
Australia	17	69.4
Ireland	18	69.1
Iceland	19	69.0
Germany	20	68.9
Israel	21	67.5
Austria	22	66.7
Belgium	23	66.1
France	24	65.3
Estonia, Republic of	25	60.5
Lithuania, Republic of	26	59.6
Slovenia, Republic of	27	59.1
United Arab Emirates	28	58.9
Spain	29	58.8
Latvia, Republic of	30	58.7
Chile	31	58.3
Czech Republic	32	57.8
Bulgaria	33	57.4
Bahrain, Kingdom of	34	57.0
Hungary	35	56.8
Slovak Republic	36	56.7
Portugal	36	56.7
Italy	36	56.7
Malaysia	39	56.4
Poland	40	56.3
Qatar	41	55.9
Macedonia, FYR	42	55.3
Cyprus	43	55.2
Georgia	44	55.0
Thailand	45	54.8
Mauritius	46	54.7
Malta	47	54.6
Tunisia	48	54.1
Saudi Arabia	48	54.1
Azerbaijan, Republic of	50	53.8
Jordan	51	53.7
South Africa	52	53.2
Croatia, Republic of	52	53.2
Kazakhstan, Republic of	54	53.1
Romania	55	53.0
Uruguay	56	52.8
Russian Federation	56	52.8
Oman	58	51.8
Kuwait	59	51.3
Costa Rica	59	51.3
Ukraine	61	50.4
Turkey	62	50.2
Mexico	62	50.2
China, People's Republic of	64	49.9
Greece	64	49.9
Panama	66	49.4
Colombia	66	49.4
Argentina	68	49.3
Botswana	69	48.9
Peru	70	48.7
El Salvador	71	48.0
Trinidad and Tobago	72	47.7
Bosnia and Herzegovina	73	47.5
Vietnam	74	47.1
Egypt, Arab Republic of	75	46.6
Ghana	76	46.4
Indonesia	77	46.0
Namibia	77	46.0
Dominican Republic	79	45.5
Jamaica	79	45.5
Philippines	81	45.3
Brazil	81	45.3
Guatemala	83	44.7
Ecuador	84	44.6
Iran, Islamic Republic of	85	44.5
Sri Lanka	86	44.4
Lebanon	87	44.3
Morocco	88	44.2
India	88	44.2
Paraguay	88	44.2
Belize	91	43.7
Honduras	92	43.4
Rwanda	93	43.2
Zambia	94	42.5
Algeria	94	42.5
Madagascar	96	42.1
Syrian Arab Republic	97	42.0
Tanzania	98	41.9
Bolivia	98	41.9
Nicaragua	100	41.5
Kenya	101	41.4
Nepal	102	40.8
Pakistan	102	40.8
Venezuela	104	40.4
Mozambique, Republic of	105	39.8
Uganda	106	39.7
Papua New Guinea	107	39.5
Ethiopia	108	39.2
Malawi	109	39.1
Senegal	110	38.6
Bangladesh	110	38.6
Suriname	112	38.4
Cambodia	113	37.4
Lao PDR	114	37.2
Cameroon	115	37.1
Nigeria	116	36.8
Yemen, Republic of	117	36.3
Congo, Republic of	118	36.0
Mauritania	118	36.0
Sudan	120	35.9
Mali	121	35.0
Côte d'Ivoire	122	32.8
Iraq	123	32.6
Guinea	124	32.1
Angola	125	31.9
Togo	126	31.2
Niger	127	31.1
Zimbabwe	128	29.6
Haiti	129	28.3
Afghanistan, Islamic Republic of	130	27.4
Chad	130	27.4

*All rankings and scores are after rounding.

Table 7. Innovation Capacity Index 2010–2011: Pillar rankings*

	Pillar 1: Institutional environment						Pillar 2: Human capital, training, and social inclusion			
	Pillar		Good governance		Country policy assessment		Pillar		Education	
COUNTRY	RANKING	SCORE	RANKING	SCORE	RANKING	SCORE	RANKING	SCORE	RANKING	SCORE
Afghanistan, Islamic Republic of	127	31.5	131	12.0	64	53.2	131	18.3	129	18.4
Algeria	111	38.7	105	30.5	105	46.8	84	49.1	77	56.1
Angola	107	39.1	120	25.1	52	54.7	130	24.9	124	27.3
Argentina	101	40.2	84	38.3	119	42.2	41	65.2	28	74.0
Australia	8	79.1	8	89.2	11	69.0	9	78.0	13	79.1
Austria	14	72.5	13	86.3	32	58.6	17	74.7	32	73.5
Azerbaijan, Republic of	60	49.8	104	30.7	12	68.9	56	57.2	74	57.7
Bahrain, Kingdom of	38	58.4	47	55.1	22	61.6	55	57.9	58	62.2
Bangladesh	105	39.3	109	29.2	88	49.4	121	34.4	115	31.1
Belgium	18	67.0	20	77.1	37	57.0	14	75.9	16	77.7
Belize	74	46.7	69	42.5	72	52.0	97	44.1	92	50.8
Bolivia	80	45.3	98	33.5	36	57.2	78	50.9	49	65.7
Bosnia and Herzegovina	78	46.1	85	37.8	47	55.2	40	65.3	33	73.1
Botswana	33	59.3	33	64.5	59	54.0	84	49.1	68	58.8
Brazil	81	45.2	62	45.2	114	45.1	70	54.2	50	65.2
Bulgaria	48	54.4	60	46.6	21	62.2	36	67.2	40	70.7
Cambodia	109	38.9	116	27.5	81	50.3	108	39.1	108	34.2
Cameroon	100	40.5	115	27.9	64	53.2	109	38.8	106	36.2
Canada	13	72.7	12	88.5	39	56.8	12	76.3	22	75.5
Chad	128	30.5	128	15.8	104	46.9	127	27.7	131	17.1
Chile	17	68.4	24	71.2	17	65.6	56	57.2	46	67.1
China, People's Republic of	58	51.4	70	41.5	24	61.2	78	50.9	89	51.3
Colombia	89	43.9	82	39.1	94	48.7	77	51.0	57	62.8
Congo, Republic of	90	43.8	121	24.9	19	64.9	105	40.4	107	35.8
Costa Rica	41	58.0	38	60.5	45	55.6	45	62.4	56	63.0
Côte d'Ivoire	125	32.6	125	20.4	115	44.7	116	35.3	117	30.3
Croatia, Republic of	56	51.8	52	51.3	70	52.4	39	66.3	44	67.9
Cyprus	21	66.1	23	71.7	25	60.4	44	62.5	35	72.4
Czech Republic	42	57.9	37	61.5	56	54.3	24	72.0	37	71.6
Denmark	3	82.2	1	93.8	9	70.5	4	84.2	1	86.1
Dominican Republic	93	42.4	79	40.0	113	45.2	71	53.7	83	53.8
Ecuador	110	38.8	112	28.3	89	49.3	74	52.7	91	51.0
Egypt, Arab Republic of	98	40.7	89	36.0	112	45.3	88	48.1	87	51.8
El Salvador	79	45.7	68	42.8	96	48.6	76	51.2	93	50.0
Estonia, Republic of	16	68.9	22	71.9	15	66.0	33	68.9	19	76.3
Ethiopia	115	37.8	108	29.4	107	46.3	107	39.5	121	29.5
Finland	9	79.0	4	92.3	16	65.7	3	84.8	2	85.8
France	24	65.2	21	76.4	60	53.9	11	76.4	27	74.9
Georgia	55	52.0	67	43.5	23	61.3	61	56.6	59	62.1
Germany	15	70.9	15	85.3	41	56.6	16	75.3	45	67.3
Ghana	59	50.6	54	49.8	76	51.3	102	41.8	100	42.5
Greece	83	45.0	50	53.6	127	36.4	20	73.0	11	80.2
Guatemala	91	43.6	87	36.7	79	50.5	94	45.5	99	43.1
Guinea	116	37.0	126	18.1	42	55.9	125	30.6	128	22.1
Haiti	121	35.2	123	22.6	89	49.3	128	27.6	104	37.6
Honduras	84	44.9	94	34.3	45	55.6	93	45.8	94	49.1
Hong Kong SAR	2	82.7	16	84.0	2	81.4	51	61.1	66	59.8
Hungary	50	53.2	39	60.3	109	46.1	28	70.7	18	76.8
Iceland	25	64.9	10	89.0	122	40.9	4	84.2	3	83.4
India	75	46.5	65	43.9	93	49.0	97	44.1	102	40.7
Indonesia	69	47.6	92	35.2	27	60.1	91	47.2	85	53.6
Iran, Islamic Republic of	114	37.9	118	26.6	79	50.5	83	49.4	67	59.4
Iraq	130	17.4	129	15.4	130	20.0	111	38.1	97	44.7
Ireland	21	66.1	14	85.7	106	46.5	12	76.3	25	75.0
Israel	37	58.5	36	62.8	57	54.2	27	71.0	25	75.0
Italy	76	46.2	51	53.3	124	39.1	19	74.5	19	76.3
Jamaica	119	36.4	65	43.9	129	28.0	65	55.5	63	60.1
Japan	40	58.1	18	79.6	125	36.7	34	68.1	38	71.4
Jordan	54	52.7	49	53.9	75	51.4	53	59.7	54	64.0
Kazakhstan, Republic of	61	49.7	88	36.2	20	63.2	42	63.2	51	64.7
Kenya	103	39.7	102	31.0	97	48.4	99	43.6	95	47.6
Korea, Republic of	34	59.1	35	63.0	47	55.2	35	67.4	7	81.8
Kuwait	30	60.8	53	50.1	6	72.6	58	57.0	69	58.5
Lao PDR	120	36.0	117	26.9	109	46.1	95	44.3	105	37.3
Latvia, Republic of	51	53.1	46	57.0	92	49.2	26	71.2	16	77.7
Lebanon	124	33.6	103	30.8	125	36.7	63	56.0	65	59.9

Table 7. Innovation Capacity Index 2010–2011: Pillar rankings* (cont'd.)

	Pillar 1: Institutional environment						Pillar 2: Human capital, training, and social inclusion			
	Pillar		Good governance		Country policy assessment		Pillar		Education	
COUNTRY	RANKING	SCORE	RANKING	SCORE	RANKING	SCORE	RANKING	SCORE	RANKING	SCORE
Lithuania, Republic of	47	54.7	41	59.1	82	50.2	23	72.2	14	78.6
Luxembourg	5	81.6	11	88.6	3	74.6	28	70.7	28	74.0
Macedonia, FYR	63	48.4	64	44.5	66	52.8	46	62.3	55	63.9
Madagascar	68	47.8	83	39.0	40	56.7	113	37.7	114	32.0
Malawi	102	39.8	75	40.3	123	39.3	110	38.3	110	34.1
Malaysia	44	56.4	48	54.6	35	58.3	67	55.4	75	57.3
Mali	82	45.1	75	40.3	84	49.9	126	30.0	126	24.5
Malta	26	64.4	26	69.5	29	59.2	50	61.4	48	65.8
Mauritania	122	34.9	110	28.7	121	41.0	116	35.3	118	29.9
Mauritius	32	59.6	34	64.3	49	54.9	69	54.4	79	55.8
Mexico	84	44.9	72	41.1	94	48.7	52	59.9	60	61.6
Morocco	88	44.1	73	40.6	103	47.6	101	42.0	101	42.2
Mozambique, Republic of	66	48.0	86	37.1	31	58.8	124	32.2	125	26.9
Namibia	34	59.1	42	59.0	30	59.1	89	47.7	82	54.0
Nepal	108	39.0	111	28.4	87	49.6	100	43.1	108	34.2
Netherlands	12	75.2	7	89.9	25	60.4	6	82.1	21	76.1
New Zealand	7	79.3	2	93.6	18	65.0	7	79.4	5	82.2
Nicaragua	86	44.2	95	34.2	57	54.2	90	47.3	96	47.5
Niger	112	38.4	93	34.9	118	42.8	129	25.6	130	17.9
Nigeria	98	40.7	114	28.0	61	53.4	115	35.5	118	29.9
Norway	3	82.2	6	90.7	4	73.8	1	87.6	5	82.2
Oman	23	65.3	40	60.0	8	70.6	82	49.5	72	58.0
Pakistan	116	37.0	122	24.3	86	49.7	112	38.0	123	29.1
Panama	52	52.8	58	47.0	32	58.6	68	54.5	62	60.3
Papua New Guinea	95	41.6	100	31.2	72	52.0	123	33.5	127	24.2
Paraguay	113	38.2	113	28.2	100	48.2	81	50.1	81	54.7
Peru	70	47.5	77	40.2	50	54.8	58	57.0	61	60.6
Philippines	103	39.7	98	33.5	111	46.0	60	56.9	78	55.9
Poland	49	54.0	43	58.2	85	49.8	31	69.1	15	78.2
Portugal	39	58.2	28	68.8	102	47.7	22	72.3	30	73.8
Qatar	11	77.8	27	69.2	1	86.5	73	52.8	73	57.8
Romania	61	49.7	56	47.5	74	51.9	48	61.6	43	68.0
Russian Federation	94	41.8	106	30.3	62	53.3	38	66.7	34	72.9
Rwanda	76	46.2	80	39.5	66	52.8	120	34.7	115	31.1
Saudi Arabia	43	56.7	61	46.4	14	67.0	86	48.7	47	66.3
Senegal	65	48.2	74	40.5	42	55.9	118	34.8	118	29.9
Singapore	10	78.4	8	89.2	13	67.5	31	69.1	41	70.1
Slovak Republic	46	55.2	45	57.7	69	52.6	30	69.4	42	68.3
Slovenia, Republic of	28	63.8	25	70.7	38	56.9	21	72.7	8	81.5
South Africa	45	56.3	43	58.2	54	54.5	64	55.7	64	60.0
Spain	36	58.9	30	66.5	77	51.2	10	77.2	23	75.4
Sri Lanka	97	40.9	91	35.4	107	46.3	87	48.3	87	51.8
Sudan	129	23.6	130	14.1	128	33.0	104	41.4	90	51.2
Suriname	73	47.0	63	44.8	89	49.3	75	51.6	76	56.7
Sweden	1	83.1	3	93.4	5	72.7	2	86.0	4	82.5
Switzerland	6	81.5	4	92.3	7	70.7	8	79.1	36	71.8
Syrian Arab Republic	106	39.2	101	31.1	99	48.3	92	46.0	84	53.7
Taiwan	29	62.5	31	65.2	28	59.9	17	74.7	9	81.1
Tanzania	70	47.5	81	39.2	44	55.8	103	41.6	122	29.4
Thailand	66	48.0	71	41.2	52	54.7	62	56.3	51	64.7
Togo	118	36.7	107	29.5	117	43.9	118	34.8	112	32.6
Trinidad and Tobago	52	52.8	57	47.1	34	58.5	42	63.2	69	58.5
Tunisia	57	51.5	54	49.8	62	53.3	54	58.9	53	64.6
Turkey	63	48.4	59	46.7	82	50.2	80	50.5	71	58.4
Uganda	86	44.2	96	34.1	55	54.4	95	44.3	113	32.4
Ukraine	96	41.0	97	34.0	101	48.0	37	66.9	12	79.3
United Arab Emirates	19	66.9	32	64.7	10	69.2	65	55.5	80	54.9
United Kingdom	20	66.4	17	81.6	77	51.2	25	71.7	23	75.4
United States	27	63.9	19	79.3	97	48.4	15	75.7	10	80.5
Uruguay	31	60.5	29	68.3	68	52.7	46	62.3	31	73.6
Venezuela	126	32.1	124	22.3	120	42.0	49	61.5	39	71.1
Vietnam	91	43.6	90	35.7	70	52.4	72	52.9	86	52.7
Yemen, Republic of	123	34.6	119	26.1	116	44.0	122	33.8	103	39.4
Zambia	70	47.5	78	40.1	50	54.8	114	36.9	111	34.0
Zimbabwe	131	15.2	127	16.2	131	14.1	105	40.4	98	43.4

Table 7. Innovation Capacity Index 2010–2011: Pillar rankings* (cont'd.)

	Pillar 2: Human capital, training, and social inclusion		Pillar 3: Regulatory and legal framework			
	Social inclusion and equity policies		Pillar		Doing business	
COUNTRY	RANKING	SCORE	RANKING	SCORE	RANKING	SCORE
Afghanistan, Islamic Republic of	131	18.1	114	49.9	114	49.9
Algeria	90	44.4	101	56.5	101	56.5
Angola	129	23.3	122	43.5	122	43.5
Argentina	43	59.3	90	59.9	90	59.9
Australia	12	77.2	13	80.2	13	80.2
Austria	15	75.5	61	67.6	61	67.6
Azerbaijan, Republic of	52	56.8	12	80.4	12	80.4
Bahrain, Kingdom of	60	54.4	16	80.0	16	80.0
Bangladesh	118	36.6	94	58.6	94	58.6
Belgium	16	74.7	40	72.4	40	72.4
Belize	109	39.6	87	60.8	87	60.8
Bolivia	104	41.1	124	41.6	124	41.6
Bosnia and Herzegovina	48	57.5	98	58.0	98	58.0
Botswana	98	42.7	42	72.0	42	72.0
Brazil	84	46.8	116	49.3	116	49.3
Bulgaria	35	64.8	32	73.9	32	73.9
Cambodia	100	42.4	108	53.9	108	53.9
Cameroon	107	40.6	121	43.8	121	43.8
Canada	14	76.9	4	87.6	4	87.6
Chad	122	34.8	127	38.3	127	38.3
Chile	72	50.7	34	73.5	34	73.5
China, People's Republic of	72	50.7	70	65.0	70	65.0
Colombia	95	43.1	20	78.0	20	78.0
Congo, Republic of	93	43.4	123	41.9	123	41.9
Costa Rica	41	62.0	105	56.0	105	56.0
Côte d'Ivoire	113	38.6	119	44.9	119	44.9
Croatia, Republic of	34	65.2	84	62.0	84	62.0
Cyprus	58	54.6	47	70.5	47	70.5
Czech Republic	19	72.2	53	68.7	53	68.7
Denmark	7	82.9	13	80.2	13	80.2
Dominican Republic	63	53.6	50	69.1	50	69.1
Ecuador	62	53.8	103	56.4	103	56.4
Egypt, Arab Republic of	88	45.7	55	68.3	55	68.3
El Salvador	71	52.0	72	64.6	72	64.6
Estonia, Republic of	36	64.0	26	76.5	26	76.5
Ethiopia	86	46.1	66	66.6	66	66.6
Finland	5	84.1	27	76.0	27	76.0
France	10	77.5	71	64.9	71	64.9
Georgia	66	52.9	8	83.7	8	83.7
Germany	8	80.6	57	68.1	57	68.1
Ghana	103	41.3	46	71.2	46	71.2
Greece	27	68.2	107	55.7	107	55.7
Guatemala	82	47.0	76	63.7	76	63.7
Guinea	120	36.2	125	40.1	125	40.1
Haiti	130	21.0	129	37.4	129	37.4
Honduras	92	43.6	109	53.6	109	53.6
Hong Kong SAR	40	62.1	3	87.8	3	87.8
Hungary	31	66.6	53	68.7	53	68.7
Iceland	4	84.9	22	77.8	22	77.8
India	85	46.4	89	60.1	89	60.1
Indonesia	96	43.0	82	62.3	82	62.3
Iran, Islamic Republic of	97	42.8	93	58.9	93	58.9
Iraq	128	24.9	96	58.1	96	58.1
Ireland	13	77.1	9	83.4	9	83.4
Israel	26	68.3	36	73.1	36	73.1
Italy	17	73.4	57	68.1	57	68.1
Jamaica	69	52.4	64	66.9	64	66.9
Japan	33	65.9	29	74.8	29	74.8
Jordan	51	56.9	75	64.0	75	64.0
Kazakhstan, Republic of	39	62.2	28	75.0	28	75.0
Kenya	106	40.9	90	59.9	90	59.9
Korea, Republic of	47	57.8	51	69.0	51	69.0
Kuwait	53	55.9	37	72.7	37	72.7
Lao PDR	79	49.0	118	47.7	118	47.7
Latvia, Republic of	29	66.8	38	72.5	38	72.5
Lebanon	66	52.9	68	65.4	68	65.4

Table 7. Innovation Capacity Index 2010–2011: Pillar rankings* (cont'd.)

