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Innovation, Productivity, and Growth in Costa Rica

Challenges and Opportunities

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Institutions for Development Sector

Competitiveness and Innovation Division

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Abstract[*]

This technical note presents a detailed review of Costa Rica's recent innovation policy. It discusses how far Costa Rica is from having innovation ecosystems (human networks that generate extraordinary creativity and output on a sustainable basis), and shows that the low innovative capacity of Costa Rican firms explains their low productivity, which in turn determines the moderate level of economic growth in the country. Among the main challenges that Costa Rica faces in moving toward an innovation-based economy, according to the evidence presented herein, is the low level of investment in research and development (R&D). Strengthening Costa Rican innovation ecosystems, creating closer linkages between SMEs and large companies including multinationals, in addition to increasing the domestic value-added of SME exports, and reduction (or even better, elimination) of the principal obstacles to the growth of companies, must be part of an innovation policy agenda. Costa Rica's economic success will depend on how well it can design and implement policies and programs that lead toward achievement of an innovation-driven economy in the near future.

JEL Codes: O31, O32, O4
Keywords: innovation, productivity, growth, research and development, investment, export, multinationals, SMEs, ecosystems.

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EXECUTIVE SUMMARY

This paper presents a review of Costa Rica's innovation policy, following the format for analysis suggested by Devlin, Daly, and Evertsen (2013). It discusses how far Costa Rica is from having innovation ecosystems, which, as defined by Hwang and Horowitt (2012), are human networks that generate extraordinary creativity and output on a sustainable basis. Based on the results of the present study, potential target sectors for vertical policies are suggested and strategies are recommended for overcoming the transaction costs that prevent Costa Rica from developing enduring innovation ecosystems.

Innovation is important for attaining high and sustained economic growth, and as international experience has shown, it is part of a pattern of growth and structural transformation that leads to rapid and sustained technological change and productivity growth, the generation of more and better jobs, more sophisticated occupational structures, and employment patterns that result in rising incomes and in poverty reduction (Nübler 2014). All these goals are already included in the National Development Plan developed by Costa Rican authorities.

Since the mid-1980s, Costa Rica has followed a growth model based on both promotion of domestic export activities and the attraction of foreign direct investment (FDI) in high-technology sectors. These efforts have allowed the country to progressively shift its export composition from primary products to high-tech manufacturing and more sophisticated services (Mulder, 2014). In addition, the country has achieved significant improvements in the living conditions of its citizens, as documented in international sources such as the Social Progress Index, where Costa Rica at 28th among 133 nations, ranks among countries with high levels of social progress.

Notwithstanding these achievements, the Costa Rican economy is not yet led by innovation, but is in a transitional stage toward this goal (World Economic Forum, 2013). As shown in this paper, the Costa Rican economy's growth is based mainly on the accumulation of productive factors (labor and capital) and not on significant increases in efficiency and productivity in the use of these factors. Furthermore, in terms of productivity (as well as in income per capita) Costa Rica is falling behind the most technologically developed countries and other emerging countries, some of them in Latin America.

This paper shows that the low innovative capacity of Costa Rican firms explains the low productivity that in turn determines the moderate level of economic growth in the country. Sustained high rates of economic growth depend not only on accumulation of

factors of production, but also on the continuous incorporation of technology and knowledge into the production processes—that is, innovation).

The empirical evidence for Costa Rica shows that the most productive firms are those that grow more quickly (Monge-González and Torres-Carballo, 2014b). Unfortunately, the number of firms exhibiting levels of productivity comparable to those of their international competitors is very small. At the same time, larger companies as well as younger ones are driving the growth of productivity. In other words, the majority of small firms exhibit lower productivity levels. Because these smaller companies account for a very important share of the total number of firms, the productivity of the economy as a whole is low. There also exists a wide dispersion in the productivity of the Costa Rican companies, both between sectors and between companies of different sizes operating within the same sector. Thus, small and medium-sized enterprises (SMEs) show the larger dispersion in productivity in this economy, as do those in the service sector.

These results highlight the need for public policies that address the problem of structural dualism in the Costa Rican economy—that is, the coexistence of one modern and dynamic sector (exporters) and another sector mainly composed of SMEs, which are unable to benefit from the opportunities provided by integration into the international economy.

Costa Rican authorities have developed programs to support the development of SMEs. However, empirical evidence shows the importance of improving the efficiency of these programs and coordination between them, focusing efforts on supporting younger companies with high growth potential (Monge-González et al., 2010) and ensuring increases in the efficiency of resource allocation from less productive to more productive firms. Based on existing empirical evidence, it is expected that this policy mix will positively affect firms' growth rates, and thereby generate more and better jobs in Costa Rica's economy (Monge-González et al., 2011).

As indicated previously, Costa Rica's economic development model is based on integration into international markets through direct exports and FDI inflows. The empirical evidence, discussed below, shows that a Costa Rican exporter or local company linked to multinationals is more likely to achieve high levels of productivity than a firm without access to such catalysts (Monge-González and Torres-Carballo, 2014a). These results seem to be associated with the existence of technology transfers and knowledge spillovers from the linkage of local companies with high-tech multinational corporations (MNCs) operating in the country, and with the possibility of learning by exporting, in which local firm

performance improves after entering export markets (De Loecker, 2007 and 2013). Unfortunately, the participation of local firms in exports and in linkages with high-tech MNCs operating in the country is still relatively low (Monge-González and Torres-Carballo, 2014b). There is space to improve the participation of local firms in these two types of international activities (exports and FDI), by focusing mostly on increasing the domestic value-added of exports by SMEs and the integration of these firms into global value chains through stronger linkages with MNCs.

Among the main challenges that Costa Rica faces in moving toward an innovation-based economy, according to the evidence presented in this paper, is the low level of investment in research and development (R&D) (0.57 percent of GDP). This is surprising for two reasons. First, the social rate of return on investment in R&D is relatively high in Costa Rica (34 percent, compared to a 6 percent return on investment in physical capital). Second, there is evidence of a strong relationship between R&D expenditures and a country's productivity (TFP) as well as between R&D expenditure and GDP per capita. Indeed, given Costa Rica's GDP per capita and the social rate of return on R&D investment, the optimal level of this type of investment should be 2.53 percent of GDP. In other words, Costa Rica should invest five times more in R&D than it currently does.

Related to this finding, Costa Rica also lacks a "culture of innovation"—that is, a climate that produces a collective enthusiasm for creativity, and glorifies productive innovators in the same way that great artists or great sportsmen are glorified and that challenges people to take risks without fear of being stigmatized by failure. This lack of an innovation-supporting culture largely explains the country's low number of researchers in per capita terms, as well as its low levels of investment in R&D.

It is important to facilitate the participation of foreign talent in innovative activities undertaken by firms in Costa Rica. Improving the system of recognition of qualifications would promote interaction between foreign experts and national companies in innovative projects. It is equally important to improve the higher educational system: to make it bilingual and to encourage higher-level studies by Costa Ricans in recognized universities worldwide.

Another important challenge Costa Rica faces in becoming an innovation-based economy is the lack of a sufficient stock of human capital (a shortage of scientists, engineers, and technicians) due to deficiencies in coverage and quality of the educational system. These deficiencies have led to a misalignment between educational specializations and the needs of the productive sector.

Other challenges include low levels of collaboration by universities in innovative activities undertaken by businesses; a lack of a culture that offers protection for business´ intellectual property; the underdevelopment of financial instruments to support new ventures and innovations; and the SMEs' lack of access to highly skilled workers by smaller firms.

The last challenge, the lack of financing, is very important. It has two separate origins. First, many companies cannot provide tangible assets as collateral for loans—only intangible assets that are not accepted by banks. Second, the lack of proper balance in public finances drives up the interest rate in the country and makes financing less available for the private sector (the "crowding-out" effect). Firms find that they cannot rely on the financial markets for medium- to long-term lending that supports innovation; they are constrained to rely on self-financing, which may not be generally available.

At the end of this paper it is suggested that strengthening Costa Rican innovation ecosystems, creating closer linkages between SMEs and MNCs, in addition to increasing the domestic value-added of SME exports, and reduction (or even better, elimination) of the principal obstacles to the growth of companies, must be part of an innovation policy agenda. The empirical evidence discussed in the following sections suggests that such an agenda will support growth and employment generation in Costa Rica.

Technology and knowledge incorporation in production processes condition the efficiency and productivity of factors of production and their returns in terms of economic growth. Thus, the economic success of Costa Rica will depend on how well it can design and implement policies and programs that lead toward achievement of an innovation-driven economy in the near future. As a first step in this direction, Kang and Bullon (2015) suggest implementing institutional reforms that promote the capacity for innovation in Costa Rica. These reforms should cover three areas: (i) reinforcing organizations, (ii) formulating policies, and (iii) building governance structure. It would be advisable to improve the institutional framework of the Presidential Council on Competitiveness and Innovation (PCCI), following the recommendations of Ortega (2013), creating a body capable of carrying out the design, implementation, and monitoring of the required tasks. In other words, a restructuring of the PCCI must strengthen political leadership and horizontal coordination, and should also improve its diagnostic capabilities (Organisation for Economic Co-Operation and Development (OECD), 2012).

The paper is organized into seven sections. Section 1 describes the imperative to innovate, presenting some of the main findings of the study in this area. Section 2

discusses the recent economic performance of Costa Rica, analyzing the main components of this growth, accumulation of production factors and productivity growth. Section 3 discusses Costa Rica's innovative capacity, taking into account both enablers of innovation and innovation outputs, and contrasting them with those from a comparable group of countries. Section 4 identifies the main innovation stakeholders in the country and discusses their recent performance. Section 5 analyzes public policies for the promotion of innovation in Costa Rica. In short, the discussion covers the process of defining strategies, the rationale of major innovation policies and programs, and the implementation process for such policies and programs. Section 6 identifies potential target sectors for vertical intervention policies, and Section 7 concludes the report with a discussion of main findings and recommendations.

1. THE IMPERATIVE TO INNOVATE

Innovation is a new frontier for Costa Rica. It also is a topic somewhat less in tune with public opinion and policy discourse than other policy objectives, such as poverty reduction, the environment, employment, and even competitiveness. Consequently, mobilization of public policy and resources to promote innovation activities is a political challenge. It is therefore important to understand why innovation is so critical for increasing economic growth and achieving important development goals, such as poverty reduction and employment generation.

Costa Rica is a small economy that has grown throughout its history through its integration into international trade. Its recent economic performance has established it as one of the most prosperous economies in the Latin American region, with a certain degree of macroeconomic stability. However, its growth rate, measured in terms of per capita GDP, has not been high enough and sustained enough to generate the leap in per capita income that would permit the country to reach significant levels of economic and social development. The Costa Rica can only achieve both of these objectives through inclusive and sustained high growth.

Sustained high rates of economic growth depend not only on accumulation of factors of production (labor and capital), but also on the continuous incorporation of technology and knowledge into production processes—that is, innovation. Indeed, technology and knowledge incorporation condition the efficiency and productivity of factors of production and their returns in economic growth. This fact is of utmost importance in the case of Costa Rica, where three-quarters of the growth rate of the economy is explained by the accumulation of factors and one quarter by increases in total factor productivity (TFP).

In short, the accumulation of physical factors, mainly through FDI and the incorporation of more labor, explain most of Costa Rica's economic growth during the past 50 years. From the point of view of productivity, as shown in later sections of this document, Costa Rica shows a tendency to diverge from both the most technologically developed countries and from other Latin American and emerging countries.

Innovation can take the form of use or development of new technologies, new advanced capital goods and services, new worker or management skills, new production processes, new organization, new marketing, among others—all of which affect the productivity of firms. Newness need not be relative to the world as a whole, but can rather be relative to a country, a region, and/or a firm. As will be shown in later sections of this

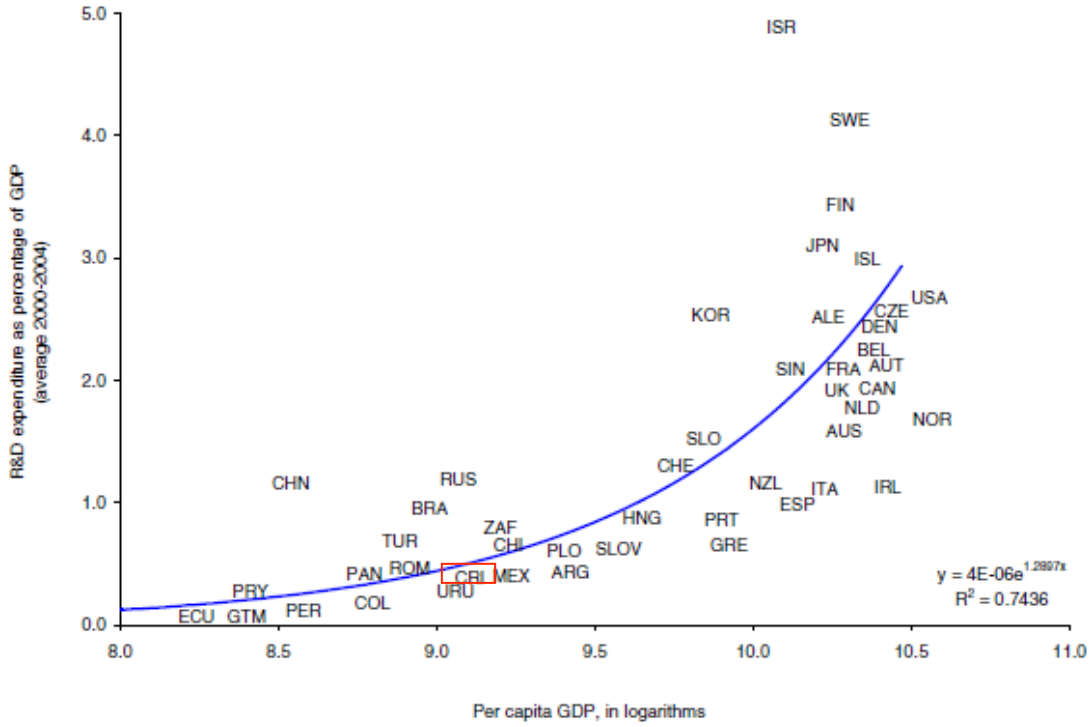
document, it is in these activities that Costa Rica must improve its performance and overcome important challenges.

Innovation is a medium- to long-term investment that will not necessarily yield tangible benefits in the near term. Often a different investment approach and changes in mindsets are required to achieve innovation. Reconfiguring approaches to investment approaches and cultural attitudes to innovation takes time, but there are often opportunities that can be exploited in the near term.

By contrast, technological change in the world economy is very rapid. Costa Rica's relative openness exposes it to many opportunities for incorporation of new knowledge; however, the absorption of new technologies and knowledge is not automatic: it requires development of capabilities and know-how. Costa Rica faces important challenges in building up a strong stock of human capital that allows firms to absorb, create, and disseminate knowledge.

Investments in innovation increase domestic capacity to generate new knowledge or absorb and adapt knowledge generated by others. Some idea of the degree of effort dedicated to innovation can be had by considering expenditures on R&D: there is significant evidence of a strong relationship between R&D expenditures and a country's TFP as well as between R&D expenditure/GDP and GDP per capita (Economic Commission for Latin America and the Caribbean (ECLAC), 2008). As shown in Figure 1.1, investment in R&D in Costa Rica (CRI) is lower than it should be, given its level of per capita.

Figure 1.1 Selected Countries: Innovation Efforts and Per Capita Income

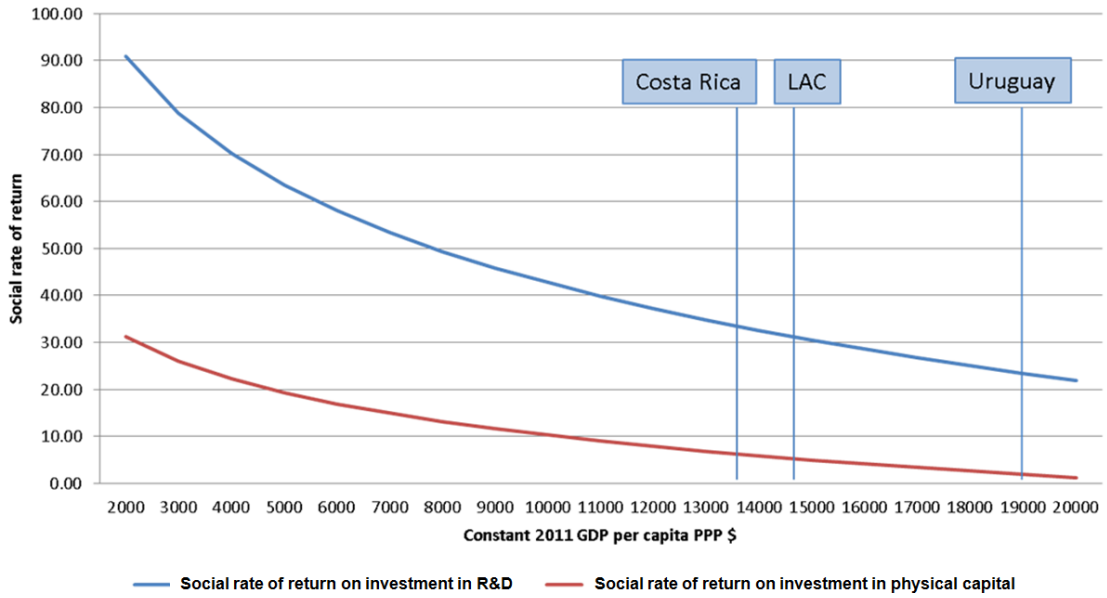


Source: ECLAC (2008).
Note: CRI = Costa Rica.

Lederman and Maloney (2003) found that for many developing countries the social rate of return on R&D expenditures is very high, and that actual investment in R&D in these countries is lower than the optimal level. Following the methodology used by these authors, Figure 1.2 shows new estimations of the social rate of returns on R&D investment and physical capital investment for 2013. The rate of return on R&D for Costa Rica is 34 percent, as compared to a 6 percent return on investment in physical capital.[1] This means that the return on an investment in R&D is almost six times higher than that from investing in physical capital in this country. In addition, given the high rate of return for investment in R&D in Costa Rica, it is striking that the level of R&D investment made in this country (approximately 0.57 percent of GDP in 2014) and the participation of the private sector in this field are as low as they are, as documented later in this paper.

[1] Following Lederman and Maloney (2003), the social rate of return on R&D investment (r^S) is equal to:
And the social rate of return on physical capital investment (r) is equal to:
Because this approach does not incorporate the process of knowledge accumulation, these estimates indicate the lower limit of the real value of social returns (Guaipatin and Schwartz, 2014).

Figure 1.2 Social Returns on R&D and Physical Capital Investment



Source: Author's elaboration based on Lederman and Maloney (2003) and World Bank (2013).
Note: Terms of GDP per capita for the year 2013 expressed in constant 2005 international dollars, based on World Bank, World Development Indicators.

The actual level of investment in R&D in Costa Rica is five times lower than optimal, given its GDP per capita; following Guaipatin and Schwartz's (2014) methodology, the estimated optimal level of investment in R&D for Costa Rica is 2.53 percent of GDP.[2]

Not all innovation needs to be based on formal expenditures on R&D. Importing capital equipment, licensing, worker training, recruitment of more skilled labor, management retooling and efforts to enter (or reposition in) production value chains, exporting new products or old products to new markets, et cetera, can also help to promote innovation. In fact, the literature clearly indicates the importance of the difference between technological innovation (products or processes), and nontechnological innovation (organizational and trading), all of which are valuable in terms of increasing the productivity of businesses. In this context, the opening of the Costa Rican economy has been and is an important factor favoring companies' innovation efforts. In particular, it enables the attraction of high-technology FDI, as well as greater access to foreign inputs with high technological content, which may be used by domestic firms to produce goods and services for sale in the local market and abroad. Given that Costa Rica still has

[2] Following Guaipatin and Schwartz (2014), the optimal rate of R&D investment (s^*) in Costa Rica can be estimated as follows: where s is the actual R&D investment as a percentage of GDP, r^s is the social return on R&D investment, and r the social return on physical capital investment.

important barriers to trade in certain goods and services (e.g., commodities such as rice and sugar), deepening the process of economic openness is a policy step in the right direction for promoting innovation and, therefore, sustained economic growth.

Innovation is a multifaceted concurrent process involving interactions and information search/exchange among private and public stakeholders (entrepreneurs, academia, ministries and their executing agencies, and other relevant agents) that move new ideas to, from, and within the commercial marketplace. This network of actors (which includes international linkages) and its institutional foundations determine the nature of innovation systems at the national, regional, and sectoral levels. The more integrated the system is in terms of the actions of main stakeholders and the alignment of incentives and institutional frameworks, the more conducive the environment is to innovation.