	Pillar 2: Human capital, training, and social inclusion		Pillar 3: Regulatory and legal framework			
	Social inclusion and equity policies		Pillar		Doing business	
COUNTRY	RANKING	SCORE	RANKING	SCORE	RANKING	SCORE
Lithuania, Republic of	28	67.9	30	74.7	30	74.7
Luxembourg	24	68.8	78	63.1	78	63.1
Macedonia, FYR	42	61.2	18	78.9	18	78.9
Madagascar	102	41.5	63	67.1	63	67.1
Malawi	105	41.0	90	59.9	90	59.9
Malaysia	61	54.1	23	77.5	23	77.5
Mali	124	33.8	111	52.0	111	52.0
Malta	46	57.9	ND	ND	ND	ND
Mauritania	111	39.0	99	57.5	99	57.5
Mauritius	64	53.3	13	80.2	13	80.2
Mexico	44	58.8	60	67.7	60	67.7
Morocco	101	41.9	96	58.1	96	58.1
Mozambique, Republic of	121	35.7	80	62.8	80	62.8
Namibia	93	43.4	85	61.9	85	61.9
Nepal	78	49.1	65	66.8	65	66.8
Netherlands	3	86.1	38	72.5	38	72.5
New Zealand	10	77.5	1	96.3	1	96.3
Nicaragua	81	47.1	110	53.2	110	53.2
Niger	126	30.8	115	49.7	115	49.7
Nigeria	110	39.3	113	50.4	113	50.4
Norway	1	91.2	11	81.6	11	81.6
Oman	99	42.6	19	78.4	19	78.4
Pakistan	91	44.0	67	65.7	67	65.7
Panama	75	50.6	80	62.8	80	62.8
Papua New Guinea	115	38.1	49	69.2	49	69.2
Paraguay	82	47.0	78	63.1	78	63.1
Peru	58	54.6	43	71.9	43	71.9
Philippines	48	57.5	104	56.2	104	56.2
Poland	37	63.1	77	63.6	77	63.6
Portugal	20	71.3	40	72.4	40	72.4
Qatar	77	49.5	31	74.6	31	74.6
Romania	50	57.3	52	68.8	52	68.8
Russian Federation	38	62.6	57	68.1	57	68.1
Rwanda	117	37.0	16	80.0	16	80.0
Saudi Arabia	123	34.7	6	86.6	6	86.6
Senegal	116	38.0	120	44.3	120	44.3
Singapore	25	68.4	2	92.9	2	92.9
Slovak Republic	22	70.1	33	73.8	33	73.8
Slovenia, Republic of	29	66.8	56	68.2	56	68.2
South Africa	68	52.8	25	76.7	25	76.7
Spain	9	78.4	73	64.3	73	64.3
Sri Lanka	87	45.9	73	64.3	73	64.3
Sudan	125	33.6	88	60.5	88	60.5
Suriname	80	48.3	130	32.6	130	32.6
Sweden	2	88.4	20	78.0	20	78.0
Switzerland	6	83.9	44	71.5	44	71.5
Syrian Arab Republic	108	39.9	86	61.1	86	61.1
Taiwan	21	70.4	45	71.4	45	71.4
Tanzania	76	49.7	100	56.6	100	56.6
Thailand	72	50.7	10	82.9	10	82.9
Togo	119	36.3	127	38.3	127	38.3
Trinidad and Tobago	32	66.3	69	65.1	69	65.1
Tunisia	56	55.1	62	67.5	62	67.5
Turkey	89	45.3	35	73.4	35	73.4
Uganda	70	52.2	112	51.3	112	51.3
Ukraine	45	58.6	101	56.5	101	56.5
United Arab Emirates	53	55.9	24	77.4	24	77.4
United Kingdom	23	69.2	7	85.7	7	85.7
United States	18	72.5	5	87.1	5	87.1
Uruguay	57	54.8	105	56.0	105	56.0
Venezuela	55	55.2	126	38.4	126	38.4
Vietnam	65	53.0	95	58.3	95	58.3
Yemen, Republic of	127	30.0	83	62.2	83	62.2
Zambia	112	38.8	48	69.3	48	69.3
Zimbabwe	114	38.4	117	48.6	117	48.6

Table 7. Innovation Capacity Index 2010–2011: Pillar rankings* (cont'd.)

	Pillar 4: Research and development						Pillar 5: Adoption and use of information and communication technologies			
	Pillar		R&D infrastructure		Patents and trademarks		Pillar		Telephone communications	
COUNTRY	RANKING	SCORE	RANKING	SCORE	RANKING	SCORE	RANKING	SCORE	RANKING	SCORE
Afghanistan, Islamic Republic of	131	0.0	129	0.0	121	0.0	120	24.8	111	58.2
Algeria	70	13.0	76	18.2	82	0.9	79	48.9	57	83.7
Angola	89	8.8	79	17.5	111	0.1	111	30.9	85	76.5
Argentina	57	15.7	76	18.2	32	12.8	53	57.4	44	86.5
Australia	19	45.0	15	55.4	20	30.4	18	80.5	17	94.0
Austria	15	48.2	13	58.5	17	33.7	19	80.1	27	92.1
Azerbaijan, Republic of	104	4.7	98	9.6	83	0.8	71	51.1	64	82.3
Bahrain, Kingdom of	80	9.9	37	33.7	52	5.1	22	79.1	35	89.9
Bangladesh	64	14.4	59	24.9	94	0.4	102	33.3	107	64.0
Belgium	16	46.8	20	50.8	14	41.1	23	77.6	23	93.0
Belize	113	3.2	114	5.8	70	2.1	95	39.7	89	74.5
Bolivia	85	9.2	86	15.5	73	1.6	98	38.1	105	65.6
Bosnia and Herzegovina	120	1.3	118	1.8	80	1.1	68	52.2	75	78.4
Botswana	100	5.3	101	9.1	89	0.6	86	44.1	77	78.0
Brazil	52	16.6	59	24.9	53	5.0	62	54.4	65	81.7
Bulgaria	42	19.8	48	28.6	44	7.4	47	61.5	43	86.6
Cambodia	113	3.2	113	6.0	99	0.3	115	29.6	113	57.4
Cameroon	63	14.6	62	24.2	111	0.1	112	30.8	117	55.8
Canada	11	53.3	9	64.6	16	37.5	11	84.1	10	96.1
Chad	107	4.3	91	12.9	121	0.0	130	18.2	124	45.3
Chile	33	23.7	47	29.0	27	16.4	52	57.8	54	84.4
China, People's Republic of	49	17.1	55	26.0	40	8.1	85	45.3	118	54.9
Colombia	76	10.4	82	15.8	67	2.9	57	56.6	48	85.6
Congo, Republic of	107	4.3	109	7.2	121	0.0	128	19.8	129	27.6
Costa Rica	65	13.7	85	15.6	35	11.1	66	52.8	36	89.1
Côte d'Ivoire	105	4.5	108	7.4	111	0.1	113	29.9	112	57.9
Croatia, Republic of	34	23.3	32	36.7	45	7.2	34	68.9	28	91.6
Cyprus	41	20.0	53	26.4	33	12.3	38	67.3	22	93.1
Czech Republic	26	33.6	22	50.0	36	10.7	33	69.8	47	85.8
Denmark	13	52.2	10	63.1	24	26.9	5	86.6	16	94.1
Dominican Republic	128	0.2	128	0.1	99	0.3	72	50.7	68	80.5
Ecuador	87	9.0	90	13.4	63	3.6	75	49.6	70	80.0
Egypt, Arab Republic of	65	13.7	67	22.5	94	0.4	77	49.4	81	77.2
El Salvador	88	8.9	92	12.2	83	0.8	69	51.4	67	81.3
Estonia, Republic of	32	26.5	31	38.8	34	11.7	29	71.8	34	90.1
Ethiopia	98	5.8	103	8.7	111	0.1	125	21.1	118	54.9
Finland	2	69.2	3	73.7	6	63.0	21	79.2	32	90.6
France	19	45.0	16	53.5	19	33.1	14	82.3	9	96.9
Georgia	97	6.0	96	11.6	73	1.6	70	51.3	86	76.3
Germany	14	50.4	14	57.0	13	41.2	9	85.2	3	98.4
Ghana	79	10.1	80	16.9	121	0.0	100	34.7	100	67.9
Greece	35	22.2	40	32.1	39	8.4	36	67.7	11	95.9
Guatemala	96	6.7	98	9.6	61	3.8	84	46.0	90	73.5
Guinea	55	16.0	41	32.0	121	0.0	124	21.8	120	50.4
Haiti	126	0.3	129	0.0	99	0.3	129	19.2	130	27.5
Honduras	62	14.8	69	21.2	58	4.3	94	39.9	114	57.3
Hong Kong SAR	24	39.1	25	46.3	22	29.0	6	86.1	4	98.1
Hungary	29	30.7	30	39.1	26	19.0	39	67.0	41	86.7
Iceland	17	46.6	8	65.2	25	24.1	16	81.7	2	98.6
India	74	10.7	73	19.1	89	0.6	96	39.1	76	78.2
Indonesia	91	8.5	89	14.3	73	1.6	88	42.7	79	77.7
Iran, Islamic Republic of	60	15.2	54	26.2	71	2.0	74	50.5	72	79.3
Iraq	75	10.6	42	30.9	94	0.4	104	33.2	116	57.2
Ireland	17	46.6	26	46.1	11	47.4	17	80.6	14	94.8
Israel	7	63.1	1	76.6	12	47.0	32	70.7	25	92.8
Italy	31	28.7	29	39.3	31	13.8	26	74.5	30	91.2
Jamaica	101	5.2	111	6.8	65	3.2	59	55.5	106	64.2
Japan	6	65.9	7	65.4	3	66.6	24	76.2	31	90.9
Jordan	54	16.2	58	25.4	111	0.1	60	55.4	81	77.2
Kazakhstan, Republic of	115	3.1	115	5.4	78	1.2	45	62.6	63	82.6
Kenya	69	13.1	34	34.5	107	0.2	109	31.4	108	63.3
Korea, Republic of	5	67.6	6	68.5	4	66.3	10	84.5	17	94.0
Kuwait	105	4.5	107	7.6	86	0.7	47	61.5	40	86.8
Lao PDR	110	4.0	106	7.8	111	0.1	108	31.5	91	71.7
Latvia, Republic of	43	19.7	43	30.6	47	6.6	37	67.6	58	83.6
Lebanon	78	10.3	65	23.9	111	0.1	80	48.7	95	69.1

Table 7. Innovation Capacity Index 2010–2011: Pillar rankings* (cont'd.)

	Pillar 4: Research and development						Pillar 5: Adoption and use of information and communication technologies			
	Pillar		R&D infrastructure		Patents and trademarks		Pillar		Telephone communications	
COUNTRY	RANKING	SCORE	RANKING	SCORE	RANKING	SCORE	RANKING	SCORE	RANKING	SCORE
Lithuania, Republic of	43	19.7	43	30.6	48	6.5	40	66.5	39	87.0
Luxembourg	8	62.4	23	47.0	2	81.6	7	85.5	8	97.0
Macedonia, FYR	59	15.5	57	25.8	65	3.2	43	63.5	62	82.8
Madagascar	95	6.9	93	11.8	94	0.4	123	23.4	122	48.8
Malawi	92	7.4	87	15.1	72	1.7	115	29.6	94	69.8
Malaysia	40	20.7	45	30.3	46	7.1	42	66.0	52	84.8
Mali	128	0.2	124	0.4	121	0.0	126	20.6	126	39.8
Malta	27	32.7	49	28.3	15	37.9	30	70.9	7	97.1
Mauritania	118	2.2	116	4.4	121	0.0	107	32.3	103	66.3
Mauritius	83	9.3	87	15.1	92	0.5	51	58.4	38	87.4
Mexico	49	17.1	55	26.0	55	4.7	67	52.5	60	83.3
Morocco	46	19.1	35	33.9	76	1.5	81	48.3	92	70.6
Mozambique, Republic of	93	7.0	97	11.0	99	0.3	121	24.6	125	43.0
Namibia	111	3.8	105	7.9	86	0.7	89	42.2	70	80.0
Nepal	122	0.6	120	1.0	99	0.3	119	27.4	110	59.4
Netherlands	12	52.5	19	50.9	9	55.5	3	89.3	19	93.8
New Zealand	23	41.1	21	50.7	23	27.8	20	79.6	26	92.2
Nicaragua	119	1.6	121	0.9	68	2.6	105	33.1	123	45.6
Niger	93	7.0	94	11.7	121	0.0	131	12.8	128	30.0
Nigeria	107	4.3	104	8.6	111	0.1	101	33.8	101	67.7
Norway	22	43.4	17	53.4	21	29.2	7	85.5	24	92.9
Oman	82	9.4	51	27.6	99	0.3	56	56.7	55	84.0
Pakistan	76	10.4	75	18.6	92	0.5	92	40.8	79	77.7
Panama	68	13.5	82	15.8	36	10.7	63	53.4	58	83.6
Papua New Guinea	124	0.4	122	0.7	107	0.2	110	31.1	88	75.0
Paraguay	112	3.5	119	1.4	42	7.7	83	47.2	83	76.7
Peru	99	5.6	112	6.7	58	4.3	78	49.1	83	76.7
Philippines	81	9.5	84	15.7	83	0.8	91	41.8	114	57.3
Poland	37	21.7	38	33.0	50	5.9	44	63.4	50	85.3
Portugal	30	29.3	28	39.9	29	14.5	35	67.8	32	90.6
Qatar	72	11.8	71	19.4	99	0.3	45	62.6	45	86.3
Romania	53	16.4	61	24.3	51	5.4	49	60.0	51	85.0
Russian Federation	38	21.2	36	33.8	62	3.7	50	58.9	78	77.9
Rwanda	122	0.6	127	0.3	86	0.7	118	28.8	109	59.8
Saudi Arabia	71	11.9	69	21.2	107	0.2	40	66.5	49	85.4
Senegal	67	13.6	74	18.9	111	0.1	99	35.3	102	67.1
Singapore	10	60.4	5	69.8	10	49.2	13	82.7	21	93.4
Slovak Republic	35	22.2	39	32.3	41	8.0	31	70.8	41	86.7
Slovenia, Republic of	25	34.0	24	46.7	28	16.2	28	72.0	15	94.6
South Africa	47	18.3	50	28.0	55	4.7	82	47.4	73	79.1
Spain	28	32.2	27	45.1	30	14.2	25	75.4	20	93.6
Sri Lanka	102	5.1	102	8.9	77	1.3	87	43.1	98	68.8
Sudan	116	2.8	117	4.1	81	1.0	93	40.6	69	80.1
Suriname	83	9.3	78	18.1	64	3.5	97	38.7	87	75.5
Sweden	2	69.2	2	74.8	8	61.4	1	90.0	6	97.4
Switzerland	1	70.3	11	62.9	1	87.6	4	89.0	1	99.4
Syrian Arab Republic	126	0.3	124	0.4	107	0.2	89	42.2	99	68.0
Taiwan	4	68.5	4	72.7	5	63.3	15	82.0	5	98.0
Tanzania	86	9.1	66	22.7	121	0.0	114	29.8	104	65.9
Thailand	55	16.0	64	24.0	55	4.7	64	53.3	73	79.1
Togo	128	0.2	124	0.4	111	0.1	127	20.3	131	20.4
Trinidad and Tobago	72	11.8	68	21.5	69	2.2	54	57.1	56	83.9
Tunisia	45	19.2	46	30.0	94	0.4	58	55.6	53	84.7
Turkey	48	17.3	62	24.2	43	7.5	61	54.8	46	86.2
Uganda	102	5.1	110	7.1	121	0.0	122	24.1	127	36.6
Ukraine	51	16.8	52	27.3	60	4.1	73	50.6	93	70.4
United Arab Emirates	38	21.2	33	35.0	89	0.6	27	73.7	28	91.6
United Kingdom	21	44.8	18	53.0	18	33.4	2	89.6	13	95.0
United States	9	61.3	12	61.2	7	61.5	12	83.4	12	95.1
Uruguay	58	15.6	71	19.4	38	10.4	54	57.1	37	87.6
Venezuela	90	8.6	94	11.7	53	5.0	65	53.2	66	81.4
Vietnam	60	15.2	81	16.5	49	6.0	76	49.5	61	83.2
Yemen, Republic of	121	0.9	129	0.0	78	1.2	106	32.7	96	69.0
Zambia	124	0.4	123	0.5	99	0.3	102	33.3	97	68.9
Zimbabwe	117	2.7	100	9.5	121	0.0	117	29.1	121	50.3

Table 7. Innovation Capacity Index 2010–2011: Pillar rankings* (cont'd.)

	Pillar 5: Adoption and use of information and communication technologies							
	Mobile cellular ommunications		Internet, computers, and TV		Government ICT usage		Quality of the infrastructure	
COUNTRY	RANKING	SCORE	RANKING	SCORE	RANKING	SCORE	RANKING	SCORE
Afghanistan, Islamic Republic of	124	27.6	117	1.9	122	21.0	116	29.3
Algeria	64	76.6	93	7.5	96	31.8	49	83.4
Angola	127	23.1	118	1.8	97	31.1	113	37.0
Argentina	28	85.8	60	22.3	46	54.7	68	69.8
Australia	57	78.4	14	74.1	8	78.6	57	77.5
Austria	40	82.8	20	69.3	23	66.8	6	98.5
Azerbaijan, Republic of	62	76.9	72	17.3	71	45.7	71	67.7
Bahrain, Kingdom of	2	99.5	24	60.1	13	73.6	25	92.7
Bangladesh	104	50.9	116	2.1	99	30.3	103	45.3
Belgium	37	83.1	23	62.1	16	72.3	29	91.6
Belize	99	52.5	77	16.2	90	35.1	123	17.0
Bolivia	102	51.5	94	7.4	79	42.8	94	52.3
Bosnia and Herzegovina	59	77.5	59	22.4	63	47.0	73	66.6
Botswana	49	79.7	101	5.4	87	36.4	94	52.3
Brazil	77	72.3	52	27.1	55	50.1	79	62.2
Bulgaria	22	87.3	50	28.4	42	55.9	21	94.0
Cambodia	110	47.4	129	0.5	104	28.8	110	38.1
Cameroon	108	47.7	114	2.4	111	27.2	101	47.2
Canada	83	65.2	4	86.5	3	84.5	58	77.4
Chad	126	26.2	128	0.6	128	12.4	130	0.8
Chile	53	79.0	53	25.6	33	60.1	66	70.5
China, People's Republic of	94	55.4	64	19.5	63	47.0	39	88.2
Colombia	55	78.7	56	24.6	29	61.3	84	60.0
Congo, Republic of	107	47.9	113	2.5	100	30.2	128	8.3
Costa Rica	105	49.7	54	25.4	62	47.5	64	71.7
Côte d'Ivoire	116	40.1	115	2.3	105	28.1	104	45.0
Croatia, Republic of	9	92.5	38	43.4	34	58.6	44	86.2
Cyprus	27	86.3	39	42.6	39	57.1	53	80.3
Czech Republic	20	88.1	32	48.3	32	60.6	12	97.7
Denmark	58	77.9	7	84.0	7	78.7	2	98.9
Dominican Republic	72	74.7	80	12.8	72	45.6	54	78.1
Ecuador	71	75.2	66	19.2	77	43.2	93	52.6
Egypt, Arab Republic of	81	66.5	85	11.2	73	45.2	36	89.5
El Salvador	12	91.2	87	10.1	63	47.0	75	66.5
Estonia, Republic of	6	95.3	27	53.1	19	69.7	90	59.1
Ethiopia	131	3.4	129	0.5	125	20.3	107	39.7
Finland	62	76.9	16	73.0	19	69.7	40	87.6
France	74	73.2	15	73.5	10	75.1	6	98.5
Georgia	87	61.4	47	30.7	80	42.5	78	63.1
Germany	19	88.4	13	74.6	14	73.1	3	98.8
Ghana	101	51.6	112	2.6	109	27.5	99	48.7
Greece	18	88.6	45	34.0	39	57.1	20	95.0
Guatemala	49	79.7	91	8.0	86	39.4	72	66.8
Guinea	123	34.6	127	0.8	127	14.3	127	9.8
Haiti	129	17.5	96	6.6	123	20.7	106	40.4
Honduras	70	75.6	92	7.8	83	40.7	92	53.4
Hong Kong SAR	13	89.5	11	74.9	ND	ND	22	93.7
Hungary	24	87.1	34	47.3	26	63.2	77	64.2
Iceland	54	78.8	10	78.0	22	67.0	55	77.9
India	111	45.2	102	4.8	89	35.7	89	59.3
Indonesia	92	56.9	97	6.0	84	40.3	75	66.5
Iran, Islamic Republic of	85	62.2	70	17.8	82	42.3	48	83.6
Iraq	97	54.7	119	1.5	101	30.0	38	89.3
Ireland	17	89.0	22	65.7	21	68.7	13	97.6
Israel	56	78.5	35	45.0	25	65.5	5	98.6
Italy	1	99.7	30	49.8	37	58.0	10	98.0
Jamaica	21	87.9	48	29.8	74	44.7	52	82.7
Japan	80	67.2	21	66.8	17	71.5	27	92.0
Jordan	41	82.3	76	16.4	49	52.8	18	95.4
Kazakhstan, Republic of	30	84.5	61	22.2	43	55.8	35	90.7
Kenya	119	37.5	104	4.5	91	33.4	111	37.6
Korea, Republic of	15	89.4	17	72.9	1	87.9	28	91.7
Kuwait	47	80.8	49	28.9	48	52.9	32	91.3
Lao PDR	115	40.5	104	4.5	113	26.4	125	13.4
Latvia, Republic of	43	82.0	31	48.7	36	58.3	29	91.6
Lebanon	93	56.8	64	19.5	76	43.9	36	89.5

Table 7. Innovation Capacity Index 2010–2011: Pillar rankings* (cont'd.)

	Pillar 5: Adoption and use of information and communication technologies							
	Mobile cellular communications		Internet, computers, and TV		Government ICT usage		Quality of the infrastructure	
COUNTRY	RANKING	SCORE	RANKING	SCORE	RANKING	SCORE	RANKING	SCORE
Lithuania, Republic of	8	93.0	37	44.0	27	63.0	82	60.6
Luxembourg	29	85.7	9	79.5	24	66.7	1	99.0
Macedonia, FYR	11	91.3	40	40.4	50	52.6	67	70.4
Madagascar	122	36.2	122	1.3	103	28.9	126	13.3
Malawi	117	39.9	125	1.2	116	23.6	119	26.0
Malaysia	39	83.0	41	38.7	31	61.0	26	92.5
Mali	120	37.2	119	1.5	126	18.2	122	18.0
Malta	33	83.6	33	47.7	29	61.3	41	87.1
Mauritania	95	55.2	111	3.1	116	23.6	117	26.8
Mauritius	52	79.4	55	25.3	66	46.5	16	96.0
Mexico	68	75.7	63	20.5	52	51.5	81	61.0
Morocco	67	75.8	73	17.1	93	32.9	60	76.1
Mozambique, Republic of	114	41.0	122	1.3	118	22.9	112	37.1
Namibia	88	59.6	79	13.2	92	33.1	109	39.1
Nepal	128	18.6	125	1.2	114	25.7	91	55.9
Netherlands	35	83.3	2	89.6	5	81.0	17	95.6
New Zealand	35	83.3	19	69.4	14	73.1	43	86.4
Nicaragua	86	62.1	104	4.5	88	36.3	96	51.8
Niger	130	14.2	131	0.4	129	11.0	120	20.7
Nigeria	121	36.8	95	6.9	112	26.9	97	49.9
Norway	65	76.3	6	84.5	6	80.2	33	91.1
Oman	13	89.5	62	21.9	70	45.8	62	74.0
Pakistan	96	55.1	99	5.5	108	27.6	73	66.6
Panama	34	83.5	71	17.4	69	46.2	70	67.9
Papua New Guinea	98	53.6	109	3.5	124	20.4	129	3.5
Paraguay	79	68.1	82	12.1	81	42.4	56	77.6
Peru	75	72.4	75	16.9	57	49.2	88	59.4
Philippines	61	77.1	89	8.4	68	46.4	87	59.5
Poland	32	84.1	42	36.4	43	55.8	34	91.0
Portugal	7	94.3	43	35.7	38	57.9	23	93.4
Qatar	4	99.0	51	27.7	56	49.3	46	84.4
Romania	31	84.2	44	34.6	45	54.8	85	59.9
Russian Federation	26	86.4	46	30.9	53	51.4	45	85.6
Rwanda	109	47.5	121	1.4	109	27.5	121	19.0
Saudi Arabia	5	96.3	36	44.3	53	51.4	65	70.7
Senegal	89	58.3	103	4.7	119	22.4	102	45.6
Singapore	22	87.3	18	70.8	11	74.8	4	98.7
Slovak Republic	60	77.2	25	58.1	41	56.4	31	91.5
Slovenia, Republic of	68	75.7	27	53.1	28	62.4	13	97.6
South Africa	66	75.9	86	10.8	78	43.1	85	59.9
Spain	48	79.9	26	53.7	9	75.2	8	98.4
Sri Lanka	82	66.1	99	5.5	85	40.0	59	77.1
Sudan	103	51.2	83	11.8	115	25.4	99	48.7
Suriname	84	65.1	88	8.6	94	32.8	118	26.3
Sweden	44	81.8	1	98.9	12	74.7	61	75.1
Switzerland	42	82.2	3	87.9	18	71.4	9	98.2
Syrian Arab Republic	90	58.2	81	12.6	98	31.0	51	82.8
Taiwan	73	73.9	12	74.9	ND	ND	ND	ND
Tanzania	118	37.7	122	1.3	102	29.3	114	33.4
Thailand	75	72.4	78	15.1	66	46.5	15	97.3
Togo	106	48.6	107	3.8	120	21.5	115	30.7
Trinidad and Tobago	10	91.8	67	18.3	59	48.1	50	83.1
Tunisia	46	81.0	69	17.9	58	48.3	47	84.1
Turkey	51	79.6	57	24.3	60	47.8	83	60.2
Uganda	100	52.1	107	3.8	105	28.1	124	16.0
Ukraine	25	86.9	83	11.8	51	51.8	24	93.3
United Arab Emirates	3	99.3	29	49.9	47	53.5	19	95.2
United Kingdom	16	89.1	5	86.2	4	81.5	11	97.9
United States	78	69.6	8	79.9	2	85.1	42	86.7
Uruguay	45	81.2	57	24.3	35	58.5	80	61.4
Venezuela	37	83.1	68	18.0	61	47.7	69	68.1
Vietnam	91	57.2	73	17.1	75	44.5	63	73.8
Yemen, Republic of	113	41.5	98	5.9	120	21.5	108	39.5
Zambia	112	42.8	110	3.2	105	28.1	105	44.9
Zimbabwe	125	26.9	90	8.2	95	32.3	98	48.9

Table 8. Innovation Capacity Index 2010–2011: Country clusters: Index scores and rankings*

High-income: GNI per capita > US$11,906			
Full democracies	Within group rank	Overall ICI rank	ICI score
Sweden	1	1	80.3
Switzerland	2	2	78.1
Finland	3	4	76.1
United States	4	5	74.8
Denmark	5	6	74.3
Canada	6	7	73.6
Netherlands	7	8	72.8
Luxembourg	8	10	72.2
Korea, Republic of	9	11	72.1
Norway	10	12	72.0
New Zealand	11	14	71.3
United Kingdom	11	14	71.3
Japan	13	16	70.2
Australia	14	17	69.4
Ireland	15	18	69.1
Iceland	16	19	69.0
Germany	17	20	68.9
Austria	18	22	66.7
Belgium	19	23	66.1
France	20	24	65.3
Slovenia, Republic of	21	27	59.1
Spain	22	29	58.8
Czech Republic	23	32	57.8
Portugal	24	36	56.7
Italy	24	36	56.7
Malta	26	47	54.6
Greece	27	64	49.9
Flawed democracies	Within group rank	Overall ICI rank	ICI score
Taiwan	1	9	72.5
Israel	2	21	67.5
Estonia, Republic of	3	25	60.5
Hungary	4	35	56.8
Slovak Republic	5	36	56.7
Cyprus	6	43	55.2
Croatia, Republic of	7	52	53.2
Trinidad and Tobago	8	72	47.7
Hybrid regimes	Within group rank	Overall ICI rank	ICI score
Singapore	1	3	76.7
Hong Kong SAR	2	13	71.4
Authoritarian regimes	Within group rank	Overall ICI rank	ICI score
United Arab Emirates	1	28	58.9
Bahrain, Kingdom of	2	34	57.0
Qatar	3	41	55.9
Saudi Arabia	4	48	54.1
Oman	5	58	51.8
Kuwait	6	59	51.3

Upper-middle-income: GNI per capita: US$3,856–US$11,905			
Full democracies	Within group rank	Overall ICI rank	ICI score
Mauritius	1	46	54.7
Uruguay	2	56	52.8
Costa Rica	3	59	51.3
Flawed democracies	Within group rank	Overall ICI rank	ICI score
Lithuania, Republic of	1	26	59.6
Latvia, Republic of	2	30	58.7
Chile	3	31	58.3
Bulgaria	4	33	57.4
Malaysia	5	39	56.4
Poland	6	40	56.3
Macedonia, FYR	7	42	55.3
South Africa	8	52	53.2
Romania	9	55	53.0
Mexico	10	62	50.2
Panama	11	66	49.4
Colombia	11	66	49.4
Argentina	13	68	49.3
Botswana	14	69	48.9
Peru	15	70	48.7
Namibia	16	77	46.0
Dominican Republic	17	79	45.5
Jamaica	17	79	45.5
Brazil	19	81	45.3
Suriname	20	112	38.4
Hybrid regimes	Within group rank	Overall ICI rank	ICI score
Russian Federation	1	56	52.8
Turkey	2	62	50.2
Bosnia and Herzegovina	3	73	47.5
Lebanon	4	87	44.3
Venezuela	5	104	40.4
Authoritarian regimes	Within group rank	Overall ICI rank	ICI score
Kazakhstan, Republic of	1	54	53.1
Algeria	2	94	42.5

*All rankings and scores are after rounding.

Table 8. Innovation Capacity Index 2010–2011: Country clusters: Index scores and rankings* (cont'd.)

Lower-middle-income: GNI per capita: US$976–US$3,855							
Flawed democracies	Within group rank	Overall ICI rank	ICI score	**Hybrid regimes**	Within group rank	Overall ICI rank	ICI score
Thailand	1	45	54.8	Georgia	1	44	55.0
Ukraine	2	61	50.4	Ecuador	2	84	44.6
El Salvador	3	71	48.0	Pakistan	3	102	40.8
Indonesia	4	77	46.0	Iraq	4	123	32.6
Philippines	5	81	45.3	**Authoritarian regimes**	Within group rank	Overall ICI rank	ICI score
Guatemala	6	83	44.7	Tunisia	1	48	54.1
Sri Lanka	7	86	44.4	Azerbaijan, Republic of	2	50	53.8
India	8	88	44.2	Jordan	3	51	53.7
Paraguay	8	88	44.2	China, People's Republic of	4	64	49.9
Belize	10	91	43.7	Egypt, Arab Republic of	5	75	46.6
Honduras	11	92	43.4	Iran, Islamic Republic of	6	85	44.5
Bolivia	12	98	41.9	Morocco	7	88	44.2
Nicaragua	13	100	41.5	Syrian Arab Republic	8	97	42.0
Papua New Guinea	14	107	39.5	Cameroon	9	115	37.1
				Nigeria	10	116	36.8
				Congo, Republic of	11	118	36.0
				Sudan	12	120	35.9
				Côte d'Ivoire	13	122	32.8
				Angola	14	125	31.9

Low-income: GNI per capita < US$975							
Hybrid regimes	Within group rank	Overall ICI rank	ICI score	**Authoritarian regimes**	Within group rank	Overall ICI rank	ICI score
Ghana	1	76	46.4	Vietnam	1	74	47.1
Zambia	2	94	42.5	Rwanda	2	93	43.2
Madagascar	3	96	42.1	Lao PDR	3	114	37.2
Tanzania	4	98	41.9	Yemen, Republic of	4	117	36.3
Kenya	5	101	41.4	Mauritania	5	118	36.0
Nepal	6	102	40.8	Guinea	6	124	32.1
Mozambique, Republic of	7	105	39.8	Togo	7	126	31.2
Uganda	8	106	39.7	Niger	8	127	31.1
Ethiopia	9	108	39.2	Zimbabwe	9	128	29.6
Malawi	10	109	39.1	Afghanistan, Islamic Republic of	10	130	27.4
Senegal	11	110	38.6				
Bangladesh	11	110	38.6	Chad	10	130	27.4
Cambodia	13	113	37.4				
Mali	14	121	35.0				
Haiti	15	129	28.3				

*All rankings and scores are after rounding.

Korea: Impressive innovation capacity

Korea is ranked 11 in the 2010 edition of the Innovation Capacity Index, because it does extremely well in many of the areas captured by the Index. Figure 3 shows Korea's relative performance with respect to other high-income countries in ten of the indicators used in the estimation of the Index.

Let us begin by highlighting a few facts about Korea's innovation capacity. First, the information and communications technology industry is a powerful engine of economic growth, contributing over 40 percent to the total expansion of GDP growth in recent years. Second, expenditure on research and development in relation to GDP has risen from under 1 percent in the 1980s to close to 3.5 percent in 2009, well above the OECD average. Third, the share of R&D expenditure carried out by the private sector had risen from 29 percent in 1970 to over 70 percent by 2000. Fourth, the average number of patents granted in the United States to Korean firms rose from about 10 per year during the period 1963–1986 to an average of about 4,800 per year during the period 2002–2007, a close to 500-fold increase. Fifth, the share of ICT in total manufacturing in Korea is 20.2 percent, higher than in any other country in the OECD other than Finland, where it is slightly higher. Indeed, the share of ICT goods in total merchandise exports (close to 35 percent) is higher in Korea than in any other member of the OECD, except for Israel. Finally, Samsung, the company that perhaps best exemplifies Korea's transformation over the past five decades from an agricultural society into a technology powerhouse now has research centers in Europe, the United States, Japan, Russia, India, and China, 27 manufacturing facilities in 12 countries, and an extensive network of sales organizations in 50 countries across the world.[29]

The role of government policy

What are some of the factors that have contributed to this impressive performance, perhaps matched only by Taiwan over the same period? Without doubt, a primary engine of change has been government policy, which at various times has provided critical support to the development of the ICT sector through a variety of policy instruments and incentives. The Korean economy has opened rapidly over the past 30 years and this has facilitated technology transfer, boosted international competition in the domestic market, and allowed economies of scale. A first step was taken in 1984 when the law regulating FDI was amended to broaden the sectors into which investment was permitted, with restrictions changed from a positive to a negative list, and restrictions on majority ownership relaxed. A second wave of liberalization for FDI came ahead of OECD entry in 1996. This was boosted further after the 1997–98 financial crisis, which had the effect of persuading the Korean authorities of the clear advantages of non-debt capital inflows to finance economic development. The New Foreign Investment Promotion Act (1998) brought about several incentives to promote inward FDI, including corporate income tax concessions, exemptions from customs duties on imported capital goods and various subsidies for firms setting up in specially designated economic zones. In parallel to the creation of an increasingly friendly environment for foreign investment—and thus a strong reliance on foreign technology—the capacity of Korean firms to enter into strategic alliances with companies abroad was significantly enhanced. For instance, over the past decade or so Samsung has signed a number of partnerships: with Nokia (2007) to co-develop technology for handsets; with IBM (2006) to co-develop and market technologies for industrial printers; with Sun Microsystems (2005) to cooperate on next-generation computing systems; with Sony (2004) for collaboration on development of 7th generation LCDs; with Hewlett-Packard (2003) to share technology for ink-jet printers; and with Microsoft (2001), to co-develop digital household electronics, to name just a few.[30] All of these companies, and many others, have established research centers in Korea.

The virtues of an open trade regime

A second dimension of increasing openness has been a fairly ambitious program of trade liberalization. For instance, average most-favored nation (MFN) tariffs for manufactures of electrical industrial machinery were reduced from 19.6 percent in 1988 to 4.6 percent by 2006. Tariffs on manufactures of radio, television, and communications equipment were reduced from 13.1 percent in 1988 to 1.1 percent by 2006. Similar tariff reductions applied to other ICT-related products. A particularly

[29] See Onodera and Hann, 2008.
[30] OECD, 2008, p. 147.