Notwithstanding the importance of innovation for firm productivity and economic growth, it may not occur at a desirable pace and level because many factors that can undermine development of an innovation cultural mindset. The list of factors that may need to be addressed to improve the business climate includes (Devlin, Daly, and Evertsen, 2013):

- Lack of competition (protected markets, monopolistic markets, natural rents, dominant market position with high profits, undemanding clients)
- Magnified economic and/or political uncertainties
- Public regulatory uncertainties/deficiencies (e.g., patent protection, obstacles to approval of new business start-ups)
- Small markets/sunset industries/lack of opportunities
- Difficulties in obtaining returns on innovation
- Lack of access to credit for financing different activities that support an innovation and its subsequent diffusion
- Lack of science and technology information and/or its diffusion
- Infrastructure bottlenecks (transport, information communication and technologies (ICT), research facilities)
- Market shortages of appropriate skilled/technical/academic labor
- Dysfunctional tax regimes
- Information bottlenecks and lack of coordination among innovation actors

Public policy should address these and other bottlenecks. Public executing agencies must be capable of supervising the network of concurrent activities supporting knowledge

production, application, and diffusion, so as to identify gaps in the response of autonomous market forces and supplement them with support from public programs.

Costa Rica has been making major efforts for several years to improve the level of coordination required between various public and private institutions to improve their capacity to execute public policy, in particular through the creation and implementation of the PCCI. However, major changes are still needed within these institutions and in the operation of the PCCI to achieve the best possible results; the country's economic growth performance indicates that there is still much work to do for achieving this objective.

Innovation is a medium- to long-term activity; therefore, it is important for public policy in this area to properly manage expectations. Support for public programs should aim for efficacy, rather than pure efficiency, in the deployment of public resources, because innovation involves time and risk-taking. The issue of time means that support for public programs and impact evaluation need a consistent strategic horizon that extends through political cycles. The presence of inherent risk means that program failures are part of the process. Indeed, a public support program that is 100 percent successful could actually be a bad program. This is an important message for ministers of finance who are typically skeptical of any program that may produce losses. Given the risk inherent in innovation projects, many of them may fail; therefore, their outcomes should be measured in the aggregate and not only at the level of specific projects. Furthermore, the authorities should adopt a strategy of experimentation that is not overly concerned with avoiding occasional failures, understanding that success is reached only after many trials.

Experience has shown that investment in successful public support programs for innovation is an investment in economic growth, and hence will generate net returns for the fiscal accounts and the country as a whole over time. To some extent, this has been the case of the MNC backward productive linkages (CR Provee) and innovation programs (PROPYME) in Costa Rica (Monge-González and Rodriguez-Alvarez, 2013; Monge-González and Torres-Carballo, 2014a). Box 1 shows a good example of the importance of programs such CR Provee and PROPYME in supporting the set-up and growth of innovative domestic firms.

Box 1.1: From a Family Recipe to a Food Processing Company through Innovation

The company Natural Sins, which produces fruit crisps, is a clear example of innovation. This firm began operations in 2011, and today exports its products to four markets (Japan, Canada, Central America, Japan, and the United States). This small enterprise decided to introduce a new product to the international market—leaflets of dried fruit for human consumption—which were healthy (low in calories) and whose packaging was highly attractive to consumers. At first, the operation was financed with its own resources, and was subsequently funded from private banks, which required mortgage collateral for loans. The product idea was born from a family recipe, which its owner and manager decided to industrialize, carrying out R&D activities that would allow him to develop a novel process for cutting and drying the fruit, producing very low-calorie thin fruit crisps. Since its inception, the company has enjoyed the support of PROCOMER, specifically through its Productive Linkages (former CR Provee) and Creating Exporters programs. With assistance from the first of these programs, it was possible to identify local suppliers of fruit and packaging needed to start production operations, while the second program helped to provide training that made it possible to start exporting the finished product. Natural Sins has also had support from PROCOMER to participate in international trade fairs of worldwide renown at reduced cost.

Another collaboration received from public institutions was a grant by PROPYME used to obtain an FSSC 22000 quality certification, which allows the company to import raw materials, process them, and return the final products to original owners in the United States (*maquila*). The Costa Rican Tourism Institute also has supported export efforts by Natural Sins through the participation of the company in the "Save the Americans" campaign for the United States and Canada. The manager of the company (who is an engineer) carries out R&D activities with the collaboration (under contract) of a food technologist within the company. Natural Sins today has an accounting system that allows it to keep track of budgets and expenditures on R&D. As part of its efforts to improve innovation on a daily basis, it constantly trains workers and rewards them with bonuses in cash (U.S. dollars) or in kind (more free time) for providing ideas on how improve the production process. This has generated new ideas for reducing the drying time of the fruit and for the thickness that the fruit slices should have to increase performance of processing, all of which affect the productivity of the company. An important component of this policy is that the workers themselves manage statistics on the performance of different stages in the production process.

As for relationships with the academic sector, the company has promoted internships for students from different universities, both public and private, in many different fields. In just three and a half years, it has had more than 100 interns in areas such as management, marketing, international business, and food technology. Recently, the company won a US$150,000 prize in the La Idea Business Pitch Competition, awarded by the U.S. government to Latin American companies doing business in that country. This award enabled Natural Sins to invest an additional US$50,000 in the production process, as well as US$100,000 to hire specialized services, with which they employed a law firm in the United States to secure a U.S. patent.

As mentioned previously, the bulk of R&D expenditures in Costa Rica are funded by the public sector (70.3 percent in 2011[3]). The government's investment in innovation and related polices is geared to compensating for and overcoming market failures that inhibit private sector innovation. However, the country's public policies should be more successful in promoting supportive market architecture and an innovation mindset in the private sector, so that private investments in R&D may eventually overtake public sector expenditures to account for two-thirds or more of total investments in this area. In addition, R&D expenditure financed by the public sector does not necessarily make concrete contributions to innovation, owing, among other reasons, to perverse incentives confronted by academics. That is, the current incentives do not motivate academics to work in innovation projects demanded by firms. It is therefore important to work to correct incentives that hinder the appropriate use of these resources, assuring that these expenditures have an important impact on the private sector's productive activities.

Governments have often gone beyond market-failure types of interventions to play an entrepreneurial role and innovate in areas that are initially outside a market's purview, as in the creation of the Internet by the U.S. government (Devlin, Daly, and Evertsen, 2013). Moreover, such government-funded research has often been related to commercial innovations; e.g., much of Apple's recent product line (Mazzucato, 2013).

For Costa Rica, a country playing catch-up from behind the technological frontier, effectively coordinated and purpose-based innovation networks are essential components of innovation systems. Strengthening the diagnostic, exploratory, and coordinating capacities of PCCI policies becomes important, especially when considering the importance of the main policies being developed in the National Science, Technology and Innovation Plan (PNCTI).

Innovation is not the exclusive domain of the private sector; it is also very relevant for government management and services provided to the public. This makes it more difficult to achieve all the necessary and sufficient conditions to become an economy based on knowledge and innovation. For the same reason, Costa Rica should strive even harder to make the transition to a knowledge and innovation economy.

In summary, the results of previous discussion and analysis clearly indicate that given its income level, Costa Rica is not investing nearly as much in R&D as other countries, and there is a need to improve public policies in this area. However, Costa Rican authorities

[3] According to Informe Estado de la Ciencia, la Tecnología y la Innovación, 2014.

have certainly made efforts to confront a number of challenges in critical areas, as set forth in the PNCTI.

First, to re-orient investment efforts in R&D financed with public resources toward innovation activities that will have real-world applications, the following initiatives are under way:

- Coordination of spaces for dialogue that will facilitate matching demand for innovation (private sector and civil society) with the supply of innovation (youth, SMEs, scientists);
- Social R+D and innovation challenges in which researchers and business people may obtain funds to develop innovative solutions to problems in relevant areas identified by civil society experts in the fields of water and environment, health, education, agriculture, and energy;
- The InnoLab Program to provide high-quality scientists and engineers with the skills and funds they need to drive innovations; and
- Use of funds from the European Union to provide financing to national businesses and researchers involved with European researchers and companies.

Second, the following actions have been taken to steer the private sector toward more innovative activities:

- Leveraging funds from the Inter-American Development Bank (IDB) and PROPYME to power the Huella PYME program, which seeks to provide SMEs with the skills and funds necessary for innovation and linkage with the global economy;
- Strengthening the network of innovation agents to support SMEs in innovative activities; and
- Promoting technology-based entrepreneurship using IDB funds.

Third, promote the culture of innovation with a focus on talented youth:

- Offer the Ruta IN Program, in which youths with talent in science and technology may learn hard and soft skills for innovation; and
- Support actors in the ecosystem through programs to strengthen values that are important for innovation.

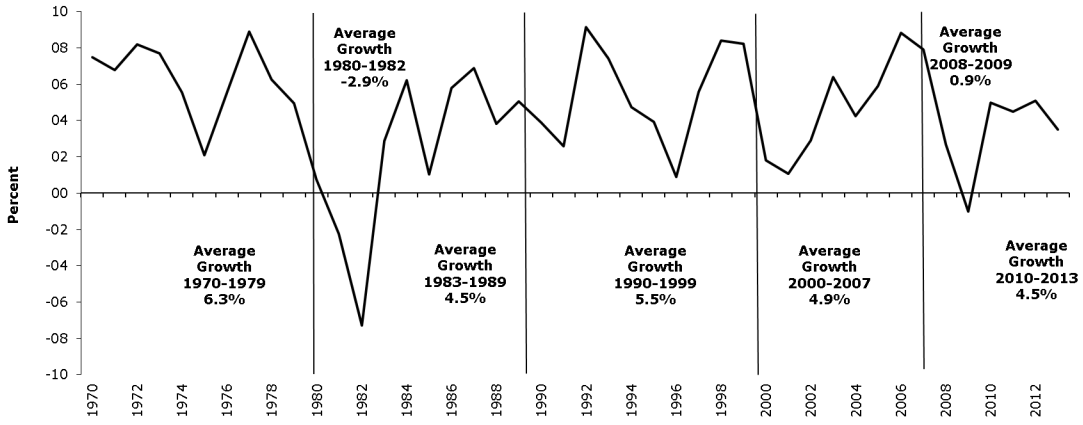
Fourth and last, institutional reforms to strengthen the role of the state in the cycle of innovation policies:

- Consulting with the IDB to strengthen the consultation process through presidential councils that are form part of the PCCI; and
- Drafting a bill for the creation of a productivity and innovation agency that will allow more agile and effective execution of policies in this field. This agency would gather together the different SME support programs that are currently scattered between the Ministry of Agriculture and Animal Husbandry (MAG), the Ministry of Economy, Industry and Trade (MEIC), the Ministry of Foreign Trade (COMEX), and the Ministry of Science, Technology and Telecommunications (MICITT). The structure of this agency would enable it to work in an agile and effective manner to seek greater efficiency in the use of resources, and to have a greater impact on the improvement of companies' productivity, particularly in the case of smaller companies.

2. ECONOMIC OVERVIEW OF COSTA RICA

Costa Rica is a small and open economy, with a population of 4.7 million inhabitants and a GDP per capita, PPP (current international dollars) of US$13,875.9 in 2013. Growth in Costa Rica has been positive in recent decades, with the clear exceptions of the 1980-82 and 2009 crises (Figure 2.1). Unfortunately, the rate of economic growth, measured in terms of GDP per capita, has not been sufficiently high and sustained to permit a significant increase in the value of income per inhabitant. In fact, during the 1970s, the country grew at an average annual rate of 6.3 percent, even taking into account years of contractions related to oil shocks at the beginning and the end of the decade and low international coffee prices during the mid-1970s. In the 1980s, growth averaged 2.3 percent, while in the 1990s it was 5.5 percent. During the 2000s, economic growth has been slower (an average of 4.2 percent); after the 2009 crisis (between 2010 and 2013), the Costa Rican economy grew at an average annual rate of 4.5 percent.

Figure 2.1 Costa Rica: Real GDP Growth
(annual percentage, 1970–2013)

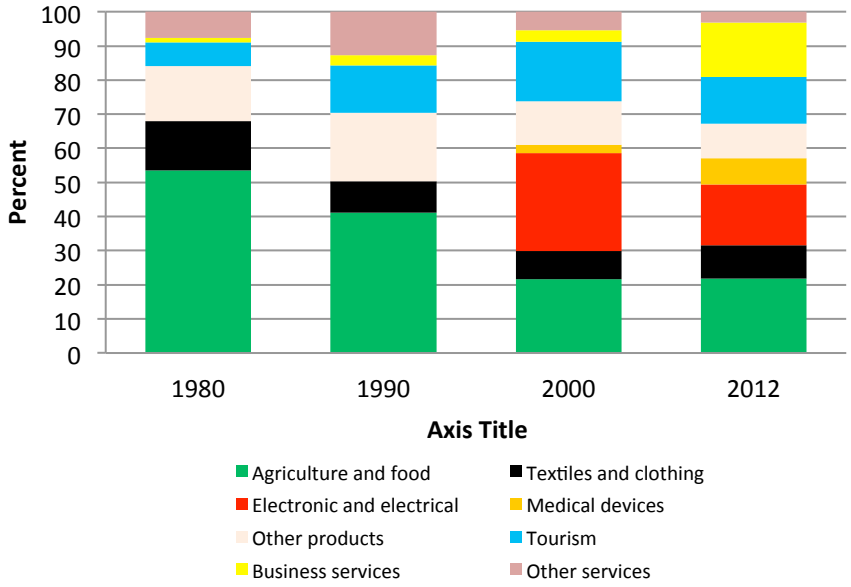


Source: Author's calculations based on World Bank (2013).

Since the mid-1980s, Costa Rica has followed a growth model based on both promotion of domestic export activities and the attraction of FDI in high-tech sectors, also focused on export markets. These efforts have allowed the country to progressively shift its export composition from primary products to high-tech manufacturing and more sophisticated services (Figure 2.2). Indeed, Costa Rica has increased the relative importance of this

type of export (electronic, electrical, medical devices, business services) from 1.2 percent in 1980 to 41.4 percent in 2012 (Mulder, 2014).

Figure 2.2 Costa Rica: Composition of Exports, Goods, and Services, 1980–2012
(in percent)

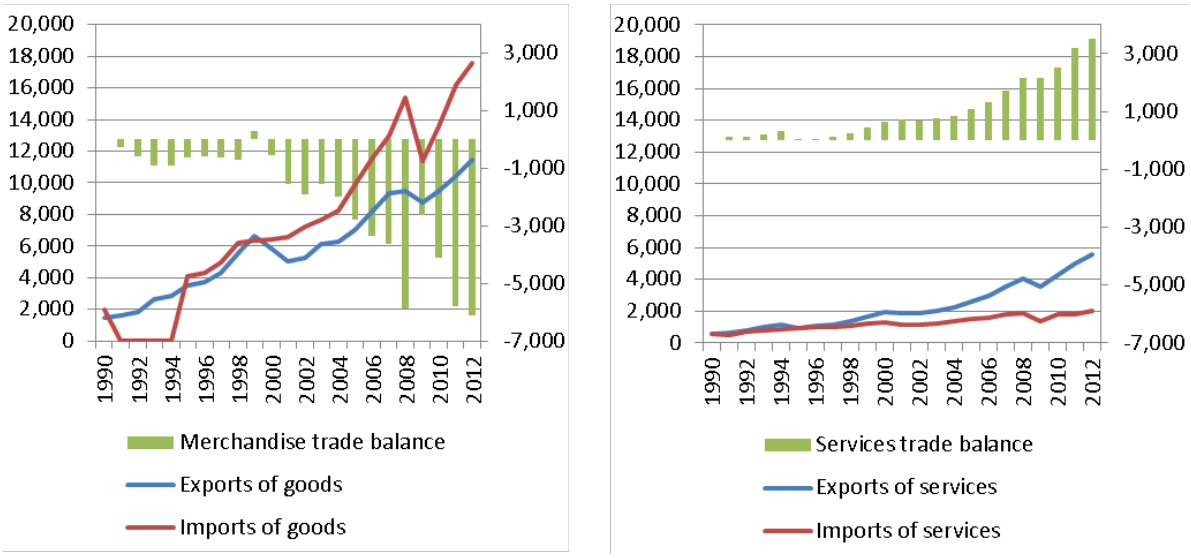


Source: Mulder (2014).

Costa Rica's exports of services partially offset the deficit in the trade balance of goods (Figure 2.3).

Figure 2.3 Costa Rica: Exports and Imports of Goods and Services, 1980–2012
(in thousands of U.S. dollars)

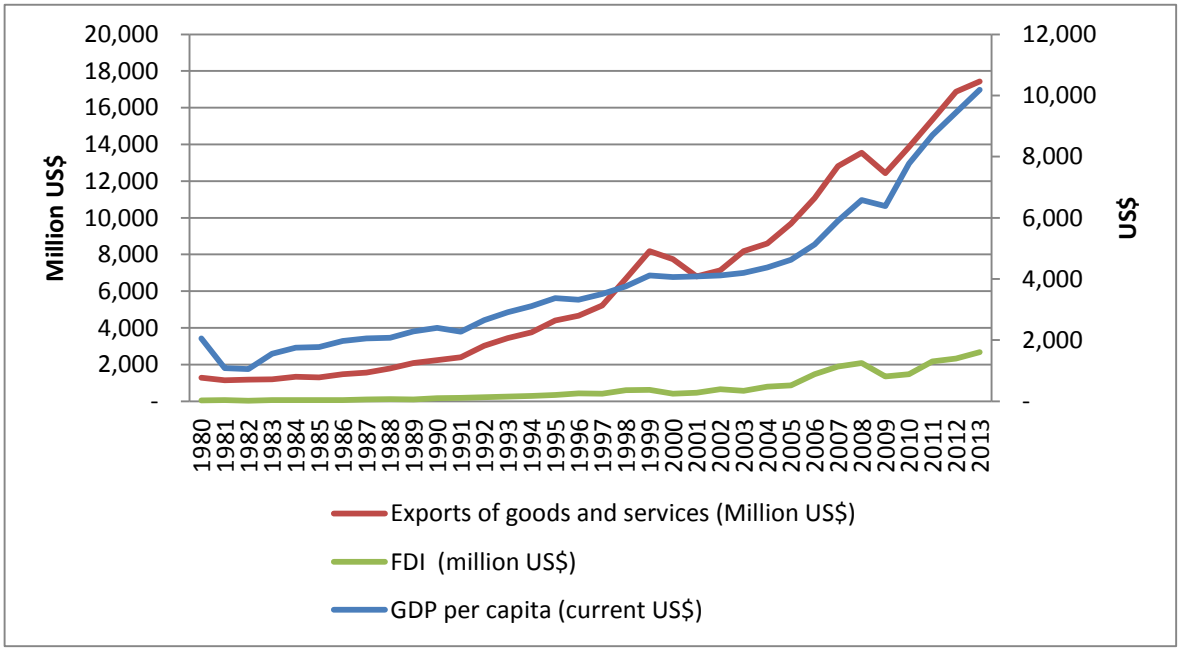
(a) Trade in goods (b) Trade in services



Source: Mulder (2014).

Figure 2.4 shows a clear and positive relationship between the behavior of exports and per capita GDP in Costa Rica. In short, it seems that the growth model based on export promotion (of both domestic and foreign firms/multinationals) has stimulated the country's economic growth during the past few decades. An important aspect of growth dynamics is the possibility of learning by exporting, through which a company's performance improves after it enters the export market. There are several mechanisms that may generate productivity gains when firms begin to export, such as investments in marketing, improvements in the quality of products, other innovations, and relationships with foreign buyers (De Loecker, 2013). In short, firms that enter into export markets have the expectation of affecting their future profits by way of a demand increase and/or a reduction in production costs. There is extensive evidence supporting the "learning by exporting" hypothesis in case studies (see Keller, 2004), and some recent econometric studies (Van Biesebroeck, 2005; Keller, 2010; De Loecker, 2007 and 2013).

Figure 2.4 Costa Rica: Exports, FDI Inflows, and GDP per Capita



Source: Author's elaboration based on World Bank (2013).

Despite the previous economic results for Costa Rica, the country still needs to achieve high and sustainable rates of growth that will ensure a much higher level of economic and social development. Indeed, during the past 25 years after economic liberalization (1986-2011), per capita income in Costa Rica has only grown at an average annual rate of 1.2 percent. At this rate, 33 years would be required for it to double. To achieve a leap in economic growth, Costa Rica needs to significantly increase its annual growth rate (GDP per capita) to at least 6 percent,[4] which would allow Costa Ricans to double their per capita income in 12 years.[5]

Given these results, it is surprising that the Costa Rican economy has not yet achieved a sustained high rate of growth. As mentioned in Section 1, sustained high rates of economic growth do not depend only on accumulation of factors of production (like FDI), but also on the continuous incorporation of technology and knowledge into production processes; that is, innovation. Indeed, it is technology and knowledge incorporation that condition the efficiency and productivity of factors of production and their return in economic growth. The economic literature points out the higher relevance of productivity

[4] This is the average rate that the literature suggests has permitted small countries such as Singapore, Hong Kong, Korea, and Taiwan to "leapfrog" in terms of GDP per capita.
[5] Applying the rule of 70, which states that the number of years it takes to double the value of a variable that grows gradually is approximately equal to 70 divided by the annual growth rate of this variable.

growth compared to factor accumulation in explaining differences in growth performance among countries (Caselli, 2005; Helpman, 2004; Klenow and Rodríguez-Clare, 1997).