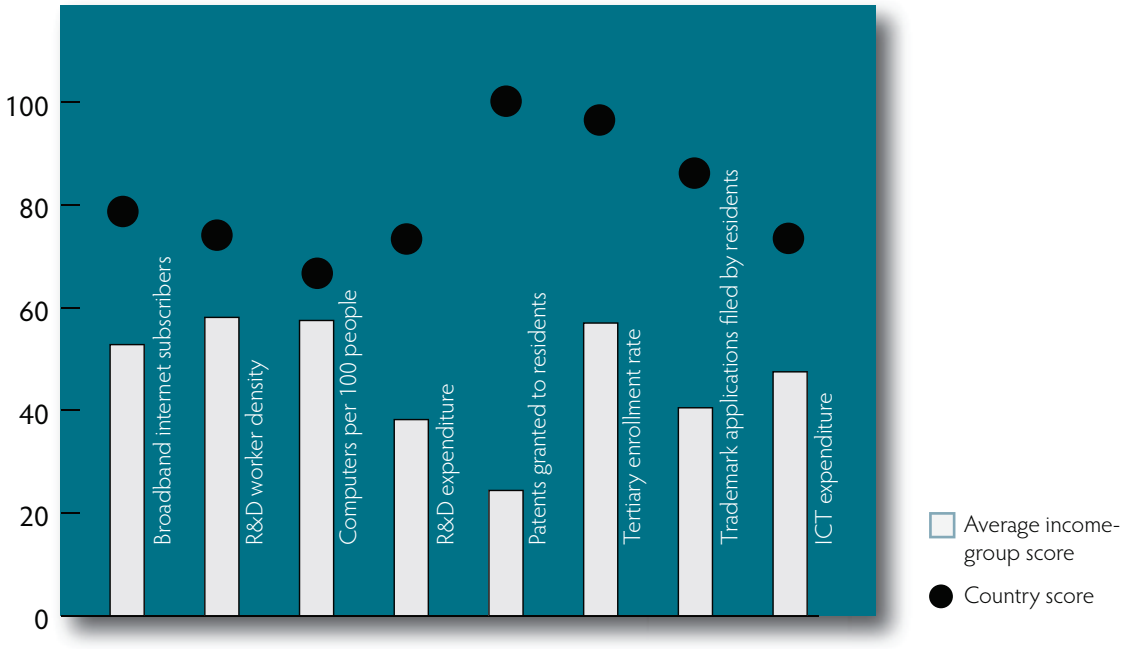
important instrument in this regard has been the WTO's Information Technology Agreement, a comprehensive framework that came into force in 1997, when 40 nations, including Korea, accounting for over 90 percent of world trade in ICT products, agreed to the elimination of tariffs on a range of ICT products. As a result, the growth of imports of ICT products accelerated sharply, but that of exports grew even faster. Indeed, the trade figures for ICT products are nothing short of spectacular. Imports in 1999 were US$30.3 billion and had risen to US$54 billion by 2005. Exports in 1999 were US$48.5 billion and rose to US$102.3 billion by 2005. As a result, the trade surplus on ICT products rose from US$18.2 billion in 1999 to US$48.4 billion in 2005. The penetration of the Chinese market was particularly swift, with Korean exports rising from US$5.5 billion in 1999 to US$35.6 by 2005.[31] To take a specific example, total exports of mobile handsets rose from under US$600 million in 1995 to well over US$17 billion in 2006, a close to 30-fold increase—impressive by any standards. Indeed, as noted by Onadera and Kim (2008, p. 114), Korea's "industrialization drive has been strongly led by exports," with the export-to-GDP ratio rising from some 5 percent in 1962, to 43.6 percent by 2009, notwithstanding a vertiginous rise in GDP, among the highest in the world.

The latest technologies and human capital

Equally impressive has been the extent to which use of the latest technologies has penetrated Korea, both within the business community, government, and civil society. Broadband Internet subscribers per 100 inhabitants rose from 13 in 2000 to 32 in 2008. Internet usage per 100 inhabitants was 45 in 2000 and had risen to 77 by 2008. There were 57 mobile phone users per 100 inhabitants in 2000 and 95 by 2008. Similar increases can be noted in personal computer use, e-commerce, and Internet banking subscribership. These penetration rates often exceed those of other OECD members having much higher levels of income per capita. The UN e-Government Readiness Index ranks Korea as number 1 among 180 countries in its latest edition, reflecting the extent to which the growth of the ICT sector in Korea has affected every dimension of economic life, including the delivery of services by the government.

But, as seen in Table 9, trade and investment policies have only been one dimension of Korea's approach to the rapid development of the ICT sector and the creation of an impressive innovation capacity. The government has also been aggressive in the way it has gone about developing a modern infrastructure for higher education and training. Korea has the highest

Figure 3. Korea: Significant indicators above income group average



[31] In 1999, the United States was Korea's most important trade partner. By 2005, by a significant margin, the most important markets for Korean ICT exports were China and the EU, accounting for roughly half of the total.

Table 9. Korea: ICI pillar rankings

	Rank	Score
Overall position	11	72.1
1. Institutional environment	34	59.1
2. Human capital, training, and social inclusion	35	67.4
3. Regulatory and legal framework	51	69.0
4. Research and development	5	67.6
5. Use of information and communication technologies	10	84.5

tertiary enrolment rate in the world: 96.1 percent. The Electronics and Telecommunications Research Institute was established in 1976, part of ten government-sponsored research institutes created with a mandate to boost Korea's science and technology capabilities, develop its skilled technological manpower, and promote private sector participation in research and development. The number of fully qualified researchers engaged in R&D in Korea rose from under 6,000 in 1970, to about 224,000 in 2007, a 37-fold increase.

Korea's rise from a relatively simple agricultural society in the early 1960s to a leading industrial and technological power by the beginning of the new century is worthy of admiration, particularly when set against the background of the relatively pessimistic expectations after the Korean war; a country with such a difficult political geography and modest natural resource endowments might well have raised questions about its long-term viability. That a country could transform itself in so short a period into a high-income industrial giant with a huge footprint on the global economy highlights two important facts: a) the powerful role of sensible economic policies in enabling a country to embark on a path of self-sustaining economic growth, and b) the extent to which governments can, in fact, contribute to rising prosperity for their populations, notwithstanding the many limitations of the free market economy, so painfully evident during the latest global financial crisis.

Brazil: Key innovation challenges

Brazil has taken important steps in recent years to modernize its economy and to lay a stable foundation for sustainable growth. Its ranking of 81 in this year's ICI, however, is extremely low, given its level of per capita income—US$10,466 on a PPP-adjusted basis in 2008. India, for instance, has a broadly similar ICI rank, but a much lower income per capita of US$2,780. What are the factors which appear to be preventing Brazil from boosting its innovation capacity? We focus our attention on four, all of them fairly central when assessing a country's ability to create an environment conducive to innovation.

Inefficiencies in resource allocation

Over the past decade and a half, successive Brazilian governments have done much to improve management of the public finances, at least when measured by the size of the government deficit and the magnitude of the public debt. Brazil had a long history of fiscal mismanagement, and improvements made in this area in recent years have, therefore, been extremely welcome. Indeed, it is noteworthy that Brazil's public debt in relation to GDP is now much lower than that of most European countries and of the United States—a remarkable development. However, there are a number of outstanding problems which need to be addressed. Brazil suffers from serious rigidities on the spending side. These take various forms: one is the pervasive earmarking of revenues for assorted purposes, affecting as much as 80 percent of total primary spending (that is, net of interest payments). Another consists of automatic adjustments to expenditures to reflect movements in other variables, of which the most important is the linking of social and pension benefits to the minimum wage. According to the IMF (2005), mandatory revenue transfers to local governments and inflexible labor legislation have also prevented a streamlining of the government payroll, which remains unduly large. A recent survey of the Brazilian economy

notes that while only 6 percent of Brazilians are of pensionable age, they take the equivalent of 11.3 percent of GDP in pension payments. In sharp contrast, in the United States, the 12 percent of the population who are pensioners receive the equivalent of 6 percent of GDP in pension payments.[32] Inevitably, this has led to a situation where Brazil spends far more in providing benefits to its older citizens than it does in educating the young, building a better educational infrastructure, or improving the country's abysmally poor roads and ports infrastructure. A government that is constrained in terms of how it can allocate its resources will, not surprisingly, end up spending less on research and development and higher education. The data for Brazil bear this out. R&D intensity is about 1 percent of GDP, less than half of the OECD average.

But this is not the whole picture. Distortions in the financial system—where the government maintains a heavy presence—continue to drive a large wedge between borrowing and deposit rates, which, in turn, have prevented a quicker expansion of investment and limited the availability of resources to small- and medium-sized enterprises, often the locus of innovation. The benchmark interest rate is currently in the 11–12 percent range, extremely high by international standards, at a time when interest rates are at record lows everywhere, and when the central bank's own inflation target is nearer 4–5 percent, implying a very high real interest rate.

A culture of heavy bureaucracy

One of the functions of government involves the issuing of licenses and permits. From cradle to grave, the average citizen in any country has to enter into transactions with some government office or bureaucrat to obtain a birth certificate, get a passport, pay taxes, open up a new business, drive a car, register property, engage in foreign trade, sell a good or service to the government, hire an employee, use a public health service, build a house, etc. Indeed, red tape had become such a bountiful source of corruption in most countries that a few years ago the World Bank began to publish an entire report that systematically looked at the prevalence of regulation in member countries. As noted earlier, the *Doing Business Report* (DBR) is now the primary reference tool for assessing the burdens of business regulation in a large number of countries. The data from the DBR for Brazil suggests that the business community labors under a heavy burden of an entrenched culture of bureaucracy and red tape. It takes 120 days and 16 procedures to start a new business in Brazil, 411 days and 18 procedures to obtain a construction permit, 42 days to register property, 616 days to enforce a contract, representing 70 more days than was the case in 2005, at a cost of 16.5 percent of the claim. Indeed, among 183 countries ranked in the DBR, Brazil's ranks are invariably low, sometimes abysmally so.

A number of surveys have shown that businesses allocate considerable time and resources to dealing with the demands of red tape. Often, they may feel that paying a bribe is the surest way to save time and enhance efficiency and, in many countries, possibly the only way to get business done, without undermining the firm's competitive position vis-à-vis those who pay bribes routinely. Obviously, the more dysfunctional the economic and legal system and the more onerous the regulations, the greater the incentives for individuals and businesses to short-circuit it by paying bribes. Since there is a well-established correlation between the prevalence of red tape and corruption, it is not surprising that in Transparency International's *Corruption Perceptions Index* Brazil ranked 75th in 2009, thirty places below it rank in 2002.[33] Excessive bureaucracy and red tape and the corruption they inevitably engender will greatly discourage entrepreneurship and innovation, and may well be one of the most important factors explaining Brazil's low ranking in the ICI, given its level of per capita income.

Lagging higher education

According to de Brito and de Mello (OECD, 2006), "Brazil's poor record in educational attainment is among the key obstacles to the generation and diffusion of innovation" (p. 23). There are several interrelated problems. First, much of the efforts over the past decade have been focused on expanding school enrolment in primary and secondary education—now close to universal—with less emphasis put on the quality of the education actually delivered. As a result, to take one important indicator, Brazil has lagged behind other countries in the region in its scores on the Program for International Student Assessment (PISA). In particular, in science, math-

[32] See *The Economist,* 2010b, pp. 45–47.

[33] Although this huge drop in rank is partly explained by the incorporation of new countries to the CPI (102 in 2002 vs. 180 in 2009), it must be noted that Brazil's score in 2002 was 4.0 out of a possible 10, whereas it had dropped to 3.7 by 2009, suggesting a worsening of corruption.

Table 10. The Innovation Capacity Index 2010–2011: Brazil and Latin America

	Selected variables								
	Innovation Capacity Index			Government effectiveness			Rule of law		
	Score	Rank* (131)	Region Rank* (22)	Score	Rank* (131)	Region Rank* (22)	Score	Rank* (131)	Region Rank* (22)
Chile	58.3	31	1	68.3	26	1	82.0	23	1
Uruguay	52.8	56	2	49.9	45	2	63.2	45	2
Costa Rica	51.3	59	3	47.7	49	3	61.7	49	3
Mexico	50.2	62	4	42.4	58	5	34.5	92	13
Colombia	49.4	66	5	41.2	60	7	38.0	83	9
Panama	49.4	66	5	42.1	59	6	45.5	65	4
Argentina	49.3	68	7	33.6	76	12	35.2	89	11
Peru	48.7	70	8	30.6	80	13	32.0	98	14
El Salvador	48.0	71	9	34.4	75	11	34.8	91	12
Trinidad and Tobago	47.7	72	10	45.4	53	4	44.3	67	5
Dominican Republic	45.5	79	11	28.4	85	14	35.5	87	10
Jamaica	45.5	79	11	40.3	64	8	38.2	81	8
Brazil	45.3	81	13	37.8	68	10	43.0	70	6
Guatemala	44.7	83	14	26.0	90	15	22.9	117	18
Ecuador	44.6	84	15	14.2	117	21	19.7	121	20
Paraguay	44.2	88	16	19.1	107	17	24.8	115	17
Honduras	43.4	92	17	24.0	94	16	28.1	106	16
Bolivia	41.9	98	18	18.3	113	18	22.4	118	19
Nicaragua	41.5	100	19	14.5	116	20	28.9	105	15
Venezuela	40.4	104	20	17.3	115	19	10.7	127	22
Suriname	38.4	112	21	38.1	66	9	42.2	73	7
Haiti	28.3	129	22	6.5	122	22	16.7	123	21
Memorandum items:									
Finland	76.1	4	-	85.8	5	-	97.5	6	-
New Zealand	71.3	14	-	81.1	11	-	97.2	8	-
Ireland	69.1	18	-	77.5	17	-	94.4	13	-
Spain	58.8	29	-	62.4	32	-	79.7	24	-
Portugal	56.7	36	-	63.7	31	-	76.3	27	-

* Ranks after rounding to one decimal point.

ematics, and reading its students' performance has been behind those of Chile, Uruguay, Mexico, and Argentina and, it goes without saying, much further behind students in other higher-income OECD countries, even Spain and Portugal, themselves well behind the OECD average. Second, the tertiary enrolment rate is extremely low by international standards, given Brazil's stage of development. At 30 percent, it is well below that of Chile (49.8 percent) and Uruguay (64.3 percent) and well below that of Argentina (68.1 percent). It is also far below that of Korea (96.1 percent), a country with a per capita income lower than that of Brazil as recently as the 1980s. Perhaps more than any other, this is an extremely troubling indicator, given the increasing complexity of the global economy and the proven success in the area of innovation of

Table 10. The Innovation Capacity Index 2010–2011: Brazil and Latin America (cont'd.)

	Selected variables								
	Corruption Perceptions Index			Gender equity			Inequality		
	Score	Rank* (131)	Region Rank* (22)	Score	Rank* (131)	Region Rank* (22)	Score	Rank* (131)	Region Rank* (22)
Chile	67.0	23	1	52.6	75	16	59.6	96	8
Uruguay	67.0	23	1	55.1	63	12	66.0	89	4
Costa Rica	53.0	37	3	68.5	30	3	65.0	92	6
Mexico	33.0	73	12	62.9	41	5	56.4	98	10
Colombia	37.0	62	4	50.8	81	20	15.3	113	22
Panama	34.0	68	9	60.4	48	7	27.2	110	19
Argentina	29.0	84	15	69.9	25	2	56.6	97	9
Peru	37.0	62	4	64.0	39	4	54.1	101	12
El Salvador	34.0	68	9	53.9	69	15	65.4	91	5
Trinidad and Tobago	36.0	66	8	80.1	14	1	78.9	64	1
Dominican Republic	30.0	78	13	55.0	64	13	65.0	92	6
Jamaica	30.0	78	13	56.4	56	10	73.3	84	2
Brazil	37.0	62	4	50.4	83	21	40.1	106	17
Guatemala	34.0	68	9	51.5	76	17	49.3	102	13
Ecuador	22.0	110	19	62.2	43	6	47.9	104	15
Paraguay	21.0	116	20	51.0	80	19	49.0	103	14
Honduras	25.0	98	17	58.9	52	8	24.7	111	20
Bolivia	27.0	92	16	51.1	79	18	29.8	109	18
Nicaragua	25.0	98	17	54.2	67	14	55.6	99	11
Venezuela	19.0	122	21	58.1	53	9	72.9	85	3
Suriname	37.0	62	4	56.0	57	11	43.1	105	16
Haiti	18.0	125	22	ND	ND	ND	21.1	112	21
Memorandum items:									
Finland	89.0	6	-	90.2	3	-	94.6	4	-
New Zealand	94.0	1	-	84.1	10	-	84.2	47	-
Ireland	80.0	14	-	72.2	23	-	88.2	30	-
Spain	61.0	29	-	83.5	11	-	86.9	34	-
Portugal	58.0	31	-	75.3	19	-	80.1	60	-

* Ranks after rounding to one decimal point.

countries which have invested heavily in education over the past three decades. Of course, the rigidities in government expenditures alluded to above have sharply limited the authorities' ability to invest more in productivity-enhancing areas, such as the building up of first-class educational institutions. Surveys carried out at Brazilian universities show students complaining about outdated libraries, the structure and content of the curriculum, and the limited availability of computer facilities. Third, spending in education—about 5 percent of GDP on an annual basis—is somewhat above the average for the region, albeit below that of the likes of Finland, New Zealand, Denmark, Iceland, and Sweden, where it is closer to 6–8 percent of GDP. Again, the issue here is one of priorities. Brazil manages to spend vast amounts in generous pensions for

Table 10. The Innovation Capacity Index 2010–2011: Brazil and Latin America (cont'd.)

	Selected variables								
	Starting a business (time)			Total fixed broadband subscribers per 100 inhabitants			E-government readiness index		
	Score	Rank* (131)	Region Rank* (22)	Score	Rank* (131)	Region Rank* (22)	Score	Rank* (131)	Region Rank* (22)
Chile	81.4	78	8	20.6	45	1	60.1	33	2
Uruguay	54.3	118	18	17.7	49	3	58.5	35	3
Costa Rica	57.9	113	16	5.8	68	12	47.5	62	10
Mexico	91.4	43	3	17.0	51	4	51.5	52	5
Colombia	86.4	65	7	10.3	61	9	61.3	29	1
Panama	92.1	39	2	14.0	54	5	46.2	69	12
Argentina	81.4	78	8	19.4	47	2	54.7	46	4
Peru	71.4	103	13	6.1	67	11	49.2	57	7
El Salvador	88.6	56	5	4.9	74	14	47.0	63	11
Trinidad and Tobago	70.0	105	14	11.1	60	8	48.1	59	8
Dominican Republic	87.1	62	6	5.5	70	13	45.6	72	13
Jamaica	95.0	26	1	8.7	64	10	44.7	74	14
Brazil	15.0	127	19	12.8	55	6	50.1	55	6
Guatemala	80.0	82	10	1.4	88	19	39.4	86	19
Ecuador	55.0	117	17	0.6	94	20	43.2	77	15
Paraguay	75.7	94	11	3.5	76	15	42.4	81	17
Honduras	90.7	47	4	0.0	115	21	40.7	83	18
Bolivia	65.0	109	15	1.6	86	17	42.8	79	16
Nicaragua	72.9	100	12	1.5	87	18	36.3	88	20
Venezuela	0.0	128	20	11.5	59	7	47.7	61	9
Suriname	0.0	128	20	2.7	82	16	32.8	94	21
Haiti	0.0	128	20	0.0	115	21	20.7	123	22
Memorandum items:									
Finland	90.7	47	-	74.1	8	-	69.7	19	-
New Zealand	100.0	1	-	52.5	24	-	73.1	14	-
Ireland	91.4	43	-	48.8	28	-	68.7	21	-
Spain	67.1	108	-	49.1	27	-	75.2	9	-
Portugal	96.4	12	-	37.2	34	-	57.9	38	-

* Ranks after rounding to one decimal point.

its public servants and can find the resources to subsidize the consumption of fuels by the population, but has not invested enough in strengthening its scientific infrastructure. According to the OECD study quoted above (2006, p.24), the stock of engineers graduated per thousand population is 0.08 in Brazil, but it is ten times higher (0.80) in Korea. Fourth, there is limited collaboration between the universities and the business community, reflecting legal impediments to the transfer and sharing of financial proceeds associated with intellectual property rights.

Low penetration of new technologies

There is a general perception in Brazil that the country has kept pace with the adoption of the latest technologies. As with

Table 11. The Innovation Capacity Index and PISA scores

	PISA (Program for International Student Assessment)*								
	Innovation Capacity Index			Science		Reading		Mathematics	
	Score	Rank** (131)	Region Rank* (22)	Score	Upper and Lower Ranks*** (57)	Score	Upper and Lower Ranks*** (57)	Score	Upper and Lower Ranks*** (57)
Sweden	80.3	1	1	503	20-23	507	7-13	502	17-23
Switzerland	78.1	2	2	512	13-20	499	11-19	530	5-9
Finland	76.1	4	3	563	1-1	547	2-2	548	1-4
United States	74.8	5	4	489	24-35	ND	ND	474	32-36
Canada	73.6	7	5	534	3-6	527	4-5	527	5-10
Netherlands	72.8	8	6	525	6-11	507	8-13	531	5-8
Taiwan	72.5	9	7	532	3-8	496	12-22	549	1-4
Korea	72.1	11	8	522	7-13	556	1-1	547	1-4
New Zealand	71.3	14	9	530	3-9	521	4-6	522	8-13
United Kingdom	71.3	14	9	515	12-18	495	14-22	495	22-27
Japan	70.2	16	11	531	3-9	498	11-21	523	6-13
Germany	68.9	20	12	516	10-19	495	12-23	504	16-23
Israel	67.5	21	13	454	39-39	439	38-40	442	40-41
France	65.3	24	14	495	22-29	488	18-28	496	21-28
Spain	58.8	29	15	488	26-34	461	34-36	480	31-34
Chile	58.3	31	16	438	40-42	442	37-40	411	44-48
Italy	56.7	36	17	475	35-38	469	31-34	462	37-39
Portugal	56.7	36	17	474	35-38	472	29-34	466	35-38
Qatar	55.9	41	19	349	56-56	312	55-55	318	56-56
Thailand	54.8	45	20	421	44-47	417	41-42	417	43-46
Russia	52.8	56	21	479	33-38	440	37-40	476	32-36
Mexico	50.2	62	22	410	48-49	410	41-44	406	46-48
Turkey	50.2	62	22	424	43-47	447	37-39	424	41-45
Greece	49.9	64	24	473	35-38	460	34-36	459	38-39
Argentina	49.3	68	25	391	50-55	374	51-53	381	50-53
Indonesia	46.0	77	26	393	50-54	393	44-51	391	49-52
Brazil	45.3	81	27	390	50-54	393	46-51	370	53-55

* *PISA 2006: Science Competencies for Tomorrow's World*. Executive Summary. OECD, 2007.

** Ranks after rounding to one decimal point.

*** Rankings for all participating countries. On the basis of the samples of students assessed by PISA, it is not always possible to say with confidence which of two countries with similar performance has a higher mean score for the whole population. However, it is possible to give a range of possible rankings within which each country falls.

several indicators of education (e.g., enrolment rates at all levels of the educational ladder), the data on the penetration rates for mobile telephones, broadband Internet subscribership, Internet and personal computer use over the past decade shows two things: Brazil has definitely made improvements with respect to its history, but there is a large gap with respect to the top performers, many of which have moved farther, faster, and deeper. Mobile usage rates have perhaps moved up the fastest, with Brazil having penetration of about 78.5 per 100 inhabitants in 2009 compared to 26.4 in 2003—impressive progress, but still well behind Argentina, Chile, Colombia, Ecuador, Guatemala, Jamaica, Paraguay, Uruguay, and Venezuela and, of course, OECD countries. Internet use in Brazil stands at 37.5 per 100 inhabitants in 2008, compared to

76.5 in Korea. Personal computer penetration rates are 16.1 in Brazil as opposed to 58.1 in Korea. The data for broadband Internet subscribers shows an even larger gap in 2008, with Brazilian coverage around 5.3 per 100 inhabitants, compared to 32.1 in Korea.

In the 1970s, Brazil tried to develop a domestic computer industry by banning imports; the net effect was less to develop native manufacturing capacity, but more to cut Brazil off from new technologies. The trade regime is now more open, but import tariffs for capital goods and intermediate inputs remain high. Much of the spending on R&D is done by the state. To move Brazil's business spending in R&D closer to the OECD average, it would have to rise by a factor of four, which highlights the challenges in creating an environment more conducive to innovation.

Like India, Brazil has great potential to move up the ranks of the ICI in coming years and, more generally, to develop local innovation capacity. But the authorities and the business community will have to join forces in addressing the glaring weaknesses identified above.

China: Enormous potential in years ahead

The last year that China's growth rate was below 7.5 percent was 1990. On a PPP-adjusted basis, Chinese GDP has already overtaken Japan and Germany, making China the world's number two economy. This impressive growth performance has turned the Chinese economy into an important contributor to global growth, a major force in commodity markets, the most important destination for foreign direct investment and, hence, an emerging power in international trade. Chinese exports and imports in relation to GDP were less than 15 percent in the mid-1980s, but by 2008 had risen to 33 percent for exports and 26 percent for imports. Whereas Chinese exports were less than 1 percent of total world trade in 1984, this share 20 years later had risen above 5 percent. So, if the intent of the strengthened reform effort seen in China in the last 20 years was to contribute to its integration to the global economy, it has succeeded well beyond anyone's expectations.

The above trends have all contributed to increasing the relative importance of the Chinese economy which, by 2009, accounted for some 7–10 percent of global GDP (the lower range corresponds to market exchange rates). They have also pulled hundreds of millions of people out of poverty, given them enhanced opportunities, and improved living standards, perhaps the most important achievement of the last 20 years.

While the Chinese authorities are to be praised for effective macroeconomic management—sometimes carried out against the background of a difficult international economic environment—it is useful to review briefly the challenges that remain, particularly those that pertain to improving the country's innovation capacity. In the medium-term perspective, the sources of Chinese growth will gradually shift to technological progress and innovation; thus, it is important to analyze those factors that might be holding the country back. This year's ICI ranking for China is 64, broadly in the same ballpark as that of Mexico, Turkey, and Greece.

Market regulations

The OECD has compiled an extremely useful set of market regulation indicators to "assess the extent to which the regulatory environment promotes or inhibits competition in markets where technology and market conditions make competition viable."[34] These indicators include a measure of the extent of price controls, the licensing and permit system, communication and simplification of rules and procedures, administrative burdens for sole proprietor firms, legal and regulatory barriers, discriminatory procedures, tariff policy, the degree of government control over business enterprises, among others. These are aggregated into three broad families which capture state control, barriers to entrepreneurship, and barriers to international trade and investment. Two major conclusions that are derived from a review of these measures are that

1. China's product markets have become increasingly competitive in recent years and market forces are now playing the leading role in the setting of prices and the behaviour of agents in the broader economy;[35]
2. China *remains* a difficult country to do business in; product market regulation is such as to continue to restrict competition in a major way.

Indeed, the OECD data suggests that market regulations are more restrictive in China than anywhere in the OECD

[34] OECD, 2010, p. 103.

[35] In 1978, state-owned enterprises accounted for 78 percent of total industrial output and employed 60 percent of the non-farm workforce. "Collectively-owned enterprises accounted for the rest, with no other type of business enterprise permitted at the time." By 2007, the state controlled 31 percent of industrial output and employed 22 percent of the non-farm workforce (OECD, 2010, pp. 105–7).

countries, including all its transition-economy members. The gaps are large across all three major areas: state control, barriers to international trade and investment, and barriers to entrepreneurship. These results are strongly corroborated by the Doing Business indicators compiled by the World Bank which show poor scores/rankings for starting a business, dealing with licenses, construction permits, employing workers, and paying taxes. The indicators measuring the extent of investor protection are likewise mediocre.

China's weaknesses in the regulatory and legal framework highlighted by the OECD and World Bank indicators are consistent with members of the business community surveyed in China, who complain of arbitrariness in the application of rules, lack of evenhandedness in the treatment of foreign and domestic investors, and high levels of corruption; the latter is strongly corroborated by a rank of 79 in the *Corruption Perceptions Index* 2009, which puts China on a par with Burkina Faso and Trinidad and Tobago. A recent report in the *Financial Times* commenting on the frustrations of doing business in China notes that "the risk-reward calculation between staying quiet and speaking up has shifted towards the latter. With China employing policies including ignoring intellectual property rights, forced technology transfer, and government procurement skewed towards domestic companies, some foreign businesses feel they are being pushed out of the country."[36]

Human capital, ICT and R&D

There are a number of other indicators used in the ICI in which China does not score very well, and which thus contribute to dragging its score down. Tertiary enrolment rates of 22 percent are better than in India, but below the majority of countries in Latin America, and below all OECD members, the latter by a significant margin. As might be expected, given China's stage of development and still relatively low income per capita, the gap is also huge with respect to Japan, Taiwan, Korea, and Singapore. Spending in education, at slightly less than 2 percent of GDP, is also low by international standards. Despite rapid urbanization (see below), China has a sizable rural population engaged in agriculture. Though the literacy rate in the country (93 percent) is well above that of India (66 percent), the fact remains that there are hundreds of millions of people in China who need to be educated and trained to increase their productivity. This will surely be one area where the government will have to do more in coming years, a need made more urgent by China's rapid integration into the global economy, and a gradual shift in the sources of Chinese competitiveness, from low labor costs and an undervalued exchange rate, to technology and innovation.

As with indicators of education, China, likewise, has mediocre scores in a broad range of indicators that capture the extent of penetration of the latest technologies. As in other parts of the world, progress has been made in recent years in boosting Internet penetration, mobile phone coverage, computer use, access to broadband Internet, and so on. But given China's large rural population, it is perhaps not surprising that the use of these technologies is still in its early stages. For instance, personal computer use per 100 inhabitants is 5.6, higher than in India (2.8) but about ten times lower than in Korea. China's rapidly rising income per capita should allow it to narrow these gaps fairly rapidly over the next decade. In the meantime, however, there is little doubt that they slow down innovation capacity.

Research and development expenditure in China is about 1.5 percent of GDP, below the average for the OECD of 2.2 percent of GDP. According to the OECD, if one further looks at R&D spending by industry, the gap with respect to the OECD is much higher, particularly for high-tech industries. This is specially the case for high-tech export industries "which lack a large R&D base in China and continue to rely heavily on foreign-sourced technology embodied in FDI and imported inputs" (OECD, 2010, p. 25).

Improving the social infrastructure

One of the more noticeable trends in China in recent years has been the massive shift of rural populations into urban environments. Whereas in 1980, less than 20 percent of China's total population of close to 1 billion was living in urban areas, by 2000 this share had risen to 33 percent. The urban population during this period expanded from about 190 million to over 420 million, an impressive growth of over 120 percent. Indeed, at least a few percentage points of the high annual

[36] See Financial Times, 2010. The article quotes an official at the US Information Technology Industry Council saying that "We are feeling less and less welcome in China, which is why you are seeing more people speaking out and reconsidering their futures in China."

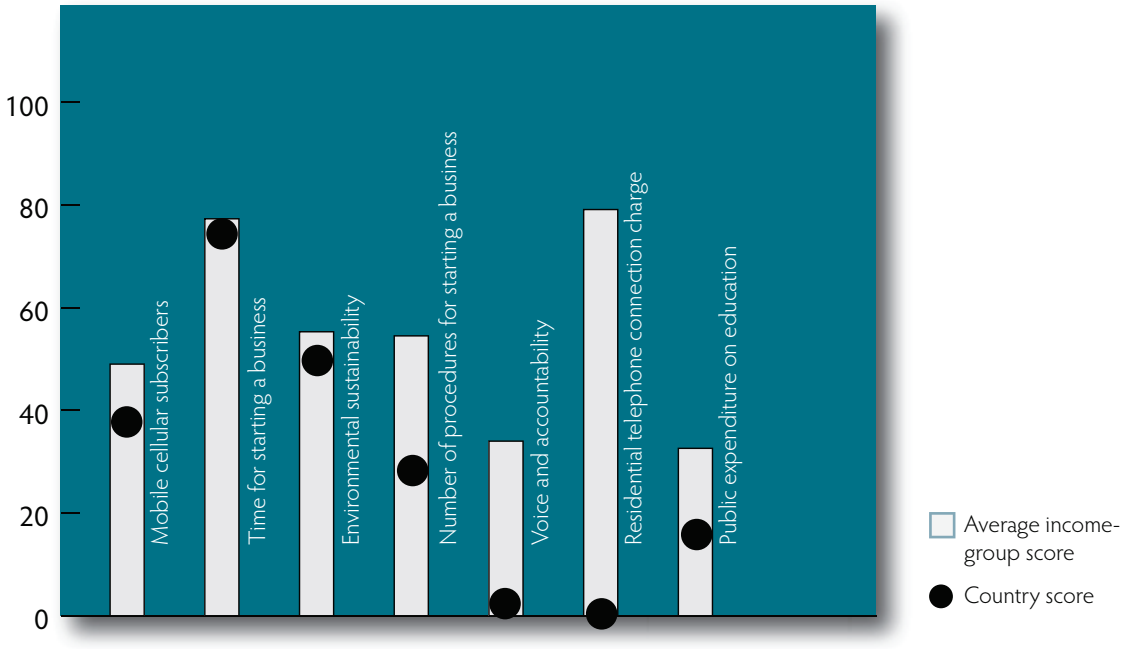
GDP growth rates seen during this period is accounted for by these internal migratory flows, since labor productivity in urban areas is much higher. This trend is expected to continue in coming years and will require careful management. There are several aspects to this.

As is well known, and as in other transition economies, there have been transitory increases in unemployment linked to the inevitable—and much needed—restructuring of the enterprise sector. This has necessitated the introduction of unemployment compensation schemes and, more generally, the buildup of safety nets to mitigate the impact of these adjustment costs on the population, particularly its most vulnerable groups. Like other countries in the industrial world, China will also have to make provisions for its aging population, and more attention will have to be given, therefore, to the development of efficient and modern systems of social protection, particularly pensions. This, in turn, will have implications for the budget. The need for further reforms in this area is highlighted by the fact that by 2030, China's urban population may well have exceeded 1 billion. Well before the country reaches this threshold, the need for a well-functioning and well-funded social infrastructure will have become a political necessity, especially if the current rural-urban income disparities continue to widen, as they have in recent years. Indeed, China's political stability will hinge critically on the speed with which the government is able to make progress in this area, at a time when rising protectionist sentiment against booming Chinese exports begins to create a more challenging external environment for the country. An additional benefit of an improved framework for social protection will be that the Chinese population will feel less of a compulsion to save (for old age) and this would stimulate domestic consumption, thereby contributing to reduce China's huge trade surplus, a constant source of tension with trade partners. Better mechanisms of social protection will also encourage entrepreneurship and long-range planning, key ingredients of successful innovation.

Managing the growth process

For some time now there has been a vigorous debate about the risks that rapid growth rates might pose for macroeconomic stability. Sceptics have pointed out that China's relatively good inflation performance and some slack in the labor markets suggest that growth could be sustained at the 9+ percent

Figure 4. China: Top priorities for policy reform



range. However, in recent years, credit growth has at times reached extremely high levels, and a consensus has emerged that managing the growth process in a way that preserves and builds upon the important gains of the past is a key priority for policymakers. This view has been buttressed by a growing perception that rapid growth is leading to a sharp deterioration of the environment, with unforeseen future consequences for public health. However, monetary policy measures—interest rate and reserve requirement increases—are not likely to be enough. There may also be a role for fiscal policies aimed at withdrawing stimulus from the economy. Fortunately, with a low revenue-to-GDP ratio, the authorities have considerable room for maneuver and should not hesitate to use it. Beyond this, further structural reforms, particularly those that boost competition in the economy, reduce the sort of barriers faced by entrepreneurs to start new businesses, and increase transparency and the rule of law will all help to make the Chinese economy more flexible, and will enhance the economy's productivity and boost its innovation capacity.

The process whereby China plays an increasingly important role in shaping the global agenda will be enhanced if the government sets in motion processes of political reform—the 21st century counterpart of the impressive reforms in the economic area implemented during the past two decades, which have done so much to boost the standards of living of the Chinese population. A China that gradually moves in the direction of giving some political voice to its people can only contribute to enhancing its own ability to nourish an environment conducive to greater innovation.

Israel: A large footprint in the ICT world[37]

A number of ingredients have led to the emergence of Israel as a powerhouse in the information and telecommunications industry and as a country otherwise well-positioned at the center of the knowledge economy. Israel does well in the ICI, ranking 21st, placing it on a virtual par with Germany and Austria. There are a number of features behind this strong performance which are worth highlighting, including close collaboration between government and business, government encouragement and support of the capacity of the private sector to compete in international markets, heavy investment in education, an intelligent use of investment incentives (sometimes favoring foreign investors to build innovation capacity), unusually high investment in R&D, and the implementation of mutually supporting incubator and venture capital programs to convert research into cutting edge businesses. These interventions have been supported by ambitious economic and institutional reforms aimed at enhancing resource allocation and contributing to the modernization of the economy. We briefly review some of these key factors.