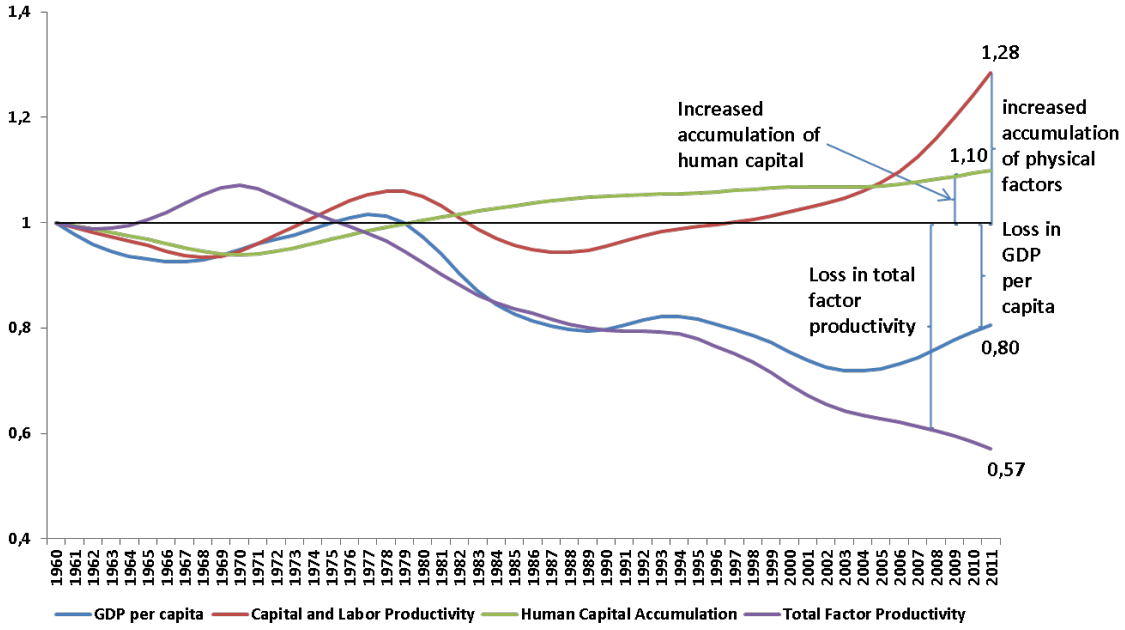
Productivity growth is of utmost importance in the case of Costa Rica, where three-quarters of the growth rate of the economy is explained by the accumulation of factors and one-quarter by the increase in productivity (see Jiménez, Robles, and Arce, 2009). Moreover, when Costa Rica is compared to leading technological nations such as the United States, its productivity is not converging. That is, although productivity in Costa Rica is growing every year, it does so at a much slower pace than in the United States.

Ferreira, Pessoa and Veloso (2008) found that outstanding performers like Ireland, the Asian Tigers, and Chile have been catching up to the United States in recent years, while Costa Rica has shown the opposite trend, similar to Latin America's performance overall.

Figure 2.5 shows both the growth of Costa Rica's GDP per capita relative to that of the United States (following the methodology used by Crespi, Fernández-Arias, and Stein (2014)), as well as the relative performance of the determinants of that growth. From this figure, it is possible to conclude that since the beginning of the 1970s, the Costa Rican economy shows an increasing productivity gap with respect to the U.S. economy (used as the leading technological country). This gap has been increasing during the past 40 years. In 2011, Costa Rica's productivity was 57 percent of that of the United States.

Figure 2.5 Trend and Composition of GDP per Capita: Costa Rica versus United States

(1960 = 1)

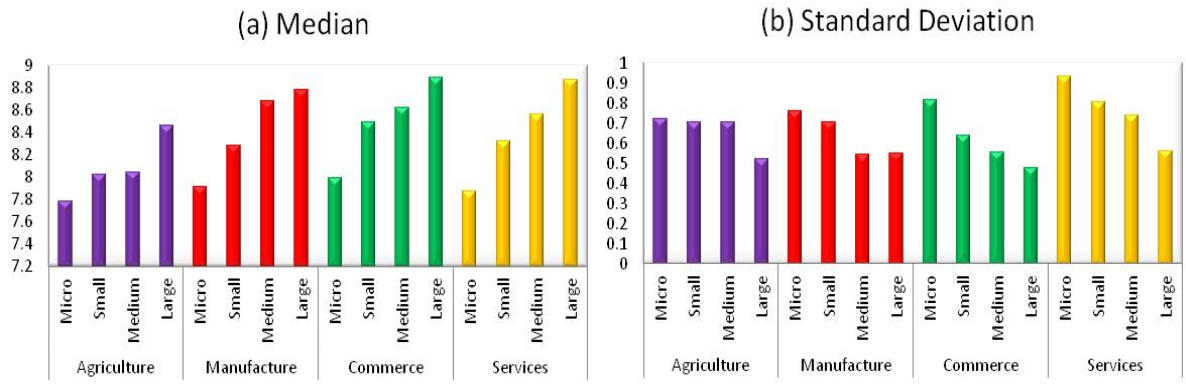


Source: Author's calculations using data from Fernández-Arias (2014).

Costa Rica's GDP per capita did, however, tend to converge with that of the United States between 1980 and 2002, mainly owing to the increase in the accumulation of physical factors (capital (FDI) and labor (migration)). In contrast, the accumulation of both human capital and physical factors has grown more in Costa Rica than in the United States, partially compensating for the gap in productivity between these countries and allowing Costa Rican per capita income to approach the level of per capita income in the US. Thus, it seems that the accumulation of physical factors, mainly owing to FDI, and the growth of the labor force have been the two main sources of economic growth in Costa Rica during the past 40 years.

Monge-González and Torres-Carballo (2014b) studied the productivity and growth of Costa Rican firms from 2001 to 2012. The authors found a wide dispersion in the productivity of Costa Rican companies, both between sectors and between companies of different sizes within a given sector (Figure 2.6). In particular, they found that apart from agriculture, service sector firms show the lowest productivity, and productivity dispersion between large and small companies in this sector is the highest in the Costa Rican economy. In addition, smaller companies show lower productivity.

Figure 2.6 Logarithms of Median Labor Productivity by Productive Sector and Business Size, 2001–12



Source: Author's calculations using data from Monge-González and Torres-Carballo (2014b).

These results lead to the conclusion that there is a clear need for productivity improvement in services sector firms, particularly in smaller ones, because this sector is the largest in the Costa Rican economy (53 percent of the productive sector). Furthermore, productivity in micro-businesses in all sectors must be promoted, because of their high relative weight within the Costa Rican productive sector (79 percent, according to Monge-González and Torres-Carballo, 2014a).

These authors also found that an important determinant of the growth of firms during the period studied was their level of productivity. This means that the most productive firms showed higher growth rates during the period. This last finding supports the idea that strengthening firms' productivity would promote higher growth rates in the Costa Rican economy.

The above results are consistent with those of the IDB (2010), in which the authors claim that the productivity of enterprises in Latin America varies widely: there are some very productive enterprises and many of extremely low productivity that result in a shortage of companies with medium levels of productivity. There is also a strong relationship between productivity and size: the more productive firms tend to be larger. This implies that there are many resources in very small companies, often with only one worker, and with very low productivity.

To understand the relative importance of these findings from the point of view of economic growth, the IDB (2010) shows that the productivity of an economy is equal to the

sum of the productivity of large business and the productivity gap between small[6] and large firms, weighted by the participation of small firms in the total of firms (*w*):

$$Prod_{economy,t} = Prod_{large,t} + w_t(Prod_{small,t} - Prod_{large,t})$$

Therefore, the productivity of the economy ($Prod_{economy}$) depends on the productivity of each group according to its size ($Prod_{small}$ and $Prod_{large}$) and the share of small firms (w_{small}). According to this equation, if the productivity of smaller companies is very low and the relative weight of these companies in the total firms is very high, both will undermine the productivity of the economy as a whole. This is exactly what is happening in Costa Rica, where the productivity of micro-businesses is very low (approximately 40 percent of the productivity of larger businesses) and its relative weight is very high, about 95 percent (Monge-Gonzalez and Torres-Carballo, 2014b). Once again, this result indicates the importance of supporting the productivity growth of smaller firms in Costa Rica (those with high potential), as a mechanism for increasing productivity in the economy as a whole. Public policies have a very important role in this field, as discussed in the last two sections of this paper.

Another important result from the empirical analysis of Monge-González and Torres-Carballo (2014a and 2014b) for Costa Rica is that an exporter or local company linked to multinationals is more likely to achieve high levels of productivity than firms without access to such catalysts will achieve. In fact, being an exporter increased firms' growth rates by 27 percent and productivity growth by 6 percent, while linkage with MNCs increased firms' growth rates by 19 percent and productivity growth by 4 percent. These results seem to be associated with the existence of technology transfer and knowledge spillovers resulting from the direct and indirect participation of these companies in international trade.

In a recent study on the interaction between ICT and IT-enabled MNCs[7] and domestic ICT firms in Costa Rica, Monge-González, Hewitt, and Torres-Carballo (2015) claim that the country still faces several important constraints that do not permit the full realization of potential benefits offered by the presence of MNCs. These constraints have to do with *the potential for knowledge spillover from MNCs, the capacity of domestic firms*

[6] This group includes SMEs. In the Costa Rican case, this means any firm with fewer than 250 employees.
[7] The MNCs that were included in the analyses are either direct producers of standardized information and communication products and services (ICT), or "IT-enabled service providers" that make intensive use of ICTs to offer their services to clients in other countries (such as outsourced service providers).

to absorb knowledge and technology from MNCs, and *the characteristics of the national environment of the host country* in which both local and MNCs companies are operating (Farole and Winkler, 2014; Paus and Gallagher, 2008). It is therefore clear that there is a need for policies that can overcome these constraints.

In the economic literature, most explanations of economic growth focus on conditions or incentives at the global or national level, as well as at the industry level. At the industrial level, the question to be answered is why some sectors prosper more than others. Using a bottom-up approach, Mezue, Christensen, and van Bever (2015: 69) show that different types of innovations have radically different effects on economic and employment growth, arguing that "there exists a well-established model of company-level investment and innovation that leads to transformative economic development and national prosperity."

By studying the extent to which innovation by Costa Rican manufacturing firms creates or displaces employment, how different innovation strategies affect employment, and how these effects vary by firm size and type of employment demand characteristics (skills), Monge-González et al. (2011) found that both product innovation and process innovation by manufacturing firms are positively related to employment growth. This indicates that appropriate policies to promote innovation activities, such as providing people with good technical and professional education, are the best way to keep creating job opportunities.

The same authors also found that product innovation generates employment in all firms regardless of size, but that because Costa Rican manufacturing firms are, on average, experiencing productivity growth, jobs related to old products are decreasing. Thus, policies are required to improve the capabilities of workers engaged in the production of old products, so that they can become involved either in process innovation activities or in the production of new goods and so avoid losing their jobs in the near future. Activities such as retraining must be a priority.

Finally, these authors claim that innovations made within firms are the ones that generate employment opportunities in Costa Rican manufacturing firms.[8] Therefore, policies that promote innovation efforts by these firms will promote, at the same time, a positive environment for new employment opportunities.

[8] Owing to data availability, the authors were only able to study the relation between innovation and employment for manufacturing firms. Newer innovation surveys that include service sectors in their samples would enable this research to extend to services in the future.

In summary, to positively impact firms' growth rates and thereby generate more and better jobs, Costa Rican authorities should design and implement policies that successfully strengthen the innovation system, improve the capacity of domestic firms to absorb knowledge and technology, and remove obstacles that prevent domestic companies from growing, especially those in the service sector which are not directly related to foreign trade. Such policies also help authorities to combat poverty and inequality in the country. Thus, moving Costa Rica toward an innovation-driven economy seems to be a good way to increase labor opportunities for both skilled and unskilled workers, if Costa Rican authorities can deal efficiently with the challenges identified above, as well as others discussed in the following sections. In fact, empirical evidence from the Costa Rican manufacturing sector shows that although product innovations are associated with a greater demand for qualified labor, process innovations are associated with a greater demand for both qualified and nonqualified labor (Monge-González et al., 2011).

Most efforts to increase productivity in Costa Rica are focused on supporting small businesses rather than large ones. Thus, it seems that what matters most is to improve the allocation of resources among smaller companies, which actually increases the overall productivity of the country, even though support for large companies can further increase overall productivity, as shown in simulations by Ibarrarán, Maffioli, and Stucchi (2009) in Latin America.

3. COSTA RICA'S INNOVATION BASELINE

To determine Costa Rica's strengths and weaknesses in innovation, it is necessary to compare its history along two dimensions: (a) enablers of innovation, and (b) outputs of innovation efforts. Such an analysis must consider Costa Rica through time and in comparison to other relevant countries, in both cases using information from the past 10 years.[9] In selecting the countries with which to compare Costa Rica the following criteria were considered: (i) countries with which Costa Rica competes in trade and attracting FDI inflows; (ii) countries that have socioeconomic characteristics similar to those of Costa Rica; (iii) countries that had socioeconomic conditions similar to those of Costa Rica a few decades ago, but today have higher levels of economic and social development than Costa Rica (emerging market countries); and (iv) countries that are currently at the forefront of knowledge and technology. Based on these criteria, the following countries

[9] In some cases it was not possible to obtain information for more than five years, or for all countries.

were selected: Chile, Colombia, Finland, Ireland, Japan, the Republic of Korea, Mexico, Panama, Peru, Singapore, the United States, and Uruguay.[10]

3.1 Enablers of Innovation

3.1.1. Human Resources

Poverty and inequality: Extensive poverty and/or inequality may signal the existence of a privileged elite that has a low incentive to innovate, and may limit the potential for innovation opportunities to arise; more important, such a situation may discourage the emergence of radical innovations in favor of marginal (low-value) innovations (Devlin, Daly, and Evertsen, 2013). It is therefore important to analyze how poverty and inequality have evolved in Costa Rica, and how the country compares in this regard to other relevant countries today.

Table 3.1 shows that the percentage of the population living below the poverty line of less than US$2 per day is relatively low in Costa Rica compared to other relevant countries, and that this percentage has decreased from 4.5 percent in 2008 to 3.1 percent in 2012. Costa Rica is better positioned in this regard than all countries in the comparison group except the United States, Uruguay, and Ireland; however, according to Székely (2015) the percentage of poor people in Costa Rica increased by 1.8 percent between 2003 and 2013. In addition, figures from Costa Rica's National Institute of Statistics and Census indicated that the percentage of poor households in the country was 22.4 percent in 2014.

[10] Chile, Colombia, Mexico, and Peru belong to the group of countries with which Costa Rica competes for trade and FDI inflows (group i). Panama and Uruguay belong to the group of countries that have socioeconomic characteristics similar to those of Costa Rica (group ii). Ireland, Korea, and Singapore belong to the group of countries that had similar socioeconomic conditions to those of Costa Rica a few decades ago, but today have higher levels of economic and social development than Costa Rica (group iii). Finally, Finland, Japan, and the United States belong to the group of countries that are currently at the forefront of knowledge and technology.

Table 3.1 Costa Rica and Comparable Countries: Poverty Headcount Ratio at US$2/ Day (PPP)

(In percent of population)

County	2008	2009	2010	2011	2012
Costa Rica	**4.5**	**5.2**	**2.9**	**3.2**	**3.1**
Competitors in Foreign Trade and Foreign Direct Investment					
Chile	...	2.6	...	1.9	...
Colombia	18.0	15.7	13.7	11.3	12.0
Mexico	5.2	...	4.5	...	4.1
Peru	12.1	9.7	8.0	8.7	8.0
Countries with Similar Socio-Economic Characteristics					
Panama	10.8	8.1	9.3	8.4	8.9
Uruguay	1.9	1.6	1.2	1.2	1.3
Emerging Economies					
Ireland	...	...	0.7	...	...
Korea. Rep.	...	...	...	...	...
Singapore	...	...	...	...	...
Knowledge and technology leaders					
Finland	...	...	0.0	...	...
Japan	0.4	...	...	...	...
United States	...	...	1.7	...	...

Source: Author's calculations using data from World Bank, World Development Indicators.
Note: … = data not available.

Income inequality has been relatively constant in Costa Rica during the past five years, as shown in Table 3.2, though the country is clearly behind knowledge and technology leaders in terms of this indicator. In short, it appears that Costa Rica should make efforts to improve income distribution and to reduce the percentage of the population living below the poverty line to increase opportunities for radical innovations. Costa Rica should also work through innovation in social programs to reduce poverty and overcome inequalities in income distribution. It is also important to improve access to education (as discussed later) and better align the supply of human resources produced by technical and higher educational centers with the needs of the productive sector.

Table 3.2 Costa Rica and Comparable Countries: GINI Coefficient, 2008–12

Country	2008	2009	2010	2011	2012
Costa Rica	**49.1**	**51.0**	**48.1**	**48.6**	**48.6**
Competitors in Foreign Trade and Foreign Direct Investment					
Chile	…	52.0	…	50.8	…
Colombia	56.1	55.9	55.5	54.2	53.5
Mexico	48.3	…	47.2	…	48.1
Peru	46.9	46.2	44.9	45.7	45.3
Countries with Similar Socio-Economic Characteristics					
Panama	52.6	52.0	51.9	51.8	51.9
Uruguay	46.3	46.3	45.3	43.4	41.3
Emerging Economies					
Ireland	…	…	32.1	…	…
Korea, Rep.	…	…	…	…	…
Singapore	…	…	…	…	…
Knowledge and technology leaders					
Finland	…	…	27.8	…	…
Japan	32.1	…	…	…	…
United States	…	…	41.1	…	…

Source: Author's calculations using data from World Bank, World Development Indicators.
Note: … = data not available.

Literacy rate: In the area of human capital, Costa Rica shows strength in the level of education of its population (Table 3.3). Indeed, the country has a literacy rate of 97.4 percent, second only to Uruguay. This result is important because a literate population is required to absorb and disseminate knowledge.

Table 3.3 Costa Rica and Comparable Countries: Literacy Rate, Adult Total
(in percent of people ages 15 and above)

Country	2008	2009	2010	2011	2012
Costa Rica	**…**	**…**	**…**	**97.4**	**…**
Competitors in Foreign Trade and Foreign Direct Investment					
Chile	98.6	98.6	…	…	…
Colombia	93.4	93.2	93.4	93.6	…
Mexico	92.9	93.4	93.1	93.5	94.2
Peru	…	…	…	…	93.8
Countries with Similar Socio-Economic Characteristics					
Panama	…	…	94.1	…	…
Uruguay	98.2	98.3	98.1	98.3	98.4
Emerging Economies					
Ireland	…	…	…	…	…
Singapore	…	…	95.9	96.2	96.4
Knowledge and technology leaders					
Finland	…	…	…	…	…
Japan	…	…	…	…	…
United States	…	…	…	…	…

Source: Author's calculations using data from World Bank, World Development Indicators.
Note: … = data not available.

Female labor force participation: Women's participation in the workforce is an important determinant of a country's capacity for innovation: if more women are integrated into the workforce there will be a larger pool of individuals who may produce innovative ideas and productive enterprises, in the latter case based on market opportunities instead of subsistence needs. In fact, in a survey of the current literature about women in science and technology, Castillo, Grazzi, and Tacsir (2014) claim that skills gaps are a key constraint on innovation, hindering productivity growth and economic development: a shortage in the supply of trained professionals in disciplines related to science, technology, engineering, and mathematics (STEM) can weaken a society's potential for innovation.

Table 3.4 shows that in Costa Rica just under half of women over 15 years old are participating in the workforce, and this situation has not changed significantly over the last five years for which data are available (2008-12). In comparison with other relevant countries, Costa Rica shows a lower percentage of participation of women in the workforce, leading only Mexico in the year 2012. This result underlines the importance of facilitating entry into the labor market so as to increase opportunities for entrepreneurship and innovation.

Table 3.4 Costa Rica and Comparable Countries: Female Participation in Workforce
(in percent of female population ages 15 and above)

Country Name	2008	2009	2010	2011	2012
Costa Rica	45.0	45.5	46.1	46.3	46.4
Competitors in Foreign Trade and Foreign Direct Investment					
Chile	42.1	42.6	46.8	48.7	49.0
Colombia	51.1	54.4	55.3	55.5	55.7
Mexico	43.5	42.8	43.8	43.2	45.0
Peru	65.5	67.5	67.6	67.8	68.0
Countries with Similar Socio-Economic Characteristics					
Panama	48.5	49.5	48.8	48.9	49.0
Uruguay	54.5	55.1	55.2	55.3	55.5
Emerging Economies					
Ireland	54.0	53.6	53.1	52.9	52.7
Korea, Rep.	49.9	49.0	49.3	49.5	49.9
Singapore	56.4	56.1	57.3	58.1	59.0
Knowledge and technology leaders					
Finland	57.5	57.1	56.2	55.9	56.0
Japan	48.5	48.7	49.4	48.1	48.1
United States	58.5	58.2	57.6	57.0	56.8

Source: Author's calculations using data from World Bank, World Development Indicators.