Education at the core

Israel has an impressive track record of human capital investment, based on a strong cultural heritage stressing excellence in education. It has several world-class institutions of higher education, including the Technion in Haifa, the Weizman Institute in Rehovot, and the Hebrew University in Jerusalem. Growing demand for higher education has been met by liberalizing higher education to allow private colleges, foreign competition, and by recognizing degrees granted by technical schools accredited by the Ministry of Education. The tertiary school enrolment rate is 60.4 percent, higher than in France, Germany, and the United Kingdom, although not as high as in the Nordic countries. Over the years there has been active collaboration between the academic establishments and the business community. For instance, in the early 1990s, industry leaders saw the need to substantially boost the number of graduates from the top universities with appropriate, cutting-edge training in electronics and computer science. This was achieved by the creation of task forces that sought to boost the science and technology component of university curricula. Israel's quite successful efforts to shift the priorities of career paths within the public university system to reflect the changing needs of industry, have contributed much to the dynamism of its high-tech sector.

Active collaboration between the universities and industry has, in turn, reflected the realization that Israeli comparative advantage resided in its qualified human capital rather than in its relatively scarce natural resources endowments. The national market was too small to sustain the emergence of national industries and the political situation precluded the

[37] This section draws in part from López-Claros and Mia (2006).

growth of trade with other countries in the neighborhood. Thus, the potential market for Israeli products had to be global in scope, demanding a focus on innovative products which could be sold on international markets. Hence, a small market size and the adverse political geography served as catalysts to spur the development of an industry which ultimately would not depend for its success on these two factors. Unable thus far to tap into a plentiful extractable commodity, Israel has been forced to trade globally on its human capital endowment. The government has sought to make improvements to the system of higher education; for instance in 2007, the Shohat Committee made a number of recommendations, including increasing the distinction between universities and colleges, allowing providers greater flexibility in the setting of fees, introducing better mechanisms for financing long-term student loans, and raising teacher-student ratios. Despite some initial moves in this direction, the Committee's recommendations remain to be implemented.

Strong government support for private R&D

Israel has had a long-standing policy of subsidizing private-sector R&D projects as a way of promoting the emergence of a technologically advanced ICT sector. This has been done largely through the Office of the Chief Scientist (OCS), at the Ministry of Industry, Trade and Labor, which administers and grants government funds for R&D, on the premise that the business sector alone will not be able to sustain adequate levels of investment in research and development projects, particularly in high-risk, albeit promising, areas.

Under existing arrangements, qualifying companies can apply for government grants normally covering between 20–50 percent of the R&D budget. If the products and processes resulting from the government-sponsored project are commercially successful, the company must pay the government back royalties, which correspond to a defined percentage of the total annual product sales. The annual budget for industrial R&D research covers an average of 1,000 projects, implemented by 500 companies. Financial support to industrial R&D has been by far the most important in terms of budgetary allocations, some US$300 million per year in recent years. Priority has generally been given to technology projects which can lead either to new products and processes, or to substantial improvements of existing ones. Areas of particular emphasis have been software, biotechnology and computing, electronics, chemical and mechanical engineering. According to the OECD, "Israel has a remarkably high level of spending on R&D: its share in GDP is greater than in all OECD countries," slightly below 5 percent (2009, p. 138).

Another innovative program, named Magnet, was put in place in the mid 1990s to strengthen the bonds between industry and the untapped first-class research capabilities of Israeli universities. Under this program, consortia of industrial firms and at least one academic institution are entitled to multi-year grants of three to five years, for up to 66 percent of the total approved R&D budget to develop pre-competitive generic technologies. The consortium commits to making the resulting technologies available to any local interested party at a moderate price. In 2005, there were 31 consortia.

The OCS has also entered into a formal mechanism of international cooperation, particularly in target commercial markets, with a view to addressing one of Israel's main weaknesses: lack of skills and expertise in international marketing resulting from the small size of the country's companies and their somewhat remote geographical location. Thus, the fostering of contacts between national and foreign companies leading to joint R&D, manufacturing, and marketing has been an important focus of government R&D policy.

Technology incubators and innovation

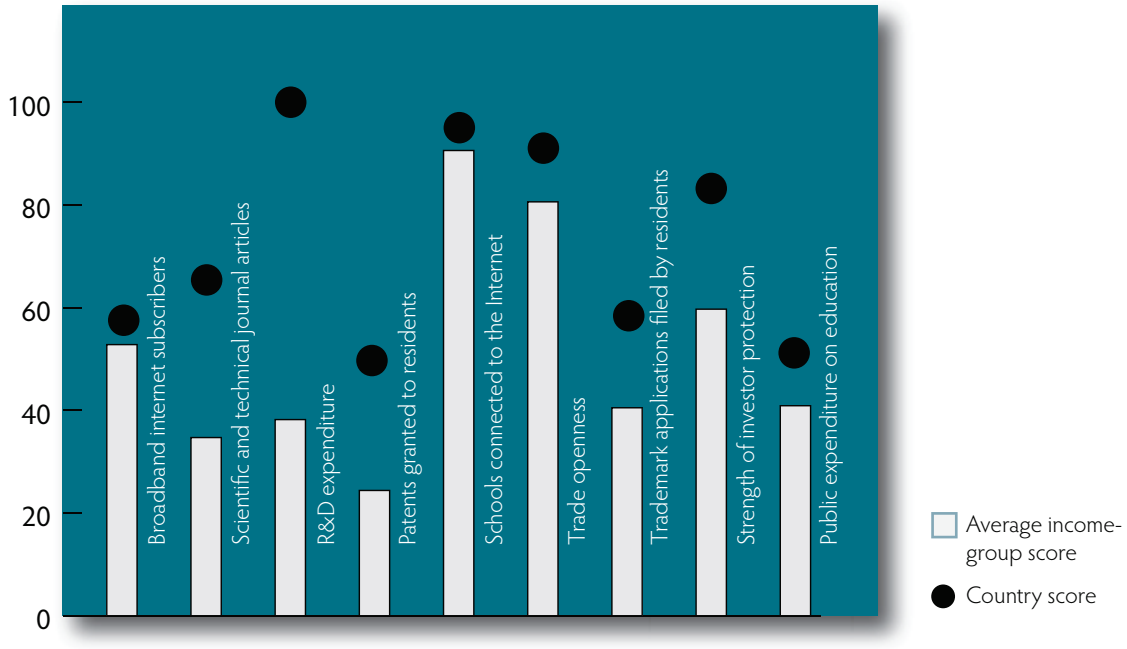
An overabundance of ideas has sometimes run up against the constraints of lack of funding, and successful innovation in technology requires both. The government noted early on that original research in the universities and institutes did not often lead to readily marketable industry applications. As noted above, it was the Magnet program that first sought to strengthen the avenues of collaboration between industry and the academic community. In a sense, the task for the authorities was to replicate the fairly successful integration of the know-how and specialized skills of qualified military personnel, particularly those working in the army's Computer and Data Communications Network Center, into the private sector.

In the early 1990s, to promote business startups, and particularly to facilitate the integration into the job market of the new wave of immigrants, the OCS initiated the incubator program. The aim of the program was to enable first time entrepreneurs with new ideas with export potential to develop them into a business. Many of the arriving immigrants had remarkable technical skills but little experience in the commercial development of innovative projects. The program sought to take selected entrepreneurs through to first round investments in product development, to the point where they could become autonomous, find strategic partners, and raise venture capital in the markets. There are currently in operation 24 technology incubators, each conducting an average of about 10 projects with an average duration of two to three years. The government provides some 85 percent of the funds in the form of grants and soft loans, with the rest funded by a venture capital firm, the incubator itself, or the entrepreneur, in exchange for a share of equity in the company. The program was so successful that by 2009, 22 of the incubators had been privatized, typically by venture capital firms, sometimes in partnership with local development authorities. A key ingredient of success has been the enforcement of strict quality control and high standards of performance—the government actively sought to ensure the commercial success of projects undertaken under the aegis of incubators, avoiding the trap, so common in other countries, of turning an initially good idea into a mere job-creation bureaucracy. The incubator program was instrumental in spawning the rapid growth of start-ups in Israel. Within a decade of the creation of the incubator program the number of start-ups had risen to 2,000, a five-fold increase, making Israel the country with the world's highest density of high-tech start-ups. By 2009, the number of start-ups had risen to some 4000. Even more impressive, the success rate of incubator start-ups—measured as the ability to raise private funding to allow the company to operate for at least two years—is 50 percent, five times higher than the corresponding success rate for start-ups in the United States. According to the OECD, "in the past decade, more than 100 Israeli start-ups have gone public on the NASDAQ" (2009, p 140), though efforts are underway recently to encourage initial public offerings locally.

Investment incentives

The government has been quite proactive in encouraging do-

Figure 5. **Israel: Significant indicators above income group average**



mestic and foreign capital investment in Israel. Enterprises, whether Israeli or foreign, which were deemed eligible by the Ministry of Industry were in a position to receive government grants to finance a portion of tangible fixed assets. Furthermore, the underlying legislation actually introduced a bias in favor of foreign investors. It was thought that a combination of tax incentives and the relative abundance of engineers and scientists would boost the attractiveness of Israel as a location for high-tech multinationals. These would not only contribute to job creation in Israel, but would also bring with them know-how and the exporting channels that the local industry needed. The government's strategy worked extremely well: international investors flocked to Israel, including high-tech giants such as IBM, Motorola, and Intel, and were followed by many others. Microsoft and Cisco built their first R&D facilities outside the United States in Israel; Motorola's R&D center in Israel is its largest worldwide. In addition to creating state-of-the-art R&D centers, companies such as Intel and Motorola established manufacturing facilities, which rapidly became some of the largest private employers in Israel. More recently, concerns about emerging skills shortages and the tough credit environment in the wake of the global financial crisis—which sharply reduced the funding to high-tech companies from venture capitalists—has prompted the government to reconsider the sorts of incentives presently on offer. The aim is to continue to nurture the growth of an industry that now accounts for 40 percent of total exports and 15 percent of GDP.

Spain: Large scope for progress

The ICI gives Spain a rank of 29, somewhere between the Baltics and Chile. The rank itself is not bad, and it is not surprising that Spain scores below Sweden, Finland, Switzerland, Taiwan, Japan, Korea, Germany, and Israel, countries with a well established track record of innovation and highly-developed and sophisticated high-tech sectors. What is noteworthy about Spain is that, whereas in 2008, its PPP-adjusted income per capita was US$30,589, that of Chile was less than half (US$14,529) and those of the Baltics ranged from US$17,106 in Latvia to US$20,561 in Estonia. In other words, for its stage of development—a rich industrial country with the world's 11th largest economy[38] —Spain's innovation capacity is lagging behind its true potential. What are the factors that have contributed to this mediocre performance? We focus our attention on three: fiscal management, market regulation (including the dysfunctionalities in Spain's labor market), and education.

Precarious public finances

The onset of the global financial crisis was met by calls from leading economists to respond to the contraction of demand with fiscal stimulus. It was essential to avoid repeating the mistakes of the Great Depression when the authorities, unwisely, sought instead to balance budgets and did not relax monetary policies to the extent that was necessary to revive domestic demand. The problem with fiscal stimulus in the middle of a crisis is that the authorities need to strike a careful balance between optimizing the benefits of increased expenditure, against the risk that too much stimulus might undermine confidence because the increase in public debt is perceived by investors as potentially unsustainable. This difficult balancing act is particularly important in countries that already have high levels of public debt, and where there is greater vulnerability to shifts in investor sentiment. If investors begin to question the solvency of the government, then what started out as an exercise aimed at softening the adjustment until consumer and investor confidence picked up and improved the economy's growth prospects, can quickly turn into a vicious circle, in which the increase in the cost of debt becomes rapidly prohibitive, confidence is undermined, and economic revival is put off.

This is what happened in Greece earlier this year and, in the context of a highly integrated region using a common currency, the Greek crisis led to contagion in Portugal and Spain, countries where the authorities were in the midst of implementing their own stimulus packages. In Spain, after having allowed the deficit to widen beyond 11 percent of GDP in 2009—a deficit without recent historical precedent—and having lost the confidence of investors, the government proceeded to introduce an adjustment package consisting of expenditure cuts and increases in taxes. This 180 degree turn in policy created social and political tensions, undermined the

[38] Using a PPP-adjusted measure of GDP. At current market exchange rates Spain ranks 9th in the world, with a GDP equal to US$1,602 billion, just below Russia (US$1,677 billion), and ahead of Brazil (US$1,573 billion).

credibility of the government, and distracted attention from more urgent reforms, for instance in the labor market (see below). Among the 131 countries ranked in the ICI, Spain's budget deficit in 2009 was the sixth largest—that is, one of the worst in the world. The ICI, quite correctly, penalizes fiscal indiscipline because of the way it distorts resource allocation, for instance, constraining the ability of the government to spend more on education or on research and development. In Spain, R&D is equivalent to slightly less than 1.3 percent of GDP, well below the OECD average of 2.2 percent of GDP, and close to a quarter of the level in Israel.

Market regulation and a dysfunctional labor market

Of the five pillars used to build the ICI, Spain's worst performance by a significant margin corresponds to pillar 3, on the regulatory and legal framework. The World Bank's 2010 *Doing Business Report* database shows an extremely poor rank (146 out of 183 countries) for the "starting a business" indicators. In Spain it takes ten procedures and a total of 47 days to get a business started, compared to six procedures and six days in Portugal (a rank of 60) and five procedures and seven days in France (a rank of 22), Spain's two neighbors. Moreover, Spain does not perform well in the indicator measuring protection of investors (a rank of 93). This indicator captures such concepts as disclosure requirements—to assess, for instance, the extent of related-party transactions—extent of liability of directors, and ease of shareholder suits—measuring how easily investors can access the courts when their interests are damaged. In all of these concepts, Spain's scores are mediocre at best, particularly considering Spain's high income per capita and large industrial country status. Consistent with this, Spain's ranking of 32 (a middling score of 6.1 on a 10-point scale) in the TI's *Corruption Perceptions Index* is also mediocre. The worst ranks, however, concern those indicators that capture aspects of the operations of the labor market, such as the obstacles that businesses might face to hiring workers, the rigidity of hours, the degree of flexibility that employers might have to adjust the payroll to changing market conditions, the costs of separation, and so on. Spain has a rank of 157 in the employing workers DBR indicator, compared to a rank of 1 in Australia and 9 in Denmark.

Spain suffers from a segmented labor market that has served the country poorly over the past couple of decades, a fact eloquently highlighted by an unemployment rate of close to 20 percent in mid-2010, and twice that high for youth and women. One part of the labor market consists of permanent contracts with high levels of job security linked to extremely high severance payments, while the other is made of temporary contracts with much lower firing costs, accounting for some 27 percent of total employment, more than twice the average for the OECD. Not surprisingly, employers have responded to such incentives by hiring an increasing number of workers under temporary contracts, often beyond the legal limits provided by the legislation. In the public sector, workers cannot be sacked and, therefore, absenteeism is high (18 percent) and there is widespread abuse of sick leave. If a publicly owned company is privatized, the workers have to be taken on to the public payroll. Accordingly, demand for public sector vacancies is extremely high; according to *The Economist,* "300 people apply for each new clerical job advertised by the Madrid government."[39] Since the large severance payments for permanent workers are forfeited if they change employment, turnover is low, contributing to lack of motivation and sclerosis. Better-educated younger workers under temporary contracts are thus the "buffer" during periods of economic distress and end up being overqualified (and underpaid) for the jobs they hold. An economy in which the highest aspiration of university graduates is to secure employment with the government and become a bureaucrat is not one likely to encourage a spirit of entrepreneurship and a culture of innovation. Labor market reform and the gradual elimination of the duality in the market is an essential precondition to putting in place the incentives that will encourage greater entrepreneurship and risk-taking.

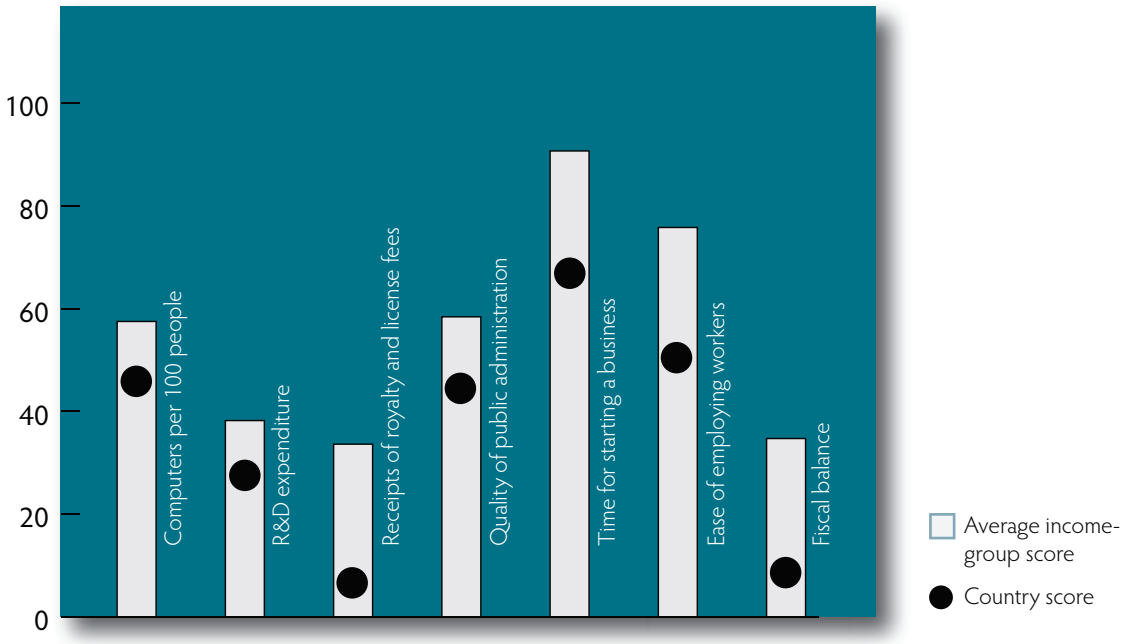
Education

There is not a single Spanish university among the best 170 in the world.[40] According to this particular set of rankings, the University of Barcelona is the best in Spain, with a rank of 171, and there are no others among the top 200. We have already made reference to the relatively low level of R&D spending

[39] *The Economist,* 2010a. 3 June.

[40] According to: http://www.topuniversities.com/world-university-rankings

Figure 6. **Spain: Top priorities for policy reform**



in Spain, which, as might be expected, has a counterpart in the inadequate funding provided by the government and the business community to the universities. There is no well-established tradition in Spain of active collaboration between the universities and the business sector, a fertile source of innovations in those countries that have succeeded in nurturing this critical relationship. Consequently, there is little use made of internships as a way of building up relevant skills and familiarizing the student with the demands of the job market. Spanish universities are by and large public entities and suffer from the same perverse incentives as the public sector. Pay is relatively poor, no one can be fired—except those on temporary contracts—and there are few mechanisms in place to encourage excellence in teaching and research. The cost of tuition covers a very small fraction of the expense incurred by the state. One implication of this is that students have no leverage to demand higher standards; since salaries are low, the university is not in a position to hire staff of exceptional quality—a damaging vicious circle. Not surprisingly, the most able emigrate, unable to find a meritocratic working environment that rewards performance and academic achievement.

The teaching of English in secondary schools is deficient and thus university students are ill-prepared for carrying out research at a sufficiently advanced level, with easy access to the vast library of research materials available in English. Student exchange programs are rare, depriving students of the expansion of intellectual horizons that these can bring. There is insufficient incorporation of the latest technologies into every aspect of the life of the university, whether it be for online course registration, access to bibliographical libraries, e-learning, and so on. Course curricula are not adequately updated, and thus do not reflect the rapidly changing needs of the Spanish labor market and the private sector. The concept of "advanced standing"—namely, that there will be students who because of earlier work experience could enter an academic program midway—is largely an alien concept. There is little effort to better integrate research, teaching, and work early on. Students are not adequately familiarized with various conventions, habits, and norms that govern academic life (academic literacies) and might encourage more in-depth learning. Teacher evaluations—a reliable source of feedback in the modern university—are seldom used. It is additionally worrisome that, given the largely public nature of the better Spanish university, often there is no arm's-length relationship

between government and university in terms of hiring, with the universities sometimes used to park out-of-work politicians. Excessive crowding is another problem, particularly in the early years of undergraduate training. Failure to address some of these glaring deficiencies will condemn Spanish universities to mediocrity and greatly hamper long-term innovation capacity—at all times and everywhere reliant on academic excellence.

Conclusions

The Innovation Capacity Index featured in this chapter correlates a wide-ranging set of relevant factors, policies, and institutional characteristics which are seen as playing a central role in boosting a nation's capacity for innovation. How can countries transform knowledge into value in ways that will result in new products and services, processes, and systems? What are the priority policy areas that merit particular attention if countries are to be able to participate successfully in an increasingly complex global economy requiring growing levels of sophistication? How do these priorities, in turn, depend on a nation's particular stage of development—the quality of its institutions, the human capital endowment of its labor force—and the nature of the political regime against which policies are framed? In building the ICI's theoretical framework, we have established a firm linkage between the stage of development of a given country and the relative importance attached to the many factors boosting innovation capacity. But we have also taken the view, firmly anchored in empirical observation, that democracies tend to be better than authoritarian regimes at encouraging the creation of friendly environments for innovation.

The Innovation Capacity Index is intended to be a policy tool to better examine the broad range of policies and institutions which underpin the creation of an environment conducive to innovation. The methodologies developed facilitate the identification of country-specific factors which demand priority attention. The reader's attention is directed to the innovation profiles in Part 3 of the *Report* which identify, for each country, the top priorities for policy reform. Although this is the second edition of the ICI, the Index will be estimated annually and it is expected that, over time, it will also provide a historical perspective on individual country performance. Above all, by identifying individual country strengths and weaknesses, the Index is intended to stimulate policy dialogue. And the rich body of data used for the calculation of the Index rankings should also provide ample opportunities for the sort of high-minded international comparisons of best practices which are an essential component of better policy formulation.

To highlight the uses to which the ICI can be deployed, in this chapter we have examined in some depth the innovation capacity of five countries: Korea, Brazil, China, Israel, and Spain. These case studies highlight a number of important lessons: (1) the fundamental role of a sensible policy framework that extends well beyond the traditional focus on macroeconomic stability, and which includes an outward orientation and active encouragement of foreign investment, for the tangible benefits it brings in terms of building innovation capacity; (2) the need to provide early support to human capital development and the building up of a modern infrastructure for training and education, without which countries will be greatly hampered in their efforts to boost productivity and to foster innovation; (3) the desirability of removing bureaucratic and regulatory obstacles to entrepreneurial activity, the excess of which can greatly stifle innovation; (4) the scope for active government policies which, through transparent and well-designed incentives, can accelerate the development of an ICT sector and, along the way, significantly boost innovation capacity—certainly the inference than can be drawn from the experiences of Korea, Israel, and Taiwan; (5) the need to constantly review government spending priorities, with gains to be made from investments in the promotion of ICTs, as against the funding of consumer subsidies or other expenditures with high opportunity costs.

The Innovation Capacity Index will be estimated annually and the results will be published, together with analyses of a select group of country case studies, as we have done this year with Korea, Brazil, China, Israel, and Spain. Readers are invited to visit a dedicated website at: http://www.innovationfordevelopmentreport.org to find innovation profiles for 61 countries not included in this year's published edition, as

well as for abstracts and short biographical sketches by the authors who contributed the other papers to this year's *Report*. It is hoped that the framework provided by the *Report* for examining factors, policies, and institutions which contribute to creating an environment that boosts nations' capacity for innovation will prove useful for analysis and policy dialogue in coming years. As countries endeavor to boost productivity and build innovation capacity with a view to more efficient engagement with the global economy, the insights provided by the ICI will become increasingly useful.

References

Balazs, Etienne. 1964. *Chinese Civilization and Bureaucracy: Variations on a Theme*. New Haven and London: Yale University Press.

Balazs, Etienne. 1968. *La Bureaucratie Céleste: Recherches sur l'Économie et la Société de la Chine Traditionnelle.* Paris: Gallimard.

Boulanger, P. M. 2007. Political uses of social indicators: Overview and application to sustainable development indicators. *International Journal of Sustainable Development* 10(1–2):14–32.

de Brito Cruz, Carlos, and Luiz de Mello. 2006. Boosting Innovation Performance in Brazil. OECD Economics Department Working Paper No. 532.

Diamond, Jared. 1999. *Guns, Germs, and Steel: The Fates of Human Societies.* New York and London: W. W. Norton and Company.

Easterly, William. 2002. *The Elusive Quest for Growth*. Cambridge, MA: MIT Press.

The Economist. 2008. Hocus-pocus: The real world consequences of producing unreal inflation figures. 14 June.

———. 2010a. The pain in Spain. 3 June.

———. 2010b. In Lula's footsteps. 3 July.

The Economist Intelligence Unit. Democracy Index.

European Innovation Scoreboard. 2007. Comparative Analysis of Innovation Performance. PRO INNO Working Paper N°6.

Ferguson, Niall. 2008. *The Ascent of Money: A Financial History of the World.* London: Allen Lane.

Financial Times. 2008. Transparency Group Fears for Staff in Bosnia. 22 July.

———. 2010. 'Foreign Friends' Lose Reluctance to Criticize China. 20 July.

Friedman, Thomas. 1999. *The Lexus and the Olive Tree: Understanding Globalization.* New York: Farrar Strauss Giroux.

Goldstone, Jack. 1996. Gender, Work and Culture: Why the Industrial Revolution Came Early to England but Late to China. *Sociological Perspectives* 39(1 Spring):1–21.

The Growth Commission. 2008. *The Growth Report: Strategies for Sustained Growth and Inclusive Development.* May. Available at: www.growthcommission.org

International Monetary Fund. 2005. Stabilization and Reform in Latin America: A Macroeconomic Perspective on the Experience Since the Early 1990s. Occasional Paper 238, Washington, D.C.

———. 2010. *World Economic Outlook: Rebalancing Growth.* Washington, D.C. April.

Johnson, Simon, Daniel Kaufmann, and Pablo Zoido-Lobatón. 1998. Regulatory Discretion and the Unofficial Economy. *American Economic Review Papers and Proceedings* 88:387–92.

Landes, David. 1998. *The Wealth and Poverty of Nations.* Little, Brown and Company.

López-Claros, A. and Irene Mia. 2006. Israel: Factors in the Emergence of an ICT Powerhouse. *Global Information Technology Report 2005–2006.* Hampshire: Palgrave Macmillan. pp. 89–105.

López-Claros, A. and Yasmina Mata. 2009. The Innovation Capacity Index: Factors, Policies, and Institutions Driving Country Innovation. *The Innovation for Development Report 2009–2010.* Palgrave Macmillan. pp. 3–65.

Mauro, Paulo. 1995. Corruption and Growth, *The Quarterly Journal of Economics* (August):681–712.

Onodera, Osamu and Earl Kim Hann. 2008. Case Study 2: Trade and Innovation in the Korean Information and Communications Technology Sector. OECD, Paris.

Organisation for Economic Co-operation and Development (OECD). 2000. *A New Economy? The Changing Role of Innovation and Information Technology in Growth. Paris: OECD.*

———. 2008. Handbook on Constructing Composite Indi-

cators: Methodology and User Guide. Paris: OECD.

———. 2009. Economic Survey: Israel. Paris.

———. 2010. Economic Survey: China. Paris.

OECD and European Communities. 2005. *Oslo Manual: Guidelines for Collecting and Interpreting Innovation data.* Joint Publication of the OECD and the Statistical Office of the European Communities.

OECD and European Community Joint Research Centre. 2008. *Handbook on Constructing Composite Indicators: Methodology and User Guide.* Geneva.

Oregon Innovation Council. 2007. Innovation Index Oregon 2007. Oregon Innovation Council. Available at: http://www.oregoninc.org

Pavlidis, P. and W. S. Noble. 2001. Analysis of strain and regional variation in gene expression in mouse brain. *Genome Biology* 2. Research 0042.1-0042.15.

Porter, Michael. 1990. *The Competitive Advantage of Nations.* New York: The Free Press.

Rostow, W. W. 1960. *The Stages of Economic Growth.* Cambridge, MA: Cambridge University Press.

Saeed, A. I., V. Sharov, J. White, J. Li, W. Liang, N. Bhagabati, J. Braisted, M. Klapa, T. Currier, M. Thiagarajan, A. Sturn, M. Snuffin, A. Rezantsev, D. Popov, A. Ryltsov, E. Kostukovich, I. Borisovsky, Z. Liu, A. Vinsavich, V. Trush, and J. Quackenbush. 2003. TM4: A free, open-source system for microarray data management and analysis. *Biotechniques* 34(2):374–8. Available at: http://www.tm4.org/mev.html

Sala-i-Martin, Xavier and Elsa Artadi. 2004. The Global Competitiveness Index. *The Global Competitiveness Report 2004–2005.* Hampshire: Palgrave Macmillan. pp. 51–80.

Sells, Michael. 1999. *Approaching the Qur'an.* Ashland, OR: White Cloud Press.

Sen, Amartya. 1999. *Development as Freedom.* Oxford University Press.

———. 2009. Adam Smith's market never stood alone. *Financial Times*. 11 March.

Shiller, Robert. 2009. A failure to control the animal spirits. *Financial Times.* 9 March.

Siegle, Joseph T., Michael W. Weinstein, and Morton H. Halperin. 2004. Why Democracies Excel. *Foreign Affairs* 83(5 September/October):57–71.

Smith, Adam. 1994. *An Inquiry into the Nature and Causes of the Wealth of Nations.* New York: The Modern Library Edition.

Transparency International. 2009. *Corruption Perceptions Index 2009*. Annual Report. Berlin.

United Nations. 2005. Global E-Government Readiness Report 2005: From E-Government to E-Inclusion. New York.

United Nations Development Programme (UNDP). Various years. *The Human Development Report*. Available at: www.undp.org

———. *Gender Empowerment Measure* (GEM). Available at: www.undp.org

———. *Gender-related Development Index* (GDI). Available at: www.undp.org

United States Patent and Trademark Office. Available at: http://www.uspto.gov/

Wei, Shang-Jin. 1997. How Taxing Is Corruption on International Investors? NBER Working Paper No. 6030. Cambridge, MA.

World Bank. 2005. Country Policy and Institutional Assessments: 2005 Assessment Questionnaire. Operations Policy and Country Services. 20 December. Available at: http://www.worldbank.org

———. 2009. *Global Economic Prospects: Commodities at the Crossroads 2009*. Washington, DC.

———. 2010a. *World Development Indicators*. Washington DC. Available at: http://web.worldbank.org

———. 2010b. *Doing Business Report*. World Bank and International Finance Corporation, Washington, DC.

Appendix. Innovation Capacity Index: Variable definitions

Variable	Source	Definition (as described by source) [41]
Pillar 1: Institutional environment		
Good governance		
Voice and accountability	World Governance Institute (WGI)—World Bank	Aggregate indicator. Measures the extent to which country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media.
Political stability	WGI	Aggregate indicator. Measures the perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including domestic violence and terrorism.
Government effectiveness	WGI	Aggregate indicator. Measures the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.
Rule of law	WGI	Aggregate indicator. Measures the extent to which agents have confidence in and abide by the rules of society, in particular the quality of contract enforcement, the police, and the courts, as well as the likelihood of crime and violence.
Property rights framework	Aggregate indicator	It is the average of the following aggregate indicators: "Property rights" and "Enforcing contracts."
Property rights	World Bank and WEF	The value of this indicator is given preferentially by the World Bank "Country Policy and Institutional Assessment (CPIA) property rights and rule-based governance" ratings. This criterion assesses the extent to which private economic activity is facilitated by an effective legal system and rule-based governance structure in which property and contract rights are reliably respected and enforced. Each of three dimensions is rated separately: (a) legal basis for secure property and contract rights; (b) predictability, transparency, and impartiality of laws and regulations affecting economic activity, and their enforcement by the legal and judicial system; and (c) crime and violence as an impediment to economic activity. For those countries without this rating, an estimate was made using the World Economic Forum's (WEF) Executive Opinion Survey (EOS) data on property rights and intellectual property protection.
Enforcing contracts	DBR	Average of the three scores corresponding to the World Bank's *Doing Business Report* (DBR) enforcing contracts variables: "number of procedures," "time," and "cost." Indicators on enforcing contracts measure the efficiency of the judicial system in resolving a commercial dispute. The data are collected by studying the codes of civil procedure and other court regulations as well as surveys completed by local litigation lawyers (and, in a quarter of the countries, by judges as well). A procedure is defined as any interaction between the parties, or between them and the judge or court officer. This includes steps to file the case, steps for trial and judgment and steps necessary to enforce the judgment. Time is recorded in calendar days, counted from the moment the plaintiff files the lawsuit in court until payment. This includes both the days when actions take place and the waiting periods between. The respondents make separate estimates of the average duration of different stages of dispute resolution: the completion of service of process (time to file the case), the issuance of judgment (time for the trial and obtaining the judgment) and the moment of payment (time for enforcement). Cost is recorded as a percentage of the claim, assumed to be equivalent to 200 percent of income per capita. Only official costs required by law are recorded, including court and enforcement costs and average attorney fees where the use of attorneys is mandatory or common.
Transparency and judicial independence	World Bank and WEF	The value of this indicator is given preferentially by the World Bank CPIA "transparency, accountability, and corruption in the public sector" ratings. This criterion assesses the extent to which the executive can be held accountable for its use of funds and the results of its actions by the electorate and by the legislature and judiciary, and the extent to which public employees within the executive are required to account for the use of resources, administrative decisions, and results obtained. Each of these three dimensions was rated separately with equal weighting: (a) the accountability of the executive to oversight institutions and of public employees for their performance; (b) access of civil society to information on public affairs; and (c) state capture by narrow vested interests. For those countries without this rating, an estimate was made using the WEF's EOS ratings on "transparency of government policy making," "judicial independence," and "diversion of public funds."

[41] The variable definitions provided here reflect, for the most part, those provided by the compiling organizations themselves.

Variable	Source	Definition (as described by source) [41]
Pillar 1: Institutional environment		
Corruption Perceptions Index	Transparency International (TI)	A country or territory's corruptions perception index score indicates the degree of public sector corruption as perceived by business people and country analysts, and ranges between 10 (highly clean) and 0 (highly corrupt).
Country policy assessment		
Public sector management		
Quality of budgetary and financial management	World Bank, WEF and *Institutional Investor* magazine Country Credit Survey	This indicator is the average of two components: a quality of budgetary and financial management score, as described below, and a credit rating score. The value of the first part of this indicator is given preferentially by the World Bank CPIA "quality of budgetary and financial management" ratings. This criterion assesses the extent to which there is: (a) a comprehensive and credible budget, linked to policy priorities; (b) effective financial management systems to ensure that the budget is implemented as intended in a controlled and predictable way; and (c) timely and accurate accounting and fiscal reporting, including timely and audited public accounts and effective arrangements for follow up. Each of these three dimensions was rated separately. For those countries without this rating, an estimate was made using the WEF's EOS "wastefulness of government spending" ratings. For the credit rating score the country-by-country credit ratings developed by the Institutional Investor magazine were used. These are based on information provided by senior economists and sovereign-risk analysts at leading global banks and money management and securities firms. They have graded each country on a scale of zero to 100, with 100 representing those countries that have the least chance of default. Participants are not permitted to rate their home countries. The individual credit responses are weighted using an institutional investor formula that gives more importance to responses from institutions with greater worldwide exposure and more-sophisticated country analysis systems.
Quality of public administration	World Bank and WEF	The value of this indicator is given preferentially by the World Bank CPIA "quality of public administration" ratings. This criterion assesses the extent to which civilian central government staffs (including teachers, health workers, and police) are structured to design and implement government policy and deliver services effectively. Civilian central government staffs include the central executive together with all other ministries and administrative departments, including autonomous agencies. It excludes the armed forces, state-owned enterprises, and sub-national government. The key dimensions for assessment are: policy coordination and responsiveness; service delivery and operational efficiency; merit and ethics; pay adequacy and management of the wage bill. For those countries without this rating, an estimate was made using the "favoritism in decisions of government officials" and "public trust of politicians" ratings of the WEF's EOS.
Structural policies		
Financial sector efficiency	World Bank and WEF	The value of this indicator is given preferentially by the World Bank CPIA "financial sector" ratings. This criterion assesses the structure of the financial sector and the policies and regulations that affect it. Three dimensions are covered: (a) financial stability; (b) the sector's efficiency, depth, and resource mobilization strength; and (c) access to financial services. These are areas that are fundamental to support successful and sustainable reforms and development. The first dimension assesses the sector's vulnerability to shocks, the banking system's soundness, and the adequacy of relevant institutional elements, such as the degree of adherence to the base core principles and the quality of risk management and supervision. The second dimension assesses efficiency, the degree of competition, and the ownership structure of the financial system, as well as its depth and resource mobilization strength. The third dimension covers institutional factors, (such as the adequacy of payment and credit reporting systems) the regulatory framework affecting financial transactions (including collateral and bankruptcy laws and their enforcement) and the extent to which consumers and firms have access to financial services. For those countries without this rating, an estimate was made using the "financial market sophistication," "venture capital availability" and "ease of access to loans" ratings from the WEF's EOS.