Education: To be able to absorb, create, and disseminate knowledge, a country needs to create a significant stock of human capital. The educational level of a country's population, measured by different indicators such as coverage (school enrollment: primary, secondary and tertiary), average years of attainment, quality, tertiary degrees in science and engineering, and in business, will therefore determine the country's ability to reach this objective.

Coverage: Costa Rica steadily increased pre-primary enrollment from 2008 to 2012, reaching coverage of 73.8 percent (Table 3.5), lower than corresponding rates for Chile, México, Japan, Uruguay, Peru, and the United States. Costa Rica had full primary enrollment during the period 2008-12, similar to corresponding rates for other countries in the comparison group. It appears that in these two areas Costa Rica shows comparative strength (Table 3.6).

Based on the data in Table 3.7, it would appear that Costa Rica faces no significant challenges in secondary education enrollment, but these data do not reflect serious problems that Costa Rica faces in this area, as will be discussed later.

Table 3.5 Costa Rica and Comparable Countries: School Enrollment, Preprimary
(in percent gross)

Country Name	2008	2009	2010	2011	2012
Costa Rica	**69.69**	**70.93**	**71.29**	**72.72**	**73.84**
Competitors in Foreign Trade and Foreign Direct Investment					
Chile	81.6	84.1	105.8	111.6	113.6
Colombia	49.1	51.3	48.6	48.6	…
Mexico	99.3	97.9	98.1	99.4	101.4
Peru	72.3	76.9	78.4	77.1	78.0
Countries with Similar Socio-Economic Characteristics					
Panama	65.2	62.1	63.2	62.2	65.4
Uruguay	86.1	88.9	88.7	…	…
Emerging Economies					
Ireland	…	…	47.5	67.0	52.4
Singapore	…	…	…	…	…
Knowledge and technology leaders					
Finland	64.8	66.2	68.1	69.5	70.5
Japan	89.6	89.7	88.2	87.3	87.9
United States	59.4	58.3	71.9	73.3	74.3

Source: Author's calculations using data from World Bank, World Development Indicators.
Note: … = data not available.

Table 3.6 Costa Rica and Comparable Countries: School Enrollment, Primary
(in percent gross)

Country Name	2008	2009	2010	2011	2012
Costa Rica	**111.3**	**111.2**	**109.5**	**107.1**	**105.3**
Competitors in Foreign Trade and Foreign Direct Investment					
Chile	106.8	105.4	102.2	101.5	101.2
Colombia	119.6	119.8	114.9	111.2	106.9
Mexico	101.6	102.9	103.5	104.2	105.0
Peru	109.5	107.8	107.3	104.9	99.6
Countries with Similar Socio-Economic Characteristics					
Panama	105.0	103.1	102.2	101.4	100.3
Uruguay	113.9	113.3	112.0	…	…
Emerging Economies					
Ireland	105.2	106.0	105.7	104.7	104.4
Korea, Rep.	103.0	102.6	103.2	103.8	102.7
Singapore	…	…	…	…	…
Knowledge and technology leaders					
Finland	98.7	98.8	99.1	99.4	100.1
Japan	101.5	102.0	102.2	102.6	102.3
United States	102.2	101.2	99.5	98.8	98.1

Source: Author's calculations using data from World Bank, World Development Indicators.
Note: … = data not available. Gross enrollment ratio (GER) for primary is the total enrollment in primary education, regardless of age, expressed as a percentage of the population of official primary education age. GER can exceed 100 percent because over-aged students (who entered late or repeated grades) and under-aged students (who entered early) are included.

Table 3.7 Costa Rica and Comparable Countries: School Enrollment, Secondary
(percent gross)

Country Name	2008	2009	2010	2011	2012
Costa Rica	**90.4**	**96.9**	**99.4**	**101.1**	**103.6**
Competitors in Foreign Trade and Foreign Direct Investment					
Chile	89.6	87.7	89.1	89.9	89.0
Colombia	90.2	94.3	96.0	97.1	92.8
Mexico	83.3	82.9	83.7	84.1	85.7
Peru	89.4	91.2	90.9	90.7	89.8
Countries with Similar Socio-Economic Characteristics					
Panama	68.0	69.1	70.3	69.7	84.0
Uruguay	87.8	90.1	90.3	…	…
Emerging Economies					
Ireland	115.4	118.3	121.2	117.8	119.1
Korea, Rep.	96.4	97.1	97.1	96.7	97.2
Singapore	…	…	…	…	…
Knowledge and technology leaders					
Finland	108.7	107.3	107.2	107.5	107.7
Japan	100.7	100.9	101.6	101.8	101.8
United States	94.9	94.3	93.2	93.6	93.7

Source: Author's calculations using data from World Bank, World Development Indicators.
Note: … = data not available. Gross enrollment ratio (GER) for primary is the total enrollment in primary education, regardless of age, expressed as a percentage of the population of official primary education age. GER can exceed 100 percent because over-aged students (who entered late or repeated grades) and under-aged students (who entered early) are included.

Table 3.8 Costa Rica and Comparable Countries: School Enrollment, Tertiary
(percent gross)

Country Name	2008	2009	2010	2011	2012
Costa Rica	…	…	…	44.45	46.74
Competitors in Foreign Trade and Foreign Direct Investment					
Chile	54.86	59.01	65.93	70.52	74.39
Colombia	35.37	36.96	38.99	42.74	45.02
Mexico	25.10	25.65	26.74	27.69	28.99
Peru	…	…	42.64	…	…
Countries with Similar Socio-Economic Characteristics					
Panama	43.12	43.03	43.92	41.78	…
Uruguay	64.60	63.24	63.15	…	…
Emerging Economies					
Ireland	59.02	63.45	70.61	73.47	71.24
Korea, Rep.	101.76	101.57	100.96	100.80	98.38
Singapore	…	…	…	…	…
Knowledge and technology leaders					
Finland	95.02	91.75	94.05	95.09	93.72
Japan	57.64	57.68	58.08	59.92	61.46
United States	84.21	87.73	93.29	95.33	94.28

Source: Author's calculations using data from World Bank, World Development Indicators.
Note: … = data not available. Gross enrollment ratio (GER) for tertiary (ISCED 5 and 6) is the total enrollment in tertiary education (ISCED 5 and 6), regardless of age, expressed as a percentage of the total population of the five-year age group following the completion of secondary education.

The rate of tertiary enrollment is relatively low in Costa Rica compared with most technologically oriented countries and with some other countries that show important progress in innovation (Table 3.8). The presence of high-tech MNCs in the country, especially in the medical device industry, suggests that viable clusters are forming in Costa Rica and that these MNCs may want to embark on more R&D-related activities in the country, but they have not yet done so because of the lack of human capital, especially persons with tertiary and higher-level degrees in statistics, materials, and biomedical sciences, and a good understanding of the Global Standards Management Process.[11]

[11] According to comments by Kaoru Nabeshima from JETRO in a workshop during his visit to Costa Rica in 2013.

Attainment: On examination of average years of education completed,[12] several problems with the Costa Rican educational system become apparent. As shown in Table 3.9, although in Costa Rica a citizen completes an average of 8.4 years of education (in 2013), in almost all countries in the comparison group this figure is much higher. This situation has not changed since the year 2000. Thus, in the most technologically oriented countries people attend school between two and four years longer than people do in Costa Rica.

Table 3.9 Costa Rica and Comparable Countries: Average Years of Formal Education, 2000–13

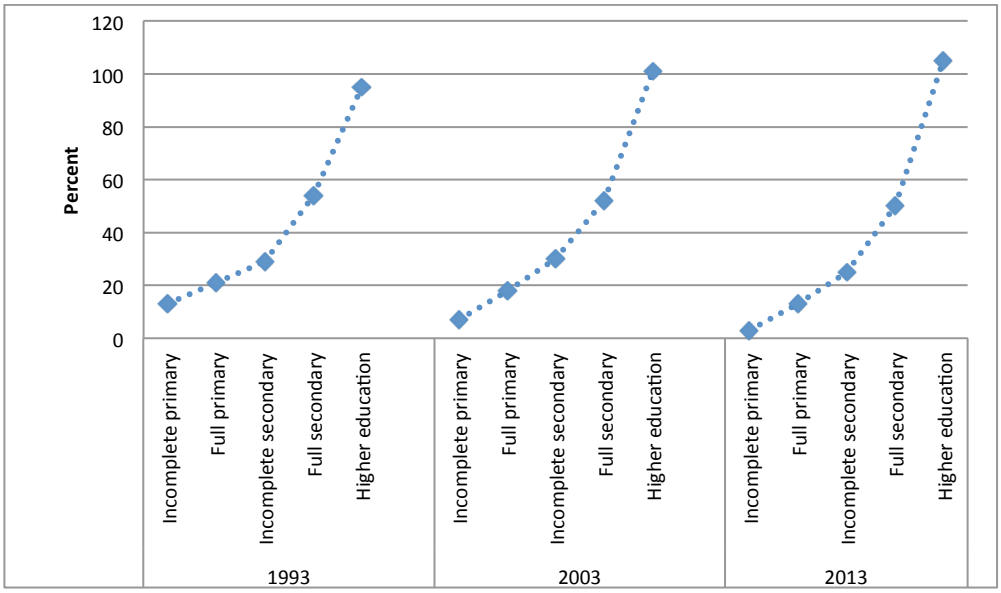
Country	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013
Costa Rica	**8**	**7.9**	**7.9**	**8**	**8.2**	**8.3**	**8.2**	**8.3**	**8.4**	**8.4**
Competitors in Foreign Trade and Foreign Direct Investment										
Chile	8.8	9.5	9.5	9.4	9.9	9.9	9.8	9.8	9.8	9.8
Colombia	6.5	6.8	6.7	6.8	7	6.9	7.1	7.1	7.1	7.1
Mexico	6.7	7.5	7.9	7.9	8	8.1	8.3	8.4	8.5	8.5
Peru	8	8.4	8.2	8.1	8.1	8.1	8.8	8.9	9.0	9.0
Countries with Similar Socio-Economic Characteristics										
Panama	8.5	9	9.1	9.2	9.2	9.3	9.4	9.4	9.4	9.4
Uruguay	8	8	8	8.2	8.3	8.3	8.3	8.4	8.5	8.5
Emerging Economies										
Ireland	11.2	11.4	11.4	11.5	11.5	11.6	11.6	11.6	11.6	11.6
Korea (Republic of)	10.6	11.4	11.4	11.5	11.6	11.7	11.8	11.8	11.8	11.8
Singapore	7.6	8.4	8.8	9.1	9.4	9.4	10.1	10.1	10.2	10.2
Knowledge and technology leaders										
Finland	8.2	10.1	10.1	10.2	10.2	10.2	10.3	10.3	10.3	10.3
Japan	10.8	11.1	11.2	11.3	11.3	11.4	11.5	11.5	11.5	11.5
United States	12.7	12.8	12.8	12.9	12.9	12.9	12.9	12.9	12.9	12.9

Source: Author's calculations using data from United Nations Development Program. (http://hdrstats.undp.org/en/indicators/103006.html).

This finding is extremely important for Costa Rica, given that there is an important wage premium in the country for an additional year of studies, or otherwise, for completing an educational level, which has been documented during the past 20 years. In fact, according to the 20th Estado de la Nación en Desarrollo Humano Sostenible (2013), moving from not having formal education to having a high-school diploma increases hourly income by slightly more than 50 percent, on average. In the case of higher education, the hourly salary increase (i.e., the premium for completing higher education) rose from 94.6 percent in 1993 to 105 percent in 2013, as shown in Figure 3.1.

[12] Average number of years of education received by people ages 25 and older, converted from education attainment levels using official durations of each level.

Figure 3.1 Premiums for Education by Education Level Completed
(in percent)



Source: Estado de la Nación en Desarrollo Humano Sostenible, 20th Report, Estado de la Nación (2013).

Quality: Another dimension where Costa Rica confronts serious challenges to creating a sufficient stock of human capital to absorb, create and disseminate knowledge is the quality of its education system.

Table 3.10 shows the mean scores in PISA evaluations for Costa Rica and several comparable countries for the year 2012. Countries are sorted first by mathematics scores, and then by science and reading scores, respectively. In mathematics, Costa Rica has a PISA score lower than all comparable countries except Colombia and Peru. In science and reading, Costa Rica scores higher than Peru, Colombia, México, and Uruguay. However, according to all the data from Table 3.10, Costa Rica, in the quality of its education system, lags behind most of the comparable countries, especially those which are most technologically oriented.

Two results of interest for Costa Rica and the rest of Latin America are found when the variances of these scores are analyzed. First, Costa Rica shows a much lower variance in the three areas evaluated than do the other Latin American countries included in the comparison. Second, even the highest averages in Costa Rica are lower or barely at the average levels of OECD member countries.

Table 3.10 Costa Rica and Comparable Countries: Average PISA Scores 2012

	Mathematics		Reading		Science	
Country	**Mean**	**Variance**	**Mean**	**Variance**	**Mean**	**Variance**
Costa Rica	**407**	**1810**	**441**	**2062**	**429**	**1871**
Competitors in Foreign Trade and Foreign Direct Investment						
Chile	423	4382	441	4138	445	4000
Colombia	376	2077	403	2721	399	2034
Mexico	413	2010	424	2588	415	1871
Peru	368	3272	384	4320	373	2759
Countries with Similar Socio-Economic Characteristics						
Panama	…	…	…	…	…	…
Uruguay	409	3518	411	4268	416	3763
Emerging Economies						
Ireland	501	1362	523	1778	522	1627
Korea, Rep.	554	3831	536	2736	538	2418
Singapore	573	3853	542	3496	551	3853
Knowledge and technology leaders						
Finland	519	935	524	1205	545	1086
Japan	536	4841	538	4615	547	4169
United States	481	1971	498	2247	497	2276
OECD Average	**494**		**496**		**501**	

Source: Author's calculations using data from OECD (2014).
Note: Includes students between the ages of 15 years 3 months and 16 years 2 months who completed the assessment in the year 2012.

Another indicator of the quality of the education system that is relevant to fostering innovation capacity is the rank of countries according to the quality of management schools. Table 3.11 shows the scores and ranks of Costa Rica and comparable countries in this area, according to the World Economic Forum's *Global Competitiveness Report* 2013/2014. Based on these data, it seems that Costa Rica has a competitive advantage in the quality of its management schools.

Table 3.11 Costa Rica and Comparable Countries: Management School Scores and Rankings, 2013/2014

Country	Higher Education and Training	
	Quality of management Schools	
Country	**Score**	**Rank**
Costa Rica	5.3	17
Competitors in Foreign Trade and Foreign Direct Investment		
Chile	5.3	16
Colombia	4.3	70
Mexico	4.3	65
Peru	4.3	67
Countries with Similar Socio-Economic Characteristics		
Panama	4.3	63
Uruguay	4.2	79
Emerging Economies		
Ireland	5.3	19
Korea, Rep.	4.5	56
Singapore	5.7	6
Knowledge and technology leaders		
Finland	5.6	10
Japan	4.0	86
United States	5.5	12

Source: Author's calculations using data from the World Economic Forum, Global Competitiveness Report 2013/2014.

In Costa Rica, the provision of higher education is dominated by five public universities: the Universidad Estatal a Distancia, the Universidad Nacional de Costa Rica, the Instituto Tecnológico de Costa Rica, the Universidad de Costa Rica, and the Universidad Técnica Nacional. At the same time, there are a growing number of private universities (51 in 2010). In 2010, public universities offered 604 professional careers and private universities offered 535. It is important to point out that 19.9 percent of the careers in public universities corresponded to the area of education, 17.5 percent to health sciences and 15.2 percent to social sciences. In private universities, programs related to education represented 21.9 percent of the careers offered, 18.1 percent were in economics science, and 18 percent in social sciences. The basic sciences represented only 2.5 percent of academic offerings and engineering 9.1 percent. Doctorates were 1.8 percent of the careers in the public universities and 0.9 percent in private universities (Estado de la Nación, 2010, cited by Padilla, Gaudin, and Rodriguez, 2012).

When the situation of higher education in Costa Rica is contrasted with those of comparable countries, it is clear that Costa Rica is at a competitive disadvantage. As shown in Table 3.12, while 5.7 percent of Costa Rican graduates from tertiary education in

the year 2011 graduated from science programs, countries like Ireland, Panamá, the United States, Finland, Uruguay, and Korea show much higher percentages (between 7.3 percent and 11.6 percent). In addition, according to UNESCO data the percentage of women graduating from science programs in Costa Rica is less than half the corresponding figure for Costa Rican men (2.7 percent versus 5.7 percent in 2012, respectively).

Table 3.12 Costa Rica and Comparable Countries: Percentage of Graduates from Tertiary Science Programs, both Sexes 2002–12

Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Costa Rica	**6.0**	..	..	..	..	**6.9**	..	..	**5.7**	**5.7**	..
Competitors in Foreign Trade and Foreign Direct Investment											
Chile	..	0.9	8.9	..	7.2	6.6	6.7	5.5	5.2	..	4.9
Colombia	2.3	..	1.6	2.1	..	2.1	1.7	1.9	..	4.9	4.4
Mexico	10.1	11.2	..	11.7	11.4	10.3	10.8	9.3	6.1	5.5	5.5
Peru	..	..	..	..	..	..	..	..	..	..	..
Countries with Similar Socio-Economic Characteristics											
Panama	3.0	3.2	5.9	7.3	8.7	4.6	4.4	4.5	4.5	11.6	..
Uruguay	..	..	..	..	5.7	5.5	6.3	6.9	7.8	..	..
Emerging Economies											
Ireland	18.4	17.6	14.8	16.2	13.8	15.1	13.9	10.9	11.2	..	11.9
Republic of Korea	10.1	10.6	10.2	7.4	7.3	7.4	7.6	7.5	..	7.3	7.1
Singapore	..	..	..	..	..	..	..	..	..	..	..
Knowledge and technology leaders											
Finland	7.4	9.0	8.8	..	8.7	8.8	..	7.6	7.8	8.0	7.5
Japan	2.8	2.9	3.0	2.9	3.0	3.0	3.0	3.0	3.1	3.1	3.1
United States	9.4	10.4	8.8	9.4	8.9	8.7	8.4	8.3	8.5	8.6	8.9

Source: Author's calculations using data from UNESCO.
Note: … = data not available.

In terms of the percentage of graduates from tertiary programs in engineering, manufacturing, and construction programs (both sexes), Costa Rica is at a disadvantage in its efforts to create a stock of human capital that will allow the country to truly absorb, create, and disseminate knowledge, and thus to move toward an innovation-based economy (Table 3.13). Indeed, most of the comparable countries show a much higher percentage of graduates in this area than does Costa Rica. In some cases, this percentage can be up to four times higher.

Table 3.13 Costa Rica and Comparable Countries: Percentage of Tertiary Graduates in Engineering, Manufacturing, and Construction, Both Sexes 2002–12

Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Costa Rica	6.0	..	..	..	..	6.2	..	..	5.7	6.2	..
Competitors in Foreign Trade and Foreign Direct Investment											
Chile	..	25.3	16.3	..	17.1	17.3	15.6	14.9	14.8	..	14.3
Colombia	22.4	..	23.3	23.4	..	23.8	25.6	22.3	..	17.4	17.1
Mexico	15.0	17.5	..	15.5	15.6	16.0	15.4	16.3	19.3	21.3	21.3
Peru	..	..	..	..	..	..	..	..	..	..	..
Countries with Similar Socio-Economic Characteristics											
Panama	15.1	16.4	7.9	11.2	11.1	15.9	14.7	14.7	14.8	10.5	..
Uruguay	..	..	..	..	6.6	6.2	5.7	6.7	7.8	..	..
Emerging Economies											
Ireland	10.6	11.7	12.6	12.0	12.1	8.5	10.5	10.8	12.0	..	11.9
Republic of Korea	30.0	28.4	27.5	29.5	28.1	26.4	24.8	23.4	..	24.6	23.9
Singapore	..	..	..	..	..	..	..	..	..	..	..
Knowledge and technology leaders											
Finland	21.3	20.7	21.2	..	20.7	19.9	..	20.6	24.0	19.7	20.1
Japan	19.4	19.2	18.6	18.5	18.2	17.8	17.7	17.5	17.4	17.2	17.1
United States	8.0	7.8	7.7	7.4	7.2	7.0	7.0	7.0	7.0	7.2	7.2

Source: Author's calculations using data from UNESCO.
Note: … = data not available.

With reference to the quality of education in Costa Rica, Padilla, Gaudín, and Rodriguez (2012) argue that the teaching methodology in the country is still generally traditional and the curriculum system is usually very rigid, which locks students into a passive mode of learning and does not encourage them to innovate and relate their studies to the productive sector (which would be facilitated by a "dual" educational methodology involving internships and formal relationships and long-term partnerships between universities and businesses in teaching). Higher education does not develop students' ability to transform their ideas into concepts and then products, services, or innovative production processes. The way in which students are taught has important consequences for the attitudes of future entrepreneurs and economic actors in countries like Costa Rica, particularly in the early phases of innovation (Dornberger, Suvelza, and Bernal, 2011), and the higher education system does not currently contribute to creating a favorable environment for innovation.

Bovenschutle (2010) argues that in countries like Costa Rica education usually does not encourage innovative and creative spirit in the population, because the system has no "new thinking" oriented toward creativity and innovation. The education system—whether primary, secondary, or tertiary—suffers from a disconnection from labor and the practical world. Education does not usually stimulate critical thinking and creativity in students, and thus encourages a passive attitude toward knowledge.

Researchers: Finally, the supply of researchers in Costa Rica, and the number of them engaged in R&D activities, are another determinant of an environment that enables

innovation; these figures indicate the human resources already dedicated to creating, adapting, and diffusing basic and applied knowledge.

Table 3.14 shows the number of researchers per million inhabitants, while Table 3.15 shows the number of researchers dedicated to R&D activities per million people. Costa Rica occupies an intermediate position, with a lower number of researchers than most technologically oriented countries, but a higher number than the Latin American countries in the comparison group. Costa Rica's relative position is the same on both measures.

Most technologically oriented countries have between three and five times more researchers, and researchers specifically dedicated to R&D activities, than Costa Rica. This last point highlights two very important gaps that Costa Rican authorities must address.

Table 3.14 Costa Rica and Comparable Countries: Researchers per Million Inhabitants, 2002–12

Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Costa Rica	**291.0**	**281.0**	**253.0**	**334.0**	**720.0**	**789.0**	**754.0**	**1570.0**	**1669.0**	**1868.0**	**..**
Competitors in Foreign Trade and Foreign Direct Investment											
Chile	..	..	..	..	..	593.0	629.0	516.0	551.0	..	..
Colombia	255.0	285.0	323.0	351.0	377.0	389.0	384.0	354.0	347.0	346.0	..
Mexico	..	413.0	..	..	324.0	334.0	327.0	369.0	382.0	386.0	..
Peru	..	..	181.0	..	..	..	..	..	..	..	..
Countries with Similar Socio-Economic Characteristics											
Panama	131.0	133.0	147.0	151.0	105.0	164.0	130.0	133.0	136.0	..	..
Uruguay	1154.0	..	..	..	955.0	..	695.0	773.0	857.0	747.0	735.0
Emerging Economies											
Ireland	3941.0	3959.0	4073.0	4246.0	4393.0	4523.0	4835.0	4739.0	4656.0	4893.0	..
Republic of Korea	4093.0	4253.0	4487.0	4990.0	5426.0	6077.0	6268.0	6710.0	7139.0	7699.0	..
Singapore	5205.0	5526.0	5771.0	6222.0	6388.0	6690.0	6881.0	6927.0	7199.0	7321.0	7247.0
Knowledge and technology leaders											
Finland	9656.0	10249.0	9796.0	9678.0	10113.0	10094.0	10378.0	10441.0	10650.0	10679.0	..
Japan	6267.0	6564.0	6551.0	6788.0	6880.0	6942.0	6996.0	6983.0	7021.0	7011.0	..
United States	..	..	..	..	..	..	..	..	..	..	..

Source: Author's calculations using data from UNESCO.
Note: … = data not available.

Table 3.15 Costa Rica and Comparable Countries: Researchers in R&D Activities per Million People, 2002–12

Country Name	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Costa Rica	**…**	**131.4**	**108.1**	**121.9**	**…**	**…**	**257.0**	**973.4**	**1199.9**	**1289.0**	**…**
Competitors in Foreign Trade and Foreign Direct Investment											
Chile	…	…	…	…	…	333.0	354.0	286.0	317.2	…	…
Colombia	127.9	139.3	155.5	165.9	176.3	184.5	181.2	163.7	154.2	184.3	…
Mexico	291.7	310.6	363.2	396.7	323.4	334.1	327.4	369.1	382.1	386.4	…
Peru											
Countries with Similar Socio-Economic Characteristics											
Panama	93.4	93.8	92.0	102.2	87.5	136.3	106.7	109.0	111.5	…	…
Uruguay	373.3	…	…	…	…	…	273.8	481.2	549.5	525.2	537.5
Emerging Economies											
Ireland	2382.2	2503.1	2694.7	2786.7	2880.2	2958.8	3332.5	3217.2	3173.1	3354.5	3513.2
Korea, Rep.	3059.0	3246.4	3337.9	3823.1	4228.9	4665.0	4933.1	5067.5	5450.9	5928.3	…
Singapore	4380.8	4706.2	4881.6	5291.8	5425.2	5769.4	5742.0	6149.9	6306.5	6494.1	6437.7
Knowledge and technology leaders											
Finland	7428.5	8003.5	7842.6	7544.6	7671.3	7369.2	7686.5	7644.0	7717.5	7422.9	7482.3
Japan	4935.0	5156.1	5156.8	5360.2	5387.0	5377.7	5157.7	5147.4	5151.3	5157.5	…
United States	3607.8	3845.4	3739.9	3692.8	3755.5	3731.4	3883.9	4042.1	3837.6	3978.7	…

Source: Author's calculations using data from UNESCO.
Note: … = data not available.

It can perhaps be claimed that Costa Rica lacks a *culture of innovation*, which according to Oppenheimer (2014: 283) is:

> "a climate that produces a collective enthusiasm for creativity, and glorifies productive innovators in the same way that the great artists or great sportsmen are glorified and that challenges people to take risks without fear of being stigmatized by failure."

This lack of innovative culture largely explains the low number of researchers, in per capita terms, and helps to explain why R&D investment is too low in Costa Rica, as will be discussed later. Hwang and Horowitt (2014: 10) best explain the importance of developing a culture of innovation as the following:

> "(…) the greatest economic value is created in transactions between people who are the most different from one another. Human nature, with its innate prejudices, creates enormous transaction costs in society. They are still constrained by invisible transaction costs caused by social barriers based on geographical distance, lack of trust, differences in language and culture, and inefficient social networks. [In order to] overcome these transaction costs a distinct set of social behaviors [is needed]. These social behaviors correspond to the mechanisms that are necessary to maximize the free flow of talent, ideas, and capital in a human network."

It is therefore important to facilitate the participation of foreign human talent in innovation activities undertaken by firms in Costa Rica, which means, among other

measures, improving the system of recognition of qualifications as recommended by the World Bank (2014) and making it easy for foreign experts and national companies to collaborate in innovation projects. Indeed, the first State of Science, Technology and Innovation in Costa Rica Report (Estado de la Nación, 2014) points out that the talents of the Costa Rican scientific community based abroad are vital to complement human resources in science and technology at home. Between November of 2012 and February of 2013, 395 persons were identified who were studying or working abroad in the areas of experimental sciences (including the exact and natural sciences, medical sciences, and agricultural sciences), engineering, and technology.

It is equally important to improve the system of higher education: making it bilingual and enabling Costa Rican students to pursue higher studies at recognized universities worldwide would promote what Oppenheimer (2014) has called the globalization of innovation.

3.1.2 Innovation Efforts

Through the analysis of Costa Rica's situation relative to comparable countries in several specific areas, it is possible to assess the degree to which the country is really working to promote innovation efforts. These areas include R&D expenditures, the number of scientific and technical journal articles per researcher, the share of capital goods in total imports, and the payment for licenses and royalties.

R&D expenditure/GDP: R&D expenditure relative to GDP is a classic measure of innovation effort. Data from Table 3.16 show that Costa Rica's position according to this indicator is similar to that of México, Chile, and Uruguay, but very low relative to most technologically oriented countries, which invest between three and eight times more in R&D than Costa Rica does. This last result shows a large gap between most technologically oriented countries and Costa Rica, where the actual level of investment in R&D is five times lower than its optimal level, which should be 2.53 percent of GDP.

In a country such as Costa Rica, many basic opportunities for innovation may exist that do not necessarily require formal expenditures in R&D; therefore, other indicators related to innovation efforts may help to form clearer ideas about this topic. Section 4 will present a more detailed analysis of R&D expenditures.

Table 3.16 Costa Rica and Comparable Countries: R&D Expenditure/GDP, 2002–12

Country Name	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Costa Rica	**…**	**0.4**	**0.4**	**…**	**0.4**	**0.4**	**0.4**	**0.5**	**0.5**	**0.5**	
Competitors in Foreign Trade and Foreign Direct Investment											
Chile	…	…	…	…	…	0.3	0.4	0.4	0.4	…	
Colombia	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2
Mexico	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.4	
Peru	0.1	0.1	0.1	…	…	…	…	…	…	…	…
Countries with Similar Socio-Economic Characteristics											
Panama	0.4	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	…	
Uruguay	0.2	…	…	…	0.4	0.4	0.4	0.4	0.4	0.4	
Emerging Economies											
Ireland	1.1	1.2	1.2	1.2	1.2	1.3	1.4	1.7	1.7	1.7	1.7
Korea, Rep.	2.4	2.5	2.7	2.8	3.0	3.2	3.4	3.6	3.7	4.0	
Singapore	2.1	2.0	2.1	2.2	2.2	2.4	2.6	2.2	2.1	2.2	2.1
Knowledge and technology leaders											
Finland	3.4	3.4	3.5	3.5	3.5	3.5	3.7	3.9	3.9	3.8	3.5
Japan	3.1	3.1	3.1	3.3	3.4	3.5	3.5	3.4	3.3	3.4	
United States	2.5	2.6	2.5	2.5	2.5	2.6	2.8	2.8	2.7	2.8	2.8

Source: Author's calculations using data from the World Bank: data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS/countries
Note: … = data not available.
Expenditures for R&D are current and capital expenditures (both public and private) on creative work undertaken systematically to increase knowledge, including knowledge of humanity, culture, and society, and the use of knowledge for new applications. R&D covers basic research, applied research, and experimental development.

Scientific and technical journal articles: The number of articles published by Costa Ricans in scientific and technical indexed journals is another indicator of research effort. Table 3.17 shows the position of Costa Rica relative to comparable countries according to this indicator: next to last, only above Peru in the number of scientific and technical journal articles per researcher.

Table 3.17 Costa Rica and Comparable Countries: Number of Scientific and Technical Journal Articles per Researcher, 2002–11

Country Name	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Costa Rica	**0.07**	**0.08**	**0.08**	**0.07**	**0.03**	**0.03**	**0.03**	**0.01**	**0.01**	**0.01**
Competitors in Foreign Trade and Foreign Direct Investment										
Chile	...	...	...	...	...	0.18	0.17	0.21	0.20	...
Colombia	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04
Mexico	0.24	0.25	0.24	0.24	0.34	0.23	0.28	0.27	...	...
Peru	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Countries with Similar Socio-Economic Characteristics										
Panama	...	...	0.10	...	...	...	...	...	...	...
Uruguay	0.04	...	...	...	0.06	...	0.11	0.09	0.08	0.11
Emerging Economies										
Ireland	0.11	0.11	0.12	0.12	0.12	0.13	0.12	0.13	0.14	0.14
Korea, Rep.	...	0.68	...	...	1.14	1.14	1.32	1.23	1.28	1.33
Singapore	0.12	0.13	0.14	0.14	0.14	0.12	0.12	0.12	0.12	0.12
Knowledge and technology leaders										
Finland	0.10	0.09	0.10	0.09	0.10	0.09	0.09	0.09	0.09	0.08
Japan	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.05	0.05
United States	...	...	...	...	...	...	...	...	...	...

Source: Author's calculations using data from World Bank, World Development Indicators.
Note: … = data not available.

Value of capital goods imports versus total imports: Capital goods imports embody knowledge that may not be available in Costa Rica, so as a share of total imports they are an important indicator of innovation effort. As shown in Table 3.18, the share of this type of goods in total imports in Costa Rica was approximately one-third between 2002 and 2006, and somewhat less from 2007 to 2013. On the other hand, in comparison to other countries Costa Rica shows a relatively high share of these goods, being surpassed only by Mexico and Singapore.

Table 3.18 Costa Rica and Comparable Countries: Share of Capital Goods Imports in Total Imports, 2002–13
(percent)

Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Costa Rica	**34.6**	**36.1**	**31.9**	**35.0**	**34.3**	**28.5**	**28.1**	**25.5**	**27.7**	**29.3**	**29.4**	**28.8**
Competitors in Foreign Trade and Foreign Direct Investment												
Chile	24.1	23.4	21.2	22.2	20.4	19.5	19.0	23.9	20.5	20.2	20.3	22.3
Colombia	21.5	23.8	24.6	25.6	24.2	24.5	24.2	23.5	23.1	21.5	22.1	22.5
Mexico	35.1	35.1	36.3	35.1	35.7	31.8	34.0	36.9	36.1	33.9	34.2	35.2
Peru	21.0	21.7	20.8	21.2	22.4	21.7	23.0	24.6	22.5	22.8	23.3	22.8
Countries with Similar Socio-Economic Characteristics												
Panama	15.8	17.0	#¡VALOR!	16.8	14.4	14.7	15.9	14.2	15.3	14.3	17.8	18.1
Uruguay	14.7	12.4	14.0	15.4	14.9	16.2	15.4	18.3	17.5	16.5	15.2	17.9
Emerging Economies												
Ireland	41.8	35.5	33.1	32.9	32.2	28.1	25.1	20.9	17.4	16.9	18.7	18.7
Singapore	53.0	52.6	53.6	50.8	49.4	46.8	39.8	41.2	41.8	36.3	36.0	37.1
Knowledge and technology leaders												
Finland	29.2	26.9	25.9	27.3	25.0	24.3	23.5	22.8	19.9	19.6	19.3	18.2
Japan	22.6	22.5	22.7	21.5	20.9	19.8	16.8	18.5	18.5	16.7	16.8	17.7
USA	23.7	23.1	23.3	22.8	22.4	22.2	21.1	23.9	23.8	23.3	23.7	24.1

Source: Author's calculations using data from COMTRADE.

Payments for licenses and royalties: The payment of licenses and royalties reflects purchases of knowledge of design and processes from nonresidents that are likely

unavailable in the country, making the amount paid for licenses and royalties related to GDP another important indicator of innovation effort. Table 3.19 shows the figures of this indictor for Costa Rica and other countries in the comparison group. As can be seen, Costa Rica spends an important amount on purchases of knowledge of design and processes; this amount did not vary significantly between 2005 and 2012. Although the figures for Costa Rica are higher than those of other Latin American countries such as Colombia, Peru, Panama, Mexico, and Uruguay, they are relatively low with respect to what most technologically oriented countries spend. Indeed, Ireland spends more than 105 times as much as Costa Rica on these payments.

Table 3.19 Costa Rica and Comparable Countries: Payment for Licenses and Royalties/GDP, 2005–12
(percent)

Country Name	2005	2006	2007	2008	2009	2010	2011	2012
Costa Rica	**0.28**	**0.39**	**0.20**	**0.21**	**0.22**	**0.18**	**0.14**	**0.19**
Competitors in Foreign Trade and Foreign Direct Investment								
Chile	0.28	0.25	0.26	0.29	0.35	0.33	0.31	0.32
Colombia	0.08	0.08	0.09	0.11	0.13	0.13	0.13	0.14
Mexico	0.22	0.19	0.13	0.08	0.20	0.06	0.07	0.09
Peru	0.11	0.11	0.11	0.13	0.13	0.13	0.13	0.12
Countries with Similar Socio-Economic Characteristics								
Panama	0.29	0.25	0.27	0.24	0.24	0.16	0.21	0.11
Uruguay	0.04	0.04	0.03	0.05	0.07	0.07	0.07	0.07
Emerging Economies								
Ireland	9.49	9.89	9.25	13.43	15.53	17.89	18.06	19.99
Korea, Rep.	0.51	0.46	0.46	0.56	0.80	0.83	0.61	0.69
Singapore	7.31	6.05	4.96	6.48	6.11	5.93	5.98	5.75
Knowledge and technology leaders								
Finland	0.57	0.62	0.59	0.78	0.56	0.55	0.52	0.66
Japan	0.32	0.36	0.38	0.38	0.33	0.34	0.32	0.34
United States	0.20	0.18	0.18	0.20	0.22	0.22	0.22	0.25

Source: Author's calculations using data from World Bank, World Development Indicators.

3.1.3 Infrastructure

When considering the infrastructure needed to promote innovation activities, three basic indicators are especially important to analyze: quality of overall infrastructure, broadband Internet subscribers, and Internet access at home. In fact, infrastructure reduces remoteness both domestically and internationally and, hence, facilitates the circulation of knowledge and formation of networks. Access to ICT, especially Internet access, is very important because it can partially compensate for deficiencies in physical transport infrastructure.

Quality of overall infrastructure: According to the World Economic Forum's *Global Competitiveness Report 2013/2014*, Costa Rica shows a very serious competitive disadvantage in the quality of overall infrastructure, occupying the 97th position among 144 countries (Table 3.20). This is without doubt a very important area in which Costa Rican authorities must work to facilitate innovation efforts.

Table 3.20 Costa Rica and Comparable Countries: Quality of Overall Infrastructure

Country Name	Score	Rank
Costa Rica	**3.8**	**97**
Competitors in Foreign Trade and Foreign Direct Investment		
Chile	5.0	45
Mexico	4.4	66
Peru	3.6	101
Colombia	3.3	117
Countries with Similar Socio-Economic Characteristics		
Panama	5.2	30
Uruguay	3.9	88
Emerging Economies		
Ireland	5.2	35
Korea, Rep.	5.6	23
Singapore	6.4	5
Knowledge and technology leaders		
Finland	6.5	3
Japan	6.0	14
United States	5.7	19

Source: Author's calculations using data from World Economic Forum, *Global Competitiveness Report 2013/2014*.

Costa Rica's infrastructure weakness is mostly associated with deficits in road, rail, and port infrastructure. However, the country has been working for several years to make more intensive use of public-private partnerships in these areas, through the mechanism of concessions. As a result, important progress was made in 2014 when the concession was granted for construction of a modern container port in Limón, the country's main port. In addition, efforts are being made to both extend the railroad network and its quality through the granting of concessions of this service. Continuous improvements are being made in the national road network, as for instance in the Cañas-Liberia and Cañas-Barranca highways, thanks to external funding from the IDB. Last, but equally important, the country has begun using the services provided by the United Nations Office for Project Services

(www.unops.org/espanol/Paginas/Home.aspx), as a mechanism to streamline the contracting and execution of public works.

ICT: The market value of firms is the central axis of an information economy, where value depends on the profits generated by the firms. In turn, these profits depend on economic growth, which is based on productivity growth. The main source of productivity growth lies in innovation growth: innovation not only in new products, but also in processes and business organization. Financial markets allow the identification of funding sources for the best firms through the stock market. All of these constitute the value of having computerized financial markets.

Broadband internet subscriptions: Broadband Internet access is highly important because it can improve the movement of knowledge inside the country, as well as between Costa Rica and foreign countries, working as a vital facilitator for the flow of talent, ideas, and capital in human networks, as shown by the experience of more developed countries such as Finland. According to Castells and Himanen (2002), the foundation of Finnish society and its development lies in *informationalism*—that is, important activities are based on ICT use, globally organized in information networks, and centered around information processing. The central axis of the Finnish economy is access to the global network of financial markets, based on ICT use. Investors manage the composition of their portfolios with the help of computerized models, at high speed and in real time. Companies optimize their profits by organizing themselves as networks through the use of ICTs, and create goods whose production processes depend highly on information processing.

Table 3.21 shows the evolution of broadband Internet subscriptions per hundred inhabitants for Costa Rica and the other countries in our comparison group. These data show that Costa Rica is still behind some of its competitors; in fact, the availability of broadband Internet access is higher in Mexico, Chile, and Uruguay than in Costa Rica, and higher still in the most technologically-oriented economies such as Korea and Finland, where broadband Internet access is four times more available than in Costa Rica. Costa Rica has significantly increased the use of this type of Internet access since 2010, however, as a result of the liberalization of the telecommunication sector.

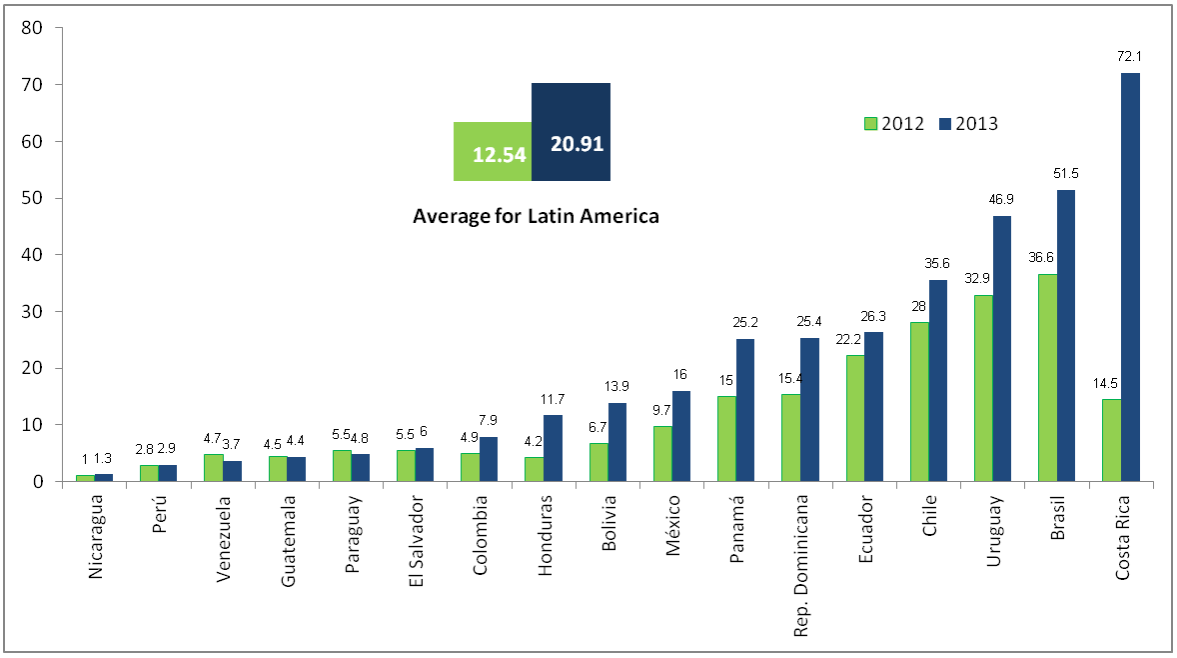
Table 3.21 Costa Rica and Comparable Countries: Broadband Internet Subscriptions per Hundred Inhabitants, 2002–13

Country Name	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Costa Rica	**0.22**	**0.36**	**0.66**	**1.04**	**1.89**	**2.13**	**2.37**	**3.91**	**8.49**	**8.73**	**9.32**	**9.72**
Competitors in Foreign Trade and Foreign Direct Investment												
Chile	1.19	2.20	2.96	4.34	6.18	7.73	8.48	9.68	10.37	11.54	12.33	12.25
Colombia	0.08	0.15	0.30	0.74	1.43	2.71	3.90	4.55	5.59	7.00	8.16	9.29
Mexico	0.22	0.40	0.97	1.74	2.69	3.94	6.46	7.97	9.42	9.94	10.52	11.14
Peru	0.14	0.35	0.83	1.27	1.73	2.01	2.53	2.80	3.12	4.02	4.74	5.18
Countries with Similar Socio-Economic Characteristics												
Panama	0.38	0.46	0.51	0.52	3.29	4.30	5.52	6.48	7.02	7.56	7.75	7.71
Uruguay	0.00	0.00	0.81	1.46	2.79	4.55	6.80	8.95	10.90	13.45	16.59	21.13
Emerging Economies												
Ireland	0.27	1.04	3.72	7.76	13.29	14.83	17.69	19.74	21.07	21.97	22.72	24.24
Korea (Rep.)	22.42	23.98	25.46	25.91	29.69	30.92	32.33	33.94	35.48	36.65	37.25	38.04
Singapore	6.53	9.80	12.46	14.60	17.08	18.94	21.12	23.58	24.98	25.62	25.44	25.70
Knowledge and technology leaders												
Finland	5.26	9.42	15.30	22.38	27.13	30.55	29.93	28.70	28.55	29.48	30.37	30.90
United States	6.85	9.47	12.64	17.16	20.02	23.11	24.69	25.32	26.50	27.45	28.45	28.54

Source: Author's calculations using data from the International Telecommunication Union (http://www.itu.int/ITU-D/ict/statistics/).

Even though Costa Rica was one of the last countries in the world to open its telecommunications market to competition, the results obtained to date encourage optimism about the future development of this sector. Certainly, as shown in Figure 3.2, in the year 2013 Costa Rica shows a clear leading role in Latin America in terms of mobile broadband Internet penetration, according to data from the International Telecommunication Union.

Figure 3.2 Costa Rica and other Latin American Countries: Mobile Broadband Internet Penetration, 2012–13



Source: Author's calculations using data from ITU (http://www.itu.int/ITU-D/ict/statistics/).

Percentage of households with Internet: Another indicator of Internet access is the percentage of households with Internet. As shown in Table 3.22, Costa Rica is relatively well positioned with respect to all Latin American countries except Uruguay. However, with respect to more technologically oriented countries, and the emerging countries in the comparison group, Costa Rica is still at a significant competitive disadvantage: in all of these countries broadband Internet penetration in households is between 25 percent and 50 percent higher than in Costa Rica.

Table 3.22 Costa Rica and Comparable Countries: Percentage of Households with Internet, 2011–13

Country Name	Internet access at home	Year of data
Costa Rica	**46.7**	**2013**
Competitors in Foreign Trade and Foreign Direct Investment		
Chile	40.9	2011
Colombia	35.7	2013
Mexico	30.7	2013
Peru	20.2	2012
Countries with Similar Socio-Economic Characteristics		
Panama	30.5	2012
Uruguay	48.4	2012
Emerging Economies		
Ireland	82.4	2013
Korea (Rep.)	98.1	2013
Singapore	84.0	2012
Knowledge and technology leaders		
Finland	89.2	2013
United States	71.7	2011

Source: Author's calculations using data from ITU (http://www.itu.int/ITU-D/ict/statistics/).

3.1.4 Business Environment

As part of the present effort, it is important to analyze indicators of the state of Costa Rica's business environment. These indicators include factors such as annual average GDP growth rates and their volatility; the general macroeconomic environment; the cost of funding (average real rate of interest); and how easy it is to do business in Costa Rica compared to the other countries included in this analysis.

Annual GDP growth rates and volatility: High rates of growth can be favorable to business investment, including innovations, but high volatility can inhibit such investment. Costa Rica's economy showed positive annual rates of growth from 2003 to 2013, except in 2009, the year of the global financial crisis (Table 3.23).[13] However, the volatility of these rates of growth during the whole period is relatively high, exceeded only by the volatilities reported for Singapore, Finland, Ireland, and Mexico. Thus, it appears that Costa Rica should not only increase the growth rate of its GDP, but also grow at a

[13] The impact of the global financial crisis was less severe in Costa Rica than in most developed countries, and the country recovered relatively quickly.

sustained rate and thus reduce volatility. Both objectives are important for improving innovation efforts.

Table 3.23 Costa Rica and Comparable Countries: Annual GDP Growth Rates and Volatility 2003–13

Country Name	GDP growth (annual %)											Volatility
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	SD
Costa Rica	**6.40**	**4.26**	**5.89**	**8.78**	**7.94**	**2.73**	**-1.02**	**4.95**	**4.51**	**5.13**	**3.50**	**2.64**
Competitors in Foreign Trade and Foreign Direct Investment												
Chile	3.96	6.04	5.56	4.40	5.16	3.29	-1.04	5.76	5.84	5.38	4.07	2.01
Colombia	3.92	5.33	4.71	6.70	6.90	3.55	1.65	3.97	6.59	4.05	4.26	1.59
Mexico	1.42	4.30	3.03	5.00	3.15	1.40	-4.70	5.11	4.04	3.98	1.07	2.79
Peru	5.16	4.96	6.28	7.53	8.52	9.14	1.05	8.45	6.45	5.95	5.82	2.24
Countries with Similar Socio-Economic Characteristics												
Panama	4.21	7.52	7.19	8.53	12.11	9.15	3.97	5.85	10.77	10.25	8.35	2.60
Uruguay	0.81	5.00	7.46	4.10	6.54	7.18	2.35	8.40	7.34	3.68	4.40	2.39
Emerging Economies												
Ireland	3.73	4.20	6.08	5.51	4.97	-2.16	-6.38	-1.06	2.17	0.16	-0.34	3.86
Korea, Rep.	2.93	4.90	3.92	5.18	5.46	2.83	0.71	6.50	3.68	2.29	2.97	1.65
Singapore	4.44	9.55	7.49	8.86	9.11	1.79	-0.60	15.24	6.06	2.50	3.85	4.45
Knowledge and technology leaders												
Finland	2.01	4.12	2.92	4.41	5.34	0.29	-8.54	3.36	2.82	-1.01	-1.38	3.92
Japan	1.69	2.36	1.30	1.69	2.19	-1.04	-5.53	4.65	-0.45	1.45	1.54	2.59
United States	2.79	3.80	3.35	2.67	1.79	-0.29	-2.80	2.51	1.85	2.78	1.88	1.87

Source: Author's calculations using data from World Development Indicators (data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG).
Note: Annual percentage growth rates of GDP are calculated using market prices based on constant local currency. Volatility of GDP growth rates is the standard deviation (SD).

Macroeconomic environment: The macroeconomic environment in Costa Rica needs to be improved to permit better promotion of innovative activities. The major concern in this area is the difficult situation of public finances, which demands important fiscal reform. According to the World Economic Forum, Costa Rica occupies position 80 out of 144 countries included in the *Global Competitiveness Report* ranking of macroeconomic environments (Table 3.24).

Table 3.24 Costa Rica and Comparable Countries: Macroeconomic Environment

	Macroeconomic Environment	
Country Name	**Score**	**Rank**
Costa Rica	4.6	80
Competitors in Foreign Trade and Foreign Direct Investment		
Chile	6.0	17
Colombia	5.6	33
Mexico	5.1	49
Peru	5.9	20
Countries with Similar Socio-Economic Characteristics		
Panama	4.9	57
Uruguay	4.5	85
Emerging Economies		
Ireland	3.6	134
Korea, Rep.	6.3	9
Singapore	6.0	18
Knowledge and technology leaders		
Finland	5.4	36
Japan	3.7	127
United States	4.0	117

Source: Author's calculations using data from the *Global Competitiveness Report 2013/2014*.

Average real rate of interest and funding: Other problems need to be solved to achieve a better climate for innovation in Costa Rica; of these, one of the most important is the cost of funding. Between 2011 and 2013 Costa Rica had, on average, the highest cost of funding among the countries in the comparison group (Table 3.25). High real interest rates suggest constraints in the financial markets on medium- to long term lending, and may discourage borrowing to finance innovation, forcing firms to rely on their own resources, which may not be generally available. The growing fiscal deficit creates significant distortions in the Costa Rican financial system; two of these distortions are the crowding-out of the private sector from access to loans, and upward pressure on interest rates as government borrowing increases demand for financing.

Table 3.25 Costa Rica and Comparable Countries: Average Real Interest Rate

Country Name	2011	2012	2013	Average
Costa Rica	**13.8**	**13.0**	**10.7**	**12.5**
Competitors in Foreign Trade and Foreign Direct Investment				
Chile	8.7	6.8	9.9	8.5
Colombia	9.2	8.0	13.9	10.3
Mexico	4.5	7.6	-1.9	3.4
Peru	…	…	…	…
Countries with Similar Socio-Economic Characteristics				
Panama	…	…	…	…
Uruguay	7.8	8.1	5.8	7.2
Emerging Economies				
Ireland	…	…	…	…
Korea, Rep.	…	…	…	…
Singapore	-0.2	0.8	2.7	1.1
Knowledge and technology leaders				
Finland	…	…	…	…
Japan	-0.2	2.6	21.4	7.9
United States	8.1	0.2	2.1	3.5

Source: Author's calculations using data from International Financial Statistics of the International Monetary Fund.

Another constraint on access to finance is that many companies cannot offer tangible assets as collateral for loans, but only intangible ones. Banks do not accept this type of collateral; Costa Rican authorities have not yet implemented legislation (the *Ley de Garantías Mobiliarias*) that allows firms—especially those in technology and knowledge—to offer intangible assets such as intellectual protection rights or the value of inventories as collateral. This would be a very important step forward, because many companies claim that their main obstacle related to the business environment is lack of access to funding (Box 2.1) (World Bank *Enterprise Survey* for Costa Rica, 2011)

Box 2.1 The Need of Funding for Growth and Innovation

Industrias Mafam specializes in the design and manufacture of biscuits and healthy snacks. This company has innovated in the production of children's snacks and unsweetened granola, addressing the need to better control the nutritional content of foods consumed by children of school age. The company invested first in its personnel, training its director of food safety in technology management, with the assistance of the technological managers program of the Ministry of Science, Technology and Telecommunications (MICITT).

After achieving management of innovation, the company needed to create a new system of incentives for workers to participate actively in proposing ideas for improvement. Through this program (Programa IDEAS) workers, on an ongoing basis, present ideas to the company on how to improve their production processes and products and how to create new products; that is, on innovation. These ideas are evaluated and assessed monthly. The winner of the month is rewarded in cash and also assigned an additional score in his/her biannual performance evaluation. The latter has a significant impact on staff remuneration. In addition, if the worker works as part of a team, the team also receives a prize.

The company has a specific budget for implementing innovative ideas a separately managed budget for R&D activities. Among the forms of support that the company has received from public institutions, training programs by the National Training Institute (INA) were used to validate the knowledge of its employees. Support from PROCOMER—for opening new markets through participation in international fairs and training in international trade—has also been valuable. As a result, the company currently exports to Central America, Colombia, Panama, and the Dominican Republic.

The company's accreditation within the Essential Costa Rica program that promotes the country's exports worldwide has also been valuable. Other support has been obtained from PROPYME for obtaining ISO-22000 certification and for training of personnel in charge of R&D. However, the potential of the company to innovate and grow is being constrained by the difficulty of obtaining financing from commercial banks. In fact, because the firm innovates in differentiating products for specific customers, its cost structure is very sensitive to the high interest rates prevailing in the Costa Rican financial system. This has limited the ability of Industrias Mafam to invest in R&D and grow in recent years.

Ease of doing business: Three subcategories of the World Bank's Doing Business index are particularly relevant in assessing the conditions for innovation in Costa Rica. These are "Starting a New Business," "Trading across Borders," and "Resolving Insolvency."

Startups (Starting a New Business): Starting a new business is a dimension of innovation. Costa Rica's position according to this indicator is 118th out of 184 countries evaluated in the Doing Business index, and it is the lowest of all countries

in the comparison group (Table 3.26). This result is owing to the relatively high number of procedures, number of days needed to complete these procedures, and the cost of starting a new business.

Table 3.26 Costa Rica and Comparable Countries: Starting a New Business

Country Name	Rank	DTF score for starting a business (0–100)	Procedures (number)	Time (days)	Cost (% of income per capita)	Minimum capital (% of income per capita)
Costa Rica	**118**	**80.9**	**9**	**24**	**11.5**	**0**
Competitors in Foreign Trade and Foreign Direct Investment						
Chile	59	89.8	7	5.5	0.7	0
Colombia	84	86.1	8	11	7.5	0
Mexico	67	88.9	6	6.3	18.6	0
Peru	89	85.1	6	26	9.2	0
Countries with Similar Socio-Economic Characteristics						
Panama	38	91.9	5	6	6.4	0
Uruguay	60	89.7	5	6.5	23.4	0
Emerging Economies						
Ireland	19	94.2	4	6	0.3	0
Korea, Rep.	17	94.4	3	4	14.5	0
Singapore	6	96.5	3	2.5	0.6	0
Knowledge and technology leaders						
Finland	27	93.1	3	14	1.1	7
Japan	83	86.2	8	10.7	7.5	0
United States	46	91.2	6	5.6	1.2	0

Source: Author's calculations using data from the Doing Business Index 2014/2015, World Bank

Trade Facilitation (Trading across Borders): The ability to export and import can stimulate innovation. Therefore, facilitating trade makes innovation more attractive as a response to market opportunities and threats. In this area, Costa Rica shows a relatively better position than was the case for starting a new business. Here, the country is ranked 47th out of 184 countries, higher than Peru, Uruguay, and Colombia among the countries in the comparison group (Table 3.27). The main reasons for this result are that while the time required (in days) to export and import is similar to that of most countries in the comparison group, obtaining documents to export and import, and the costs of such transactions, are higher than in other countries in the Table. Costa Rica has continued to make efforts to improve its export and import processes through a new technological platform, serving as a one-stop portal for foreign trade (VUCE 2.0). With this platform, all export and import procedures will be 100 percent digital, and it is expected to reduce users' costs by 90 percent. In addition, the World Trade Organization (WTO)'s Agreement

on Trade Facilitation (agreed upon in the 2013 Bali Ministerial Conference) is being implemented. Finally, efforts are being made to implement a modernization project at border crossing points.[14]

Table 3.27 Costa Rica and Comparable Countries: Trading across Borders

Country Name	Rank	DTF score for trading across borders (0–100)	Documents to export (number)	Time to export (days)	Cost to export (US$ per container)	Documents to import (number)	Time to import (days)	Cost to import (US$ per container)
Costa Rica	**47**	**80.8**	**5**	**14**	**1020**	**5**	**14**	**1070**
Competitors in Foreign Trade and Foreign Direct Investment								
Chile	40	82.1	5	15	910	5	12	860
Colombia	93	72.7	4	14	2355	6	13	2470
Mexico	44	81.3	4	12	1499	4	11.2	1888
Peru	55	78.8	5	12	890	7	17	1010
Countries with Similar Socio-Economic Characteristics								
Panama	9	91.3	3	10	665	3	9	1030
Uruguay	83	74.6	6	15	1125	7	14	1440
Emerging Economies								
Ireland	5	93.0	2	8	1160	2	9	1121
Korea, Rep.	3	93.5	3	8	670	3	7	695
Singapore	1	96.5	3	6	460	3	4	440
Knowledge and technology leaders								
Finland	14	89.1	4	9	615	5	7	625
Japan	20	87.2	3	11	829	5	11	1021
United States	16	88.3	3	6	1224	5	5.4	1289

Source: Author's calculations using data from World Bank Doing Business Index 2014/2015'

Creditor confidence in lending (Resolving Insolvency): If creditors can recover their assets, they will be more disposed to finance innovation. Costa Rica ranks 89th out of 189 countries in the Doing Business Index, and second-to-last among the group of comparable countries.

[14] According to information from the Ministry of Foreign Trade (COMEX).

Table 3.28 Costa Rica and Comparable Countries: Resolving Insolvency

Country Name	Rank	DTF score for resolving insolvency (0–100)	Time (years)	Cost (% of estate)	Recovery rate (cents on the dollar)	Strength of insolvency framework index (0–16)
Costa Rica	**89**	**44.0**	**3**	**15**	**26.5**	**9.5**
Competitors in Foreign Trade and Foreign Direct Investment						
Chile	73	47.4	3.2	15	30.0	10
Colombia	30	70.0	1.7	6	72.0	10
Mexico	27	75.6	1.8	18	68.1	11.5
Peru	76	46.6	3.1	7	28.5	10
Countries with Similar Socio-Economic Characteristics						
Panama	132	33.7	2.5	25	27.7	6
Uruguay	57	53.5	1.8	7	44.2	9.5
Emerging Economies						
Ireland	21	76.9	0.4	9	87.7	9.5
Korea, Rep.	5	90.1	1.5	4	83.1	14.5
Singapore	19	77.9	0.8	3	89.7	9.5
Knowledge and technology leaders						
Finland	1	93.9	0.9	4	90.2	14.5
Japan	2	93.7	0.6	4	92.9	14
United States	4	90.1	1.5	8	80.4	15

Source: Author's calculations using data from the World Bank Doing Business Index 2014/2015.

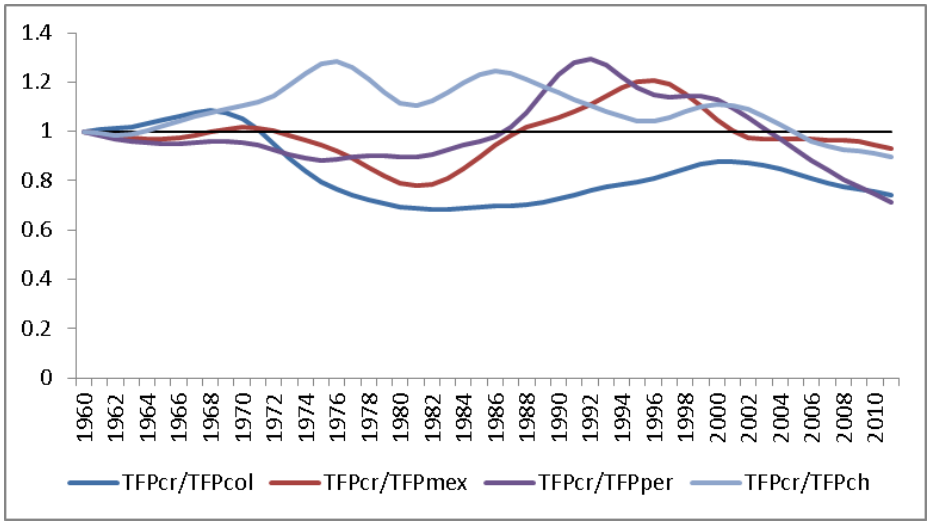
3.2. Innovation Outputs

3.2.1 Aggregate Productivity Growth

Increased productivity is the main outcome of successful innovation activities. Figure 3.3 shows the trend in TFP of Costa Rica in relation to four groups of countries, taking as a base the year 1960.

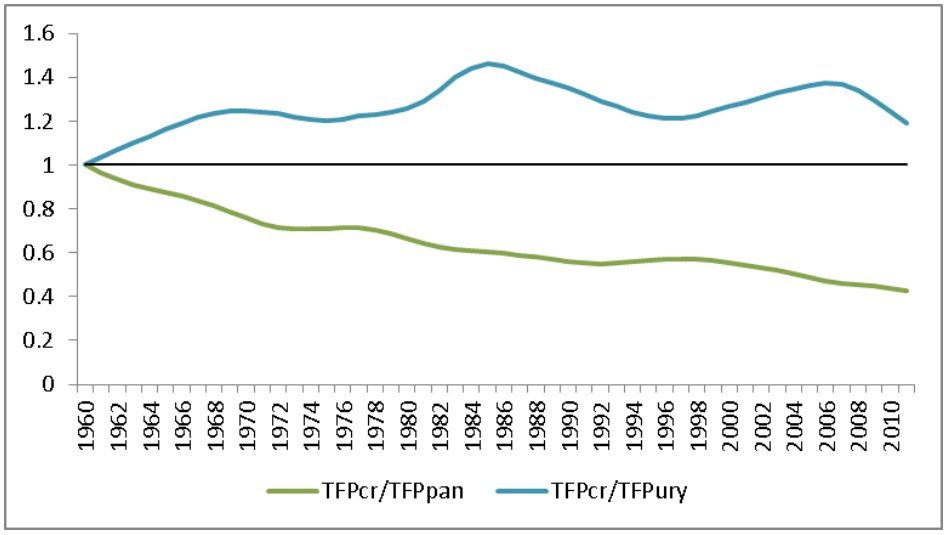
Panel 1 compares Costa Rica's TFP to those of four countries that are competitors in foreign trade and attracting FDI: Chile, Colombia, Mexico, and Peru. As can be seen in Panel 1, during the first 10 years of the analysis (1960-70) Costa Rica's productivity is not significantly different from that of the four comparison countries. However, strong differences appear between 1970 and 2000, with notable fluctuations. Starting in 2000, Costa Rica's productivity clearly begins to decline relative to the competing countries, particularly Peru and Colombia, and this situation continues to the present. In summary, Costa Rica is clearly in a period in which its productivity is growing less than that of the countries with which it competes in the international market.

Figure 3.3 Costa Rica vs. Comparable Countries: Trend of Total Factor Productivity
(1960 = 1)
Panel 1: Costa Rica vs. Competitors in Foreign Trade and FDI



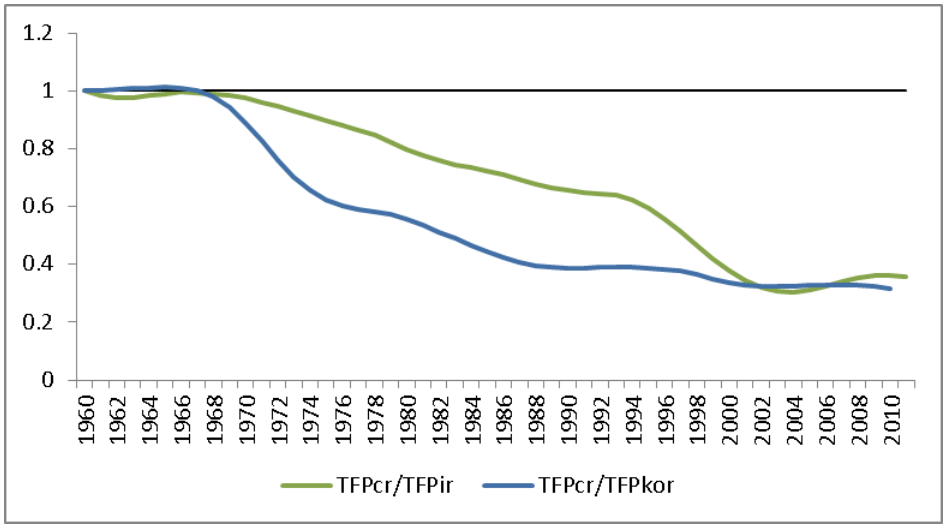
In the cases of Panama and Uruguay, two countries with socioeconomic characteristics similar to those of Costa Rica, Panel 2 shows that Costa Rica's TFP has been consistently higher than that of Uruguay, and lower than that of Panama, during the entire period analyzed. While Costa Rica's productivity relative to that of Panama decreases throughout the period—Panama's productivity is consistently growing more than Costa Rica's. The magnitude of the differences between Uruguay's productivity and Costa Rica's has fluctuated, but Costa Rica has consistently maintained higher levels of productivity.

Panel 2: Costa Rica vs. Countries with Similar Socioeconomic Characteristics

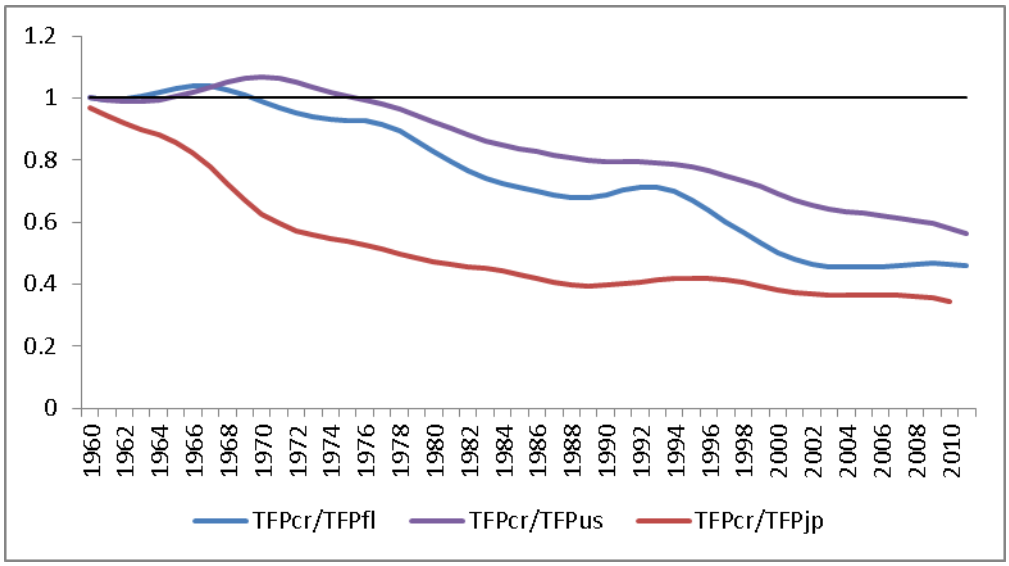


Finally, Panels 3 and 4 indicate that Costa Rica's productivity has been diverging in a sustained manner relative to Ireland's and the Republic of Korea's productivities (these are both emerging market economies), as well as vis-a-vis those of Japan, Finland, and the United States (world leaders in technology and knowledge), during almost the entire period of analysis. In other words, the productivity gap between these countries and Costa Rica is constantly increasing.

Panel 3: Costa Rica vs. Emerging Market Economies



Panel 4: Costa Rica vs. Knowledge and Technology Leaders



Source: Author's calculations using data from Fernández-Arias (2014).

These results show the great challenge: to be able to compete successfully in a more globalized world where efficiency and innovation are the key elements for success, Costa Rica needs to increase its productivity.

Finally, considering that productivity is the result of all factors, institutions, and policies that a country implements (i.e., its competitiveness agenda), it is evident that Costa Rican authorities have for many years been facing, and have not yet overcome, significant challenges in these particulars.

3.2.2 Scientific and Technical Articles

A standard way to measure success in science and technology research is the index of science and technology articles per billion of PPP$GDP. Table 3.29 shows that although Costa Rica is more successful than Colombia, Mexico, Panama, and Peru in terms of this indicator, it is still a poor performer when compared to all of the countries included in the Global Innovation Index, 95th overall out of 143 countries, far behind the rankings of the most technologically oriented countries and emerging market economies.

Table 3.29 Costa Rica and Comparable Countries: Scientific & Technical Articles
(per billion PPP$)

	Scientific & Technical articles/bn PPP$	
Country Name	**Score**	**Rank**
Costa Rica	6.5	95
Competitors in Foreign Trade and Foreign Direct Investment		
Chile	17.1	52
Colombia	6.1	97
Mexico	5.9	100
Peru	2.1	133
Countries with Similar Socio-Economic Characteristics		
Panama	5.6	103
Uruguay	12.7	67
Emerging Economies		
Ireland	36.2	22
Korea, Rep.	29.5	30
Singapore	32.3	27
Knowledge and technology leaders		
Finland	55.5	8
Japan	15.7	57
United States	20.5	45

Source: Author's calculations using data from the Global Innovation Index, 2014.

3.2.3 Number of Patents Filed

Patents filed by residents worldwide are an indicator of production of new indigenous knowledge. Residents of Costa Rica generate fewer patents than any other country in the comparison group (Table 3.30). It is interesting to note that residents from countries with similar populations, such as Uruguay and Panama, produce twice as many patents as Costa Ricans do. The position of Costa Rica in terms of patent generation appears somewhat more positive when patent applications by nonresidents are included, but the number of such applications is still low (Table 3.31).

Table 3.30 Costa Rica and Comparable Countries: Patent Applications by Residents[a]

Country Name	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Costa Rica	..	..	..	..	..	..	..	..	8	14	10
Competitors in Foreign Trade and Foreign Direct Investment											
Chile	391	329	382	361	291	403	531	343	328	339	336
Colombia	54	82	76	99	142	128	126	128	133	183	213
Mexico	526	468	565	584	574	629	685	822	951	1065	1294
Peru	29	32	38	27	39	28	31	37	39	39	54
Countries with Similar Socio-Economic Characteristics											
Panama	..	..	..	..	..	..	..	..	..	21	..
Uruguay	30	45	37	24	31	35	33	30	23	20	22
Emerging Economies											
Ireland	914	862	787	789	838	847	931	908	733	494	492
Korea, Rep.	76570	90313	105250	122188	125476	128701	127114	127316	131805	138034	148136
Singapore	624	626	641	569	626	696	793	750	895	1056	1081
Knowledge and technology leaders											
Finland	2162	1972	2011	1830	1816	1804	1799	1806	1731	1650	1698
Japan	365204	358184	368416	367960	347060	333498	330110	295315	290081	287580	287013
United States	184245	188941	189536	207867	221784	241347	231588	224912	241977	247750	268782

Source: Author's calculations using data from World Bank, *World Development Indicators*.

[a] Worldwide patent applications filed through the Patent Cooperation Treaty procedure or with a national patent office for exclusive rights to an invention.

Table 3.31 Costa Rica and Comparable Countries: Patent Applications by Nonresidents[a]

Country Name	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Costa Rica	..	..	..	..	..	..	..	..	1212	630	600
Competitors in Foreign Trade and Foreign Direct Investment											
Chile	2147	2076	2485	2646	2924	3403	3421	1374	748	2453	2683
Colombia	858	1127	1365	1662	1861	1862	1818	1551	1739	1770	1848
Mexico	12536	11739	12633	13851	14931	15970	15896	13459	13625	12990	14020
Peru	840	892	785	993	1232	1331	1504	657	261	1129	1136
Countries with Similar Socio-Economic Characteristics											
Panama	..	..	..	..	..	..	371	370	468	420	234
Uruguay	466	504	514	589	725	739	706	750	761	667	678
Emerging Economies											
Ireland	68	77	58	75	97	78	76	53	59	67	63
Korea, Rep.	29566	28338	34865	38733	40713	43768	43518	36207	38296	40890	40779
Singapore	7575	7248	7944	8036	8537	9255	8899	7986	8878	8738	8604
Knowledge and technology leaders											
Finland	207	215	209	229	202	211	147	127	102	124	129
Japan	56601	54909	54665	59118	61614	62793	60892	53281	54517	55030	55783
United States	150200	153500	167407	182866	204182	214807	224733	231194	248249	255832	274033

Source: Author's calculations using data from the World Bank, World Development Indicators

[a] Patent applications are worldwide patent applications filed through the Patent Cooperation Treaty procedure or with a national patent office for exclusive rights to an invention.

Finally, regarding patent applications by R&D researchers, it appears that Costa Rica is doing little in comparison with its peers. However, countries such as Finland and Ireland do not show outstanding performance either (Table 3.32).

Table 3.32 Costa Rica and Comparable Countries: Total Patent Applications/R&D Researchers

Country Name	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Costa Rica	**...**	**...**	**...**	**...**	**...**	**...**	**...**	**...**	**0.22**	**0.11**	**...**
Competitors in Foreign Trade and Foreign Direct Investment											
Chile	...	...	...	...	...	0.69	0.66	0.35	0.20	...	...
Colombia	0.17	0.21	0.22	0.25	0.26	0.24	0.24	0.22	0.26	0.23	...
Mexico	0.42	0.36	0.33	0.33	0.43	0.44	0.44	0.33	0.32	0.30	...
Peru	...	...	...	...	...	...	...	...	...	...	...
Countries with Similar Socio-Economic Characteristics											
Panama	...	...	...	...	...	...	...	...	...	...	...
Uruguay	0.40	...	...	...	...	...	0.81	0.48	0.42	0.39	0.38
Emerging Economies											
Ireland	0.10	0.09	0.08	0.07	0.08	0.07	0.07	0.07	0.05	0.04	0.03
Korea, Rep.	0.17	0.18	0.21	0.23	0.24	0.25	0.26	0.25	0.26	0.27	...
Singapore	0.45	0.41	0.42	0.38	0.38	0.38	0.35	0.28	0.31	0.29	0.28
Knowledge and technology leaders											
Finland	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.05
Japan	2.90	2.66	2.64	2.32	2.00	1.75	1.62	1.40	1.28	1.16	...
United States	0.32	0.31	0.33	0.36	0.38	0.41	0.39	0.37	0.41	0.41	...

Source: Author's calculations using data from the World Bank, World Development Indicators.

3.2.4 Licensing and Royalty Income

Licenses and royalty income per capita indicate market demand for the country's knowledge production. Consistent with the previous discussion, Costa Rica does not have a prominent position among the countries included in Table 3.33, indicating that the demand for the products of local knowledge production in this country is still not very strong.

Table 3.33 Costa Rica and Comparable Countries: Charges for the Use of Intellectual Property, Receipts
(BoP, current US$)/total population)

Country Name	2005	2006	2007	2008	2009	2010	2011	2012
Costa Rica	0.02	...	...	0.14	0.13	1.61	0.87	0.92
Competitors in Foreign Trade and Foreign Direct Investment								
Chile	3.31	3.34	3.68	3.78	3.48	3.74	4.35	4.32
Colombia	0.23	0.26	0.38	0.66	0.85	1.22	1.25	1.88
Mexico	0.63	0.72	0.83	0.85	0.81	0.75	0.81	0.79
Peru	0.06	0.10	0.04	0.05	0.08	0.10	0.18	0.38
Countries with Similar Socio-Economic Characteristics								
Panama	...	...	...	...	...	2.12	2.11	3.18
Uruguay	0.02	...	0.01	0.03	0.04	0.06	0.13	0.13
Emerging Economies								
Ireland	185.92	216.49	269.46	328.54	374.43	640.57	1093.20	1089.39
Korea, Rep.	14.94	16.01	13.58	18.65	25.08	24.67	33.92	26.93
Singapore	120.99	120.37	152.08	162.04	168.89	192.18	315.80	310.40
Knowledge and technology leaders								
Finland	229.97	203.15	242.24	280.14	328.54	434.27	591.60	612.40
Japan	366.76	415.44	477.98	525.05	441.18	539.97	582.35	637.79
United States	251.92	280.01	324.67	335.84	320.78	347.60	387.44	395.64

Source: Author's calculations using data from the World Bank, *World Development Indicators*.

3.2.5 ISO 9001 Quality Management Certificates/bn PPP$GDP (GII)

The issuance of ISO 9001 quality management certificates serves as an indicator of management innovation, a prerequisite for other forms of innovation. Costa Rica occupies position 74 out of 143 countries ranked in terms of this indicator (Table 3.34). Most of the technologically oriented countries do well, and some Latin American countries, such as Colombia, Uruguay, and Chile.

Table 3.34 Costa Rica and Comparable Countries: ISO 9001 Ranking, Quality Certificates
(per billion PPP$ GDP)

Country Name	Score	Rank
Costa Rica	4.0	74
Competitors in Foreign Trade and Foreign Direct Investment		
Chile	12.6	41
Colombia	19.9	21
Mexico	3.1	85
Peru	2.9	88
Countries with Similar Socio-Economic Characteristics		
Panama	2.0	99
Uruguay	13.8	34
Emerging Economies		
Ireland	12.5	42
Korea, Rep.	16.1	30
Singapore	18.0	25
Knowledge and technology leaders		
Finland	12.4	43
Japan	11.0	46
United States	1.6	110

Source: Author's calculations using data from the Global Innovation Index, 2014.

3.2.6 Trademark Applications Filed per Million Inhabitants

Trademarks indicate the capacity for creation of product differentiation. Costa Rica occupies a relatively strong position with respect to comparable countries, having been ranked between third and fifth in the capacity for creation of product differentiation on the Global Innovation Index throughout the period being analyzed (Table 3.35).

Table 3.35 Costa Rica and Comparable Countries: Trademark Applications
(per million inhabitants)

Country Name	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Costa Rica	2281.7	2189.8	2225.4	2300.6	2736.0	2633.5	..	..	2412.4	2981.2	2475.4
Competitors in Foreign Trade and Foreign Direct Investment											
Chile	1840.9	1815.1	1839.7	2066.2	1913.2	1924.6	1962.2	2350.3	2629.9	2064.5	1937.1
Colombia	371.1	390.8	398.1	461.7	494.3	539.2	519.7	460.7	559.6	617.8	669.1
Mexico	526.9	497.2	535.3	577.1	622.4	733.0	733.1	703.8	801.3	840.1	875.7
Peru	526.9	513.0	546.5	678.9	699.1	764.1	867.2	723.9	790.1	834.4	843.5
Countries with Similar Socio-Economic Characteristics											
Panama	1864.4	2368.2	2225.9	2408.5	2934.8	2752.5	3015.6	2365.4	2617.9	3040.4	3115.5
Uruguay	3688.1	3318.4	3883.5	3838.6	3668.2	3832.7	3434.3	2857.7	1699.3	1862.6	1720.9
Emerging Economies											
Ireland	1460.9	1547.3	1564.3	1520.7	1411.5	1345.3	1154.5	902.0	819.5	785.0	764.4
Korea, Rep.	2265.2	2311.2	2358.9	2556.5	2702.8	2907.3	2808.3	2728.9	2620.6	2684.7	2852.2
Singapore	3643.4	4017.9	4452.0	4944.2	4967.5	5135.3	3773.8	3074.0	3447.9	3656.5	3722.2
Knowledge and technology leaders											
Finland	1717.9	1532.5	1492.1	1474.6	1430.4	1399.2	1379.2	1042.2	1019.9	1010.9	993.7
Japan	921.7	966.1	1008.5	1064.8	1063.5	1121.0	935.4	867.2	893.7	844.2	966.1
United States	739.3	761.7	848.4	895.1	930.3	1009.6	967.0	869.8	911.1	982.2	999.3

Source: Author's calculations using data from the World Bank, World Development Indicators.

3.2.7 Startups

Data on new business ownership from the Global Entrepreneurship Monitor (GEM) indicate entrepreneurial activities that have or could generate innovations. Costa Rica is tied with Uruguay for fourth position among the countries in this index, behind only Chile, Colombia, and Peru (Table 3.36). In most Latin American countries, however, many startups are not necessarily associated with market-opportunity innovations, but rather represent survival innovations (Kantis, Ishida, and Komori, 2002; Kantis, Angelelli, and Morí, 2004; and Leiva, 2002). Therefore, this result should be interpreted cautiously.

Table 3.36 Costa Rica and Comparable Countries: New Business Ownership 2012

Country Name	Percentage
Costa Rica	**5.0**
Competitors in Foreign Trade and Foreign Direct Investment	
Chile	8.0
Colombia	7.0
Mexico	4.0
Peru	6.0
Countries with Similar Socio-Economic Characteristics	
Panama	3.0
Uruguay	5.0
Emerging Economies	
Ireland	2.0
Korea, Rep.	4.0
Singapore	4.0
Knowledge and technology leaders	
Finland	3.0
Japan	2.0
United States	4.0

Source: Author's calculations using data from the Global Entrepreneurship Monitor, 2012.

3.2.8 Export Concentration in Goods

A high degree of export concentration in goods would indicate low levels of innovation in export diversification, often considered critical for achieving economic catch-up. Table 3.37 shows the Herfindahl-Hirschman Indices (HHI) for Costa Rica and comparable countries, estimated using the six-digit Harmonized System (HS) Classification data from COMTRADE, except in the cases of Mexico and Malaysia, where data at the three-digit level had to be used owing to data availability problems.

Table 3.37 Costa Rica and Comparable Countries: Export Concentration in Goods
(Herfindahl-Hirschman Indices, 2007–13)

	2007	2008	2009	2010	2011	2012	2013
Costa Rica	0.05	0.04	0.09	0.04	0.05	0.05	0.06
Colombia	0.06	0.08	0.09	0.14	0.20	0.22	0.24
Mexico*	…	0.04	0.03	0.04	0.04	0.04	0.03
Ireland	0.03	0.03	0.04	0.05	0.04	0.04	0.04
Malaysia*	…	…	0.04	0.04	0.04	0.04	0.04

Source: Author's calculations using data from COMTRADE, 2007–13.
* Herfindahl-Hirschman Indices were estimated using six-digit Harmonized System (HS) Classification and COMTRADE data, except in the cases of Mexico and Malaysia, where three-digit HS codes were used instead.

According to the HHI values, Costa Rica and most of the other countries in Table 3.37 have a diversity of exports, which facilitates innovation activities.

3.2.9 New Goods Exports

A new export from a country is an indicator of innovation. For the purposes of this analysis, a new export is one that was not exported in either 2007 or 2008, was first exported in 2009, and continued being exported without interruption through 2013. The analysis used six-digit HS classification values; in the cases of Mexico and Malaysia, the periods analyzed include fewer years (2008–13 and 2009–13, respectively) owing to data limitations. As in the analysis of export concentration in goods, three-digit HS classification codes were used for Mexico and Malaysia.

Table 3.38 Costa Rica and Comparable Countries: New Exports, 2007–13
(Six-digit Harmonized System Classification)

Country	Total	Old exports	Unsustained new exports	Sustained new exports
Costa Rica	4095	3799	196	100
Colombia	4460	4288	144	28
Mexico*	1209	1191	13	5
Ireland	4633	4424	160	49
Malaysia*	1217	1190	14	13

Source: Author's calculations using data from COMTRADE, 2007–13
* Data for Mexico are from the period 2008-13 and, for Malaysia, from the period 2009-13; three-digit HS classification codes were used for these two countries.

Costa Rica appears to be the most innovative country in terms of new exports (Table 3.38). In fact, during the period under review, Costa Rica managed to export 296 new products, of which only 100 were exported without interruption until 2013 (sustained new exports). Some of these new exports, however, may be due to the operations of MNCs in the country; such exports do not involve new products that were developed in the country—that is, they do not involve local innovations.

3.2.10 New Export Markets

Another indication of innovation in the area of exports is diversification of new markets. Costa Rica and all other countries in Table 3.39 have high numbers of countries that are already export destinations. Costa Rica has the lowest number of previously existing export destinations, and has only been able to add one new export destination that has been sustained since 2013. This evidence does not indicate notable innovation by Costa Rica in export markets.

Table 3.39 Costa Rica and Comparable Countries: New Export Markets, 2007–13

Country	Total	Old markets	Unsustained new export markets	Sustained new export markets
Costa Rica	201	194	6	1
Colombia	210	205	5	0
Mexico*	219	211	6	2
Irlanda	227	221	6	0
Malaysia*	233	229	1	3

Source: Author's calculations using data from COMTRADE, 2007–13
* Data for Mexico come from 2008-13 and for Malaysia from 2009-13.

3.2.11 Distribution of Export Values According to Technology Intensity

More medium- and high-technology exports from a country indicates a more knowledge-based economy and more innovation, though this inference would be weakened if exports have low added value. This latter reservation is relevant in the case of Costa Rica: according to some researchers, low added value is characteristic of its high-tech exports (Paus and Gallagher, 2008; Mulder, 2014). Indeed, Mulder (2014) points out that the export sector, and especially the chains operated by MNCs in Costa Rica, has few domestic linkages, compared to Mexico, Brazil, the Asia-Pacific region, and the European Union.

Table 3.40 shows the share of medium- and high-technology exports in total exports for Costa Rica and four comparable countries, according to the Standard International Trade Classification (SITC) Rev. 2 three-digit classification. For benchmarking purposes four countries that are relevant in terms of export performance were chosen: Colombia, Mexico, Ireland, and Malaysia.

The share of medium-tech exports in Costa Rica since 2012 is similar to that of high-tech exports (slightly more than 20 percent each). Moreover, the total share of both medium- and high-tech exports is similar to those of Ireland and Malaysia, and much higher than that of Colombia. This participation is due mostly to the participation of MNCs rather than domestic firms in the international arena (Gereffi et al., 2012)

Table 3.40 Costa Rica and other Exporting Countries: Participation in Total Exports of Medium- and High-technology Goods

Year	Costa Rica	Colombia	Mexico	Ireland	Malaysia
Medium-tech exports					
2007	0.17	0.19	0.36	0.12	0.16
2008	0.18	0.13	0.35	0.14	0.15
2009	0.12	0.12	0.35	0.13	0.16
2010	0.18	0.10	0.37	0.13	0.16
2011	0.19	0.08	0.38	0.13	0.16
2012	0.21	0.08	0.39	0.14	0.17
2013	0.21	0.09	0.42	0.15	0.16
High-tech exports					
2007	0.32	0.02	0.24	0.37	0.41
2008	0.28	0.02	0.26	0.37	0.26
2009	0.22	0.03	0.28	0.39	0.39
2010	0.25	0.02	0.26	0.36	0.37
2011	0.24	0.01	0.22	0.37	0.32
2012	0.23	0.01	0.23	0.34	0.31
2013	0.26	0.01	0.22	0.32	0.31
Medium plus High-tech exports					
2007	0.49	0.21	0.59	0.49	0.58
2008	0.45	0.15	0.61	0.51	0.41
2009	0.34	0.14	0.62	0.52	0.55
2010	0.43	0.12	0.63	0.49	0.53
2011	0.43	0.09	0.6	0.50	0.48
2012	0.44	0.10	0.62	0.48	0.48
2013	0.46	0.10	0.64	0.48	0.47

Source: Author's calculations using data from the COMTRADE SITC Rev. 2 three-digit classification.

Costa Rica will need to increase the participation of domestic businesses, primarily SMEs, in the exportation of medium and high technology. An, Oh, and Monge-González (2015) have recommended the implementation of projects that support the integration of SMEs into Global Value Chains (GVCs) and increasing the domestic value added of their exports, following the successful experiences of Korea with the development of Regional Innovation Systems. Such programs should focus on four major areas: (i) strengthening the linkages of SMEs with MNCs so as to integrate SMEs into GVCs; (ii) improving the innovation technology (products and processes) of SMEs to enhance their competitiveness; (iii) developing technicians and engineers through university-industry collaboration; and (iv) accelerating startups for economic growth, innovation, job creation, and technological advances by making the governance system more friendly for startup

and developing entrepreneurship. In addition, the authors also emphasize the relative importance of working to deregulate the Costa Rican economy.

The preceding discussion allows us to conclude that Costa Rica has strengths that can be taken advantage of, as well as weaknesses that must be overcome to succeed at making the transition to an economy led by innovation. As a first step in this direction, Kang and Bullon (2015) suggest implementing institutional reforms that enhance Costa Rica's capacity for innovation. Such institutional reform should have as a goal establishing an environment where innovation can be easily generated, and should cover three areas to promote innovation: (i) reinforcing organizations, (ii) formulating policies, and (iii) building up governance structure.

4. INNOVATION STAKEHOLDERS

This section identifies the main players in Costa Rica's National Innovation System (NIS). This discussion is not intended to provide an in-depth analysis, but rather a "descriptive x-ray" of the main actors in the overall NIS. These include firms, public and private research institutions, higher education institutions, and intermediary institutions.

4.1 Firms

4.1.1 Innovation in Manufacturing Firms

As discussed in chapter 1, R&D investments in Costa Rica have stagnated at about 0.5 percent of GDP, while its structural features (GDP per capita) suggest that this figure should be five times higher. At the same time, the private sector's contribution to R&D is particularly weak, ranging between 0.19 percent of GDP in 2006 and 0.09 percent in 2011 (Table 4.1). This is particularly problematic because the only probable means of increasing total R&D investment is through more active participation of the private sector.

Table 4.1. Costa Rica: R&D Investment, by Sector
(as percentage of GDP)

Sectors	2006	2007	2008	2009	2010	2011
All	0.43	0.36	0.40	0.54	0.50	0.45
Public sector	0.06	0.06	0.07	0.13	0.18	0.14
Academy	0.16	0.18	0.19	0.26	0.21	0.22
NGOs	0.02	0.02	0.02	0.01	0.01	0.01
Firms	0.19	0.11	0.12	0.14	0.09	0.09

Source: Innovation Surveys, Ministerio de Ciencia, Tecnología y Telecomunicaciones (MICITT).

The development of a more focused and pro-innovation strategy for attracting FDI becomes increasingly attractive. Emerging market economies are increasingly hosting R&D centers made possible through a combination of public support and transnational corporate strategies of opening research labs in emerging markets. The effects of this approach may be seen in the rising R&D expenditures in countries such as China, Malaysia, and India. Although Costa Rica has seen a gradual increase in the knowledge content of multinational companies' activities, R&D investment by these companies is still very low, and they face structural constraints in the form of lack of adequate and specialized advanced human capital (Monge-González and Tacsir, 2014). Other policies must be explored, such as providing incentives for university researchers to actively participate in projects aimed at generating innovations in companies, promoting the

creation of world-class research and innovation centers in the country, and improving the system of incentives so that firms will invest in R&D.

Based on FDI Intelligence data, the OECD (2012) reports that the number of business functions carried out in Costa Rica increased between 2003–05 and 2009–11. Manufacturing is still the top activity in terms of number of projects and job creation, but it has slowed in recent years. The 2009–11 data on greenfield investment projects in Costa Rica shows interesting new types of activities being carried out, including design, development and testing, R&D, and education and training. However, design, development, and testing accounted for a scant 4 percent of total national jobs created by greenfield FDI investments, one-third less than that for Malaysia (about 6 percent). Investment in R&D specifically accounts for less than 1 percent of total national FDI-created jobs (OECD, 2012). Nevertheless, the private sector nowadays contains slightly more than 2,000 employees working on R&D, out of a national total of 6,000 working in this area (MICITT, 2012).

Although most local companies appear to be investing little in R&D, the percentage of companies indicating that they are involved in innovative activities seems to be very high (87.1 percent) in 2010/11 (Table 4.2). Firms seem to be more involved in technological innovations (products and processes, 68 percent and 62.7 percent, respectively) than in nontechnological ones (organizational and commercialization, 41.5 percent and 43.7 percent, respectively).

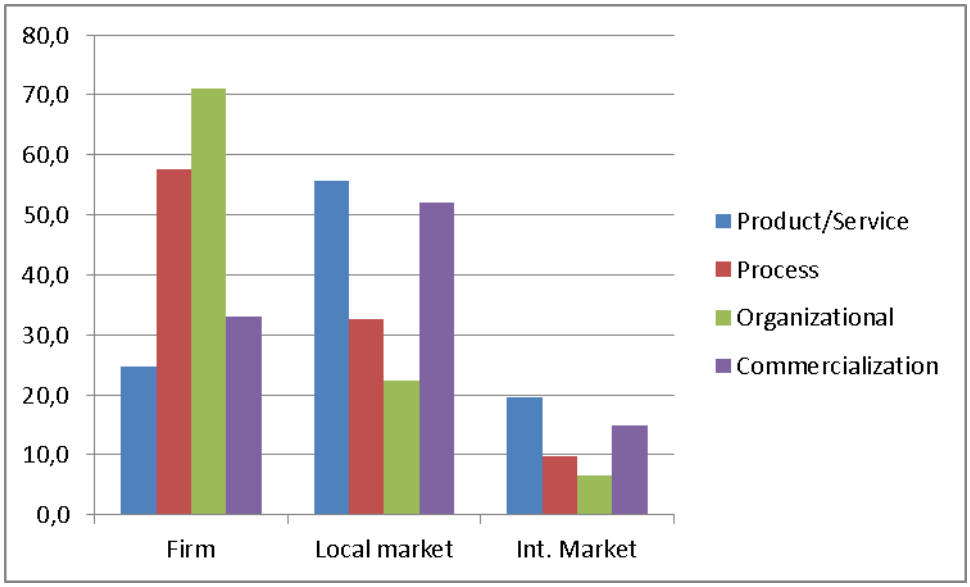
Table 4.2 Costa Rica: Firms Involved in Innovation Activities by Type of Innovation
(as a percentage of total manufacturing firms)

Innovation Type	2006-2007	2008	2009	2010-2011
Any type of innovation	93.6	90.1	87.5	87.1
Product/service	75.6	69.5	65.5	68.0
Process	65.0	56.6	49.2	62.7
Organizational	46.7	36.0	31.4	41.5
Commercialization	55.4	45.7	39.8	43.7

Source: Innovation Surveys, MICITT.

The innovative activities carried out by Costa Rican manufacturing firms seem to be more incremental than radical. Indeed, most of the firms claim that innovations are novel within their own organizations or the local market, rather than in international markets (Figure 4.1). However, there are exceptions, as discussed in Box 1.1.

Figure 4.1 Costa Rica: Novelty of Innovations by Type of Innovation, 2011



Source: Innovation Surveys, MICITT.

4.1.2 Investment in Innovation by Manufacturing Firms

The amount invested in R&D activities by manufacturing firms grew from 2006 to 2011 in firms of all sizes (Table 4.3). In fact, small businesses show an annual growth rate in this type of investment of 45.8 percent, while medium-sized and large firms show growth rates of 23.4 percent and 31 percent, respectively.

Table 4.3 Costa Rica: Average of R&D Investment, by Firm Size
(in U.S. dollars)

Firm size	2006	2007	2008	2009	2010	2011
Small	1,646	1,751	5,481	5,681	10,322	10,841
Medium	7,419	5,399	20,699	22,733	18,445	21,256
Large	76,608	46,447	74,108	107,138	255,583	296,230

Source: Innovation Surveys, MICITT.

Despite these results, the amount invested in R&D by manufacturing firms in Costa Rica is very low, amounting to less than one percent of total sales in all types of companies (Table 4.4).

Table 4.4 Costa Rica: R&D Investment as a Percentage of Total Sales, by Firm Size

Firm size	2006	2007	2008	2009	2010	2011
Small	0.44	0.37	1.01	1.02	0.86	0.73
Medium	0.48	0.19	0.53	0.72	0.43	0.44
Large	0.43	0.22	0.25	0.16	0.36	0.30

Source: Innovation Surveys, MICITT.

4.1.3 How Do Manufacturing Firms Finance Innovation Activities?

According to the 2006/2007 innovation survey, 60 percent of companies financed more than 75 percent of their spending on innovation activities by themselves, through reinvestment of their profits. Two other sources that were used to finance innovations were contributions by owners and banks, though the percentages of firms reporting this type of funding are very small (3.3 percent and 3.4 percent, respectively). This situation did not change significantly between 2006 and 2011. In fact, the funding sources used to carry out innovation activities in the overwhelming majority of companies remained the reinvestment of profits or contributions by owners. Almost no companies use the resources made available for such purposes by public agencies or international organizations, or by customers or suppliers.

Although there are a number of mechanisms in Costa Rica for financing innovation activities by SMEs (discussed further below), it is clear from the innovation surveys that the coverage of such funding sources remains too low. Only very small percentages of companies use this type of funding: 5.1 percent in the case of PROPYME and 3.4 percent in the case of the Incentives Fund. The reasons why companies do not make use of these financial instruments are very similar in all companies; the most important is that companies do not know about the availability of these funds (MICITT, 2012).

4.1.4 Public Funds for Innovation: PROPYME

In Costa Rica, only SMEs are potential beneficiaries of state support for investment in innovation activities. The idea of supporting investment in research and development (R&D) of SMEs originated more than two decades ago, with the passing of the Law for the Promotion of Scientific and Technological Development (Law 7169) in 1990, which created the Ministry of Science and Technology of Costa Rica (MICITT). A decade later, in the year 2000, a new mechanism called Financing of Technological Management for Industrial Change, or the Grants Fund (Fondo de Recursos Concursables, or FRC) was created. Its objective was to promote R&D in SMEs (companies with fewer than 100 employees) and

enhance management capacities and competitiveness. The FRC was developed by MICITT, the National Council for Scientific and Technological Research (CONICIT) and the Presidency (through the so-called Programa Impulso). In 2002, the FRC was modified in by Law 8262 (Law for the Strengthening of SMEs), which established a new fund called PROPYME (Programa de Fortalecimiento para la Innovación y Desarrollo Tecnológico de las PYMES) to promote entrepreneurship and competitiveness of Costa Rican SMEs through innovation and technological development, and to contribute to economic development.

The Economic Affairs Commission of the Congress concluded that SMEs required integrated Productive Development Policies (PDPs) to enhance systemic competitiveness and correct several distortions resulting from obsolete infrastructure, burdensome red tape and business creation costs, wide interest rate spreads, expensive public services and an inefficient tax system. The Commission supported Law 8262 based on a study that pointed out critical obstacles to SME growth, including:

- Limited access to market intelligence and advanced technologies
- Limited coordination among and between sectors
- Scarce resources for productive, R&D and training investments
- Limited access to financing due to guarantees and other banking requirements
- Low production volumes and quality standards which impede access to international markets
- Lack of entrepreneurial capabilities and limited managerial skills
- Limited support of current PDPs for SMEs

The Commission argued that the promotion of SMEs required a public policy to improve systemic competitiveness. In this context, and after reviewing the WTO Agreement on Subventions and Compensatory Measures (SCM), the Commission concluded that subsidies to correct evident market failures or those situations where high shadow costs exist (government failures) were permissible.

The transformation of the FRC into PROPYME was an important legal and institutional improvement. According to Law 8262, PROPYME resources come from Costa Rica's public budget, are allocated annually by the Incentives Commission at the MICITT, and are managed by CONICIT. This mechanism attempts to avoid resource allocation distortions caused by political influence, corruption, or, at least, moral hazard and discretionary management. The fund can be used to finance the following types of projects:

- Technology development
- Innovation and patent creation
- Technology transfer
- Human capital development
- Technological services development
- A combination or complementary pool of projects

MICITT is responsible for PROPYME policy design and implementation, and is directly involved in monitoring and accountability. In addition, the Ministry of the Economy serves as a consultative body, the Ministry of the Economy, Industry, and Commerce (MEIC) elaborates the general framework of the PDP, and CONICIT is responsible for monitoring and accountability.

Between 2003 and 2011 a total of 170 project proposals were submitted to the MICITT; only 143 were finally approved, and of the approved projects only 114 were finally funded.[15] These funded projects were carried out by 87 SMEs, and received a total amount of investment of US$1.7 million during that period—an average amount of US$15,067 allocated to each firm. The largest number of projects proposed was related to technological development; the largest number financed was related to human capital development. Funding for projects related to patents or firms did not request technology transfers during this period. The absence of funded projects aimed at registration of patents is a clear limitation on innovation and productivity growth among Costa Rican firms.

According to Monge-González, Rivera and Rosales (2010), the majority of managers in Costa Rican SMEs did not know about the existence of the PROPYME program, and were thus unable to take advantage of its financial instruments. Other companies indicated that they know about the program indirectly, because of information obtained from the Chamber of Industries. Once they learned what PROPYME did, the companies expressed their interest in applying, and emphasized the importance of this kind of policy to overcome technological and human capital weaknesses. Monge-González, Rivera, and Rosa (2010) stressed that between 2003 and 2008 local suppliers of MNCs undertook only 14 percent of the total PROPYME projects funded.

Based on the above results and the need for innovation improvements by local suppliers of MNCs, a cooperation agreement was signed in 2012 between the Ministry of

[15] Some businesses abandoned their projects for various reasons, most often because they were in disagreement with the research unit assigned to them for joint implementation of the project.

Foreign Trade (COMEX) and MICITT to increase the use of PROPYME resources by local MNC suppliers. As a result of this effort, the total amount of available resources for 2012 in PROPYME was allocated, and more than 40 of the beneficiaries were local suppliers of MNCs. This recent effort is of fundamental importance in light of an impact evaluation of PROPYME (Monge-Rodriguez and Rodriguez-Alvarez, 2013) that found that it has had positive and significant impacts on employment and exports of beneficiary firms, but not on the real average wages of the employees of these firms. In the first case, it may be concluded that among beneficiary firms, labor demand is 18.5 percentage points higher than among nonbeneficiaries. In the second case, it may be concluded that the probability of exporting among beneficiary firms is 3.2 times higher than among nonbeneficiaries. These impacts are observed for up to two years after the firm participated for the first time in the program (in the case of exports). Likewise, it was found that the time elapsed since the first treatment, as well as the amount of times a SME participated in the program, had a positive impact on labor demand, and on the beneficiary firms' likelihood of exporting.

Based on the size of the grants given to innovation and technological development projects in other Latin American countries such as Chile, Panama, and Uruguay, Maggi et al., (2012) suggest that Costa Rica should significantly increase the amount granted to firms for this type of project.[16] For example, these authors recommend increasing the amount of grants for technological R&D from $29,924 to US$90,000 and innovation grants from US$22,950 to US$40,000. Pending such increases, it remains clear that Costa Rica is currently investing very little through PROPYME in promoting innovation projects to be undertaken by domestic firms.

In summary, Costa Rican authorities face the challenge of increasing the allocation of resources for innovation activities, and the need to modify current mechanisms