Variable	Source	Definition (as described by source) [41]
Pillar 1: Institutional environment		
Trade openness	World Bank World Trade Indicators (WTI)	TTRI, *Trade Tariff Restrictiveness Index,* (MFN applied tariff) - all goods. This Index summarizes the impact of each country's non-discriminatory trade policies on its aggregate imports. It is the uniform equivalent tariff that would maintain the country's aggregate import volume at its current level (given heterogeneous tariffs). It captures the trade distortions that each country's MFN (most favored nation) tariffs impose on its import bundle using estimated elasticities to calculate the impact of a tariff schedule on a country's imports. These measures are based on actual or current trade patterns and thus do not capture restrictions facing new or potential trade. They also do not take into account domestic subsidies or export taxes. Expressed as a tariff rate.
Foreign direct investment gross inflows	UN Conference on Trade and Development (UNCTAD)	Definitions of Foreign direct investment (FDI) used by the UNCTAD WIR are contained in the Balance of Payments Manual: Fifth Edition (BPM5) (Washington, D.C., International Monetary Fund, 1993) and the Detailed Benchmark Definition of Foreign Direct Investment: Third Edition (BD3) (Paris, Organisation for Economic Co-operation and Development, 1996). According to the BPM5, FDI refers to an investment made to acquire lasting interest in enterprises operating outside of the economy of the investor. Further, in cases of FDI, the investor's purpose is to gain an effective voice in the management of the enterprise. Expressed as percent of GDP.
Macroeconomy		
Debt levels	Eurostat, IMF *World Economic Outlook* (WEO), IMF Country Reports, and CIA World Fact Book	Gross debt comprises the stock (at year-end) of all government gross liabilities (both to residents and non-residents), in percent of GDP. To avoid double counting, the data are based on a consolidated account (eliminating liabilities and assets between components of the government, such as budgetary units and social security funds). General government reflects a consolidated account of central government plus state, provincial, or local governments.
Fiscal balance	IMF World Economic Outlook (WEO), IMF Country Reports, Eurostat	Cash deficit/surplus, defined as revenue (including grants) minus expenditures, minus net acquisition of non-financial assets, in percent of GDP. For most countries, general government; in a few cases, central government.
Macro stability	International Financial Statistics (IFS), IMF WEO and Country Reports	This value is the weighted average of these three scores: "inflation," "interest rate spread," and "national savings rate." The average interest rate spread measures the difference between market short-term lending and deposit rates as published in the IMF's International Financial Statistics and Country Reports. The national savings rate is the share of GDP saved by households within the year. Consumer prices are annual percentage changes in the CPI; we use averages for the year, not end-of-period data.

Variable	Source	Definition (as described by source) [41]
Pillar 2: Human capital, training and social inclusion		
Good governance		
Education		
Adult literacy rate	*UN Human Development Report* (HDR)	The proportion of the adult population aged 15 years and older which is literate, expressed as a percentage of the corresponding population in a given country, territory, or geographic area, at a specific point in time, usually mid-year.
Secondary gross enrolment ratio	World Bank WDI	Number of pupils enrolled in a given level of education, regardless of age, expressed as a percentage of the population in the theoretical age group for the same level of education.
Tertiary gross enrolment ratio	World Bank WDI	Number of pupils enrolled in a given level of education, regardless of age, expressed as a percentage of the population in the theoretical age group for the same level of education. For the tertiary level, the population used is the five-year age group following on from the secondary school-leaving age.

Variable	Source	Definition (as described by source) [41]
Pillar 2: Human capital, training and social inclusion		
Expenditure in education	UN HDR	Public spending in education includes both capital expenditures (spending on construction, renovation, major repairs and purchases of heavy equipment or vehicles) and current expenditures (spending on goods and services that are consumed within the current year and which must be renewed the following year, including such expenditures as staff salaries and benefits, contracted or purchased services, books and teaching materials, welfare services, furniture and equipment, minor repairs, fuel, insurance, rents, telecommunications, and travel). Expressed in percent of GDP.
Social inclusion and equity policies		
Gender equity	UN HDR	The value of this indicator is given preferentially by the United Nations (UN) *Human Development Report* (HDR) "Gender Empowerment Measure" (GEM), a composite index measuring gender inequality in three basic dimensions of empowerment: economic participation and decisionmaking, political participation, and decision making and power over economic resources. For those countries without this value, an estimate was made using the UN HDR "Gender-Related Development Index" (GDI), measuring average achievement in the three basic dimensions captured in the human development index: a long and healthy life, knowledge, and a decent standard of living, adjusted to account for inequalities between men and women.
Environmental sustainability	2010 Environmental Performance Index	The 2010 Environmental Performance Index (EPI) ranks 163 countries on 25 indicators tracked across ten policy categories covering both environmental health and ecosystem vitality: environmental burden of disease, air pollution (effects on humans), water (effects on humans), air pollution (effects on ecosystem), water (effects on ecosystem), biodiversity and habitat, forestry, fisheries, agriculture, and climate change. The EPI identifies broadly accepted targets for environmental performance and measures how close each country comes to these goals. As a quantitative gauge of pollution control and natural resource management results, the Index provides a powerful tool for improving policymaking and shifting environmental decision making onto firmer analytic foundations.
Health worker density	World Bank WDI	It is calculated as a weighted average of the number of physicians, nurses, and midwives per 1000 people. Physicians are defined as graduates of any facility or school of medicine who are working in the country in any medical field (practice, teaching, research), including generalists and specialists. Nurses include professional, auxiliary, and enrolled nurses and others, such as those in dental and primary care. Midwives include professional, auxiliary, and enrolled midwives.
Inequality measure	World Bank WDI	The ratio of the income or expenditure share of the richest 20 percent group to that of the poorest 20 percent.

Variable	Source	Definition (as described by source) [41]
Pillar 3: Regulatory and legal framework		
Doing business		
Starting a business		
Number of procedures	DBR (*Doing Business Report*)	A procedure is defined as any interaction of the company founder with external parties (for example, government agencies, lawyers, auditors, or notaries). Includes procedures to legally start and operate a company, preregistration (name verification, notarization), registration in the economy's most populous city, and post-registration (social security registration, company seal)
Time	DBR	Time in days required to complete each procedure. It does not include time spent gathering information. Each procedure starts on a separate day. It is considered completed once final document is received. No prior contact with officials is needed. If a procedure can be accelerated for an additional cost, the fastest procedure is chosen.

Variable	Source	Definition (as described by source) [41]
Pillar 3: Regulatory and legal framework		
Cost	DBR	Cost as percent of income per capita required to complete each procedure: official costs only, no bribes, and no professional fees, unless these services are required by law.
Ease of employing workers		
Ease of employing workers	DBR	This value is the average of these three DBR employing worker scores: "difficulty of hiring index," "rigidity of hours index," and "difficulty of redundancy index." The difficulty of hiring index measures whether fixed-term contracts are prohibited for permanent tasks, the maximum cumulative duration of fixed-term contracts, and the ratio of the minimum wage for a trainee or first-time employee to the average value added per worker. The rigidity of hours index has five components: whether night or weekend work is unrestricted, whether the workweek can consist of 5.5 days; whether the workweek can extend to 50 hours or more (including overtime) for two months a year to respond to a seasonal increase in production; and whether paid annual vacation is 21 working days or fewer. The difficulty of redundancy index has 8 components: (i) whether redundancy is disallowed as a basis for terminating workers; (ii) whether the employer needs to notify a third party (such as a government agency) to terminate 1 redundant worker; (iii) whether the employer needs to notify a third party to terminate a group of 9 redundant workers; (iv) whether the employer needs approval from a third party to terminate 1 redundant worker; (v) whether the employer needs approval from a third party to terminate a group of 9 redundant workers; (vi) whether the law requires the employer to reassign or retrain a worker before making the worker redundant; (vii) whether priority rules apply for redundancies; and (viii) whether priority rules apply for reemployment.
Paying taxes		
Paying taxes	Aggregate indicator	This value is the average of these three DBR paying taxes scores: "number of payments per year," "hours per year," and "total tax rate." The tax payments indicator reflects the total number of taxes and contributions paid per year, the method of payment, the frequency of payment, and the number of agencies involved for this standardized case during the second year of operation. Time is recorded in hours per year. The indicator measures the time to prepare, file, and pay (or withhold) three major types of taxes and contributions: the corporate income tax, value added or sales tax and labor taxes, including payroll taxes and social contributions. Includes collecting information to compute tax payable, completing tax forms, filing with proper agencies, arranging payment or withholding, and preparing separate tax accounting books. The total tax rate measures the amount of taxes and mandatory contributions payable by the business in the second year of operation, expressed as a share of commercial profits. Includes: profit or corporate income tax, social contributions and labor taxes paid by the employer, property and property transfer taxes, dividend, capital gains, and financial transactions taxes, waste collection, vehicle, road, and other taxes.
Protecting investors		
Strength of investor protection	DBR	Strength of investor protection index: The average of the extent of the "disclosure," "extent of director liability," and "ease of shareholder suits" indexes.
Registering property		
Number of procedures	DBR	Procedures to legally transfer title on real property, including: preregistration (checking for liens, notarizing sales agreement), registration in the economy's most populous city, and post-registration (paying taxes, filing title with municipality).
Time	DBR	Time in days required to complete each procedure for registering property. Does not include time spent gathering information. Each procedure starts on a separate day. A procedure is considered completed once final document is received. No prior contact with officials is needed.
Cost	DBR	Cost is recorded as a percentage of the property value, assumed to be equivalent to 50 times income per capita. Only official costs required by law are recorded, including fees, transfer taxes, stamp duties, and any other payment to the property registry, notaries, public agencies, or lawyers.

Variable	Source	Definition (as described by source) [41]
Pillar 4: Research and development		
R&D infrastructure		
Research and development expenditure	World Bank WDI	Current and capital expenditures (including overhead) on creative, systematic activity intended to increase the stock of knowledge. Included are fundamental and applied research and experimental development work leading to new devices, products, or processes. Expressed as percent of GDP.
Information and communication technology expenditure	World Bank WDI	Includes 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. Expressed as percent of GDP.
R&D worker density	World Bank WDI	It is calculated as a weighted average of the number of researchers and technicians in R&D per million people. Researchers are people trained to work in any field of science who are engaged in professional research and development activity, usually requiring the completion of tertiary education. Technicians in R&D are people engaged in professional R&D activity, who have received vocational or technical training (usually three years beyond the first stage of secondary education) in any branch of knowledge or technology of a specified standard.
Students in science and engineering	World Bank WDI, UN HDR	Students in science, engineering, manufacturing, and construction: The share (percent) of tertiary students enrolled in natural sciences, engineering; mathematics, and computer sciences, architecture and town planning, transport and communications, trade, craft, and industrial programmes, and agriculture, forestry, and fisheries.
Scientific and technical journal articles	World Bank WDI	Scientific and engineering technical journal articles per million people published in the following fields: physics, biology, chemistry, mathematics, clinical medicine, biomedical research, engineering and technology, and earth and space sciences.
Schools connected to the Internet	World Bank WDI	Schools connected to the Internet are the share (percent) of primary and secondary schools in the country that have access to the Internet.
Patents and trademarks		
Patents granted to residents	*Trilateral Cooperation Statistical Report* (TCSR)	Patents are documents issued by a government office that grant a set of exclusive rights for exploitation (made, used, sold, and imported) of an invention to an inventor or his assignee for a fixed period of time, in exchange for the disclosure and description of the invention. The data correspond to patents granted by the US Patent and Trademark Office (USPTO), European Patent Office (EPO), Japan Patent Office (JPO), Korean Intellectual Property Office (KIPO), or State Intellectual Property Office of the People's Republic of China (SIPO). Data for each country represent the highest number of patents granted from either office, according to the current TCSR. Data are per million people.
Trademark applications filed by residents	World Bank WDI	A trademark is any distinctive word, sign, indicator, or a combination of these used by an individual, business organization, or other legal entity to identify that the products and/or services with this trademark have the same origin, and to distinguish them from others in the marketplace or trade. An application for registration of a trademark must be filed with the appropriate national or regional trademark office. Data are per million people.
Receipts of royalty and license fees	World Bank WDI	Receipts between residents and non-residents for the authorized use of intangible, non-produced, non-financial assets and proprietary rights (such as patents, trademarks, copyrights, franchises, and industrial processes) and for the use, through licensing agreements, of produced originals of prototypes (such as films and manuscripts). Data are based on the balance of payments and are on a current US$ per person basis.
Payment of royalty and license fees	World Bank WDI	Payments between residents and non-residents 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). Data are in current US$ per person and are derived from the balance of payments.

Variable	Source	Definition (as described by source) [41]
Pillar 5: Adoption and use of information and communication technologies		
Telephone Communications		
Main (fixed) telephone lines	International Telecommunication Union (ITU)	A main line is a (fixed) telephone line connecting the subscriber's terminal equipment to the public switched network, and having a dedicated port in the telephone exchange equipment. This term is synonymous with the terms main station or Direct Exchange Line (DEL) commonly used in telecommunication documents. It may not be the same as an access line or a subscriber. The number of ISDN channels and fixed wireless subscribers should be included. Data are expressed per 100 inhabitants.
Waiting list for main (fixed) lines	ITU	Unmet applications for connection to the Public Switched Telephone Network (PSTN) due to a lack of technical facilities (equipment, lines, etc.). The waiting list should reflect the total number reported by all PSTN service providers in the country. Data are expressed per 1000 inhabitants.
Business connection charge	ITU	Installation (or connection) refers to the one-off charge involved in applying for business basic telephone service. Where there are different charges for different exchange areas, the charge for the largest urban area should be used and specified in a note. Data are expressed as percent of GDP/capita.
Business monthly subscription	ITU	Monthly subscription refers to the recurring fixed charge for a business subscription to the PSTN. The charge should cover the rental of the line but not the rental of the terminal (e.g., telephone set) where the terminal equipment market is liberalized. Separate charges for first and subsequent lines should be stated where appropriate. If the rental charge includes any allowance for free or reduced rate call units, this should be indicated. If there are different charges for different exchange areas, the largest urban area should be used and specified in a note. Data are expressed as percent of GDP/capita.
Residential connection charge	ITU	Installation (or connection) refers to the one-off charge involved in applying for residential basic telephone service. Where there are different charges for different exchange areas, the charge for the largest urban area should be used and specified in a note. Data are expressed as percent of GDP/capita.
Residential monthly subscription	ITU	Monthly subscription refers to the recurring fixed charge for a residential subscription to the PSTN. The charge should cover the rental of the line, but not the rental of the terminal (e.g., telephone set) where the terminal equipment market is liberalized. Separate charges for first and subsequent lines should be stated where appropriate. If the rental charge includes any allowance for free or reduced rate call units, this should be indicated. If there are different charges for different exchange areas, the largest urban area should be used and specified in a note. Data are expressed as percent of GDP/capita.
Mobile cellular communications		
Subscribers	ITU	Refers to the use of portable telephones subscribing to a public mobile telephone service and provides access to Public Switched Telephone Network (PSTN) using cellular technology. This can include analog and digital cellular systems. This should also include subscribers to IMT-2000 (Third Generation, 3G). Subscribers to public mobile data services or radio paging services should not be included. Data are per 100 inhabitants.
Prepaid subscribers	ITU	Number of mobile cellular subscribers using prepaid cards. These are subscribers who, rather than paying a fixed monthly subscription fee, choose to purchase blocks of usage time. Only active prepaid subscribers who have used the system within a reasonable period of time should be included. This period (e.g., 3 months) should be indicated in a note. Data are per 100 inhabitants.
Population coverage	ITU	Mobile cellular coverage of population in percent. This indicator measures the percentage of inhabitants who are within range of a mobile cellular signal, irrespective of whether or not they are subscribers. This is calculated by dividing the number of inhabitants within range of a mobile cellular signal by the total population. Note that this is not the same as the mobile subscription density or penetration.
Connection charge	ITU	The initial, one-time charge for a new subscription. Refundable deposits should not be counted. Although some operators waive the connection charge, this does not include the cost of the Subscriber Identity Module (SIM) card. The price of the SIM card should be included in the connection charge. A note should indicate whether taxes are included (preferred) or not. It should also be noted if free minutes are included in the plan. Data are expressed as percent of GDP/capita.

Variable	Source	Definition (as described by source) [41]
Pillar 5: Adoption and use of information and communication technologies		
Internet, computers, and TV		
Total fixed internet subscribers	ITU	The number of total Internet subscribers with fixed access, including dial-up, total fixed broadband, cable modem, DSL Internet, other broadband, and leased line Internet subscribers. Only active subscribers who have used the system within a reasonable period of time should be included. This period (e.g., 3 months) should be indicated in a note. Data are per 100 inhabitants.
Total fixed broadband subscribers	ITU	Total Internet subscribers excluding dial-up Internet: cable-modem (cable TV), DSL, leased line, and others (satellite, fibre, LAN, wireless, wimax...). Total broadband Internet subscribers refers to a subscriber who pays for high-speed access to the public Internet (a TCP/IP connection), at speeds equal to, or greater than, 256 kbit/s, in one or both directions. If countries use a different definition of broadband, this should be indicated in a note. This total is measured irrespective of the method of payment. It excludes subscribers with access to data communications (including the Internet) via mobile cellular networks. Data are per 100 inhabitants.
Internet users	ITU	The estimated number of Internet users per 100 inhabitants. A growing number of countries are measuring this through regular surveys. Surveys usually indicate a percentage of the population for a certain age group (e.g., 15–74 years old). The number of Internet users in this age group should be supplied and not the percentage of Internet users in this age group multiplied by the entire population. In situations where surveys are not available, an estimate can be derived based on the number of subscribers. The methodology used should be supplied, including reference to the frequency of use (e.g., in the last month).
Personal computers	ITU	The number of Personal Computers (PC) measures the number of computers installed in a country per 100 inhabitants. The statistic includes PCs, laptops, notebooks etc., but excludes terminals connected to mainframe and minicomputers that are primarily intended for shared use, and devices such as smartphones that have only some, but not all, of the functions of a PC (e.g., they may lack a full sized keyboard, a large screen, an Internet connection, drives, etc).
Television receivers	ITU	The total number of television sets per 100 inhabitants. A television set is a device capable of receiving broadcast television signals, using popular access means such as over-the-air, cable, and satellite. A television set may be a stand-alone device, or it may be integrated into another device, such as a computer or a mobile phone. It may be useful to distinguish between digital and analog signal delivery and between TV sets receiving only a limited number of signals (usually over-the-air) and those that have multiple channels available (e.g., by satellite or cable).
Government ICT usage		
E-government readiness index	UN Global E-*Government Readiness Report*	E-government readiness is a composite index comprising the Web measure index, the telecommunication infrastructure index and the human capital index. E-government is defined as the use of ICT and its application by the government for the provision of information and public services to the people. The aim of e-government therefore is to provide efficient government management of information to the citizen, better service delivery to citizens, and empowerment of the people through access to information and participation in public policy decision making.
Quality of the infrastructure		
Electrification rate	UN HDR	The number of people with electricity access as a percentage of the total population.
Electric power transmission and distribution losses	World Bank WDI	Electric power transmission and distribution losses include losses in transmission between sources of supply and points of distribution and in the distribution to consumers, including pilferage. It is expressed as percent of output.
Roads paved	World Bank WDI	Paved roads are those surfaced with crushed stone (macadam) and hydrocarbon binder or bituminized agents, with concrete, or with cobblestones, as a percentage of all the country's roads, measured in length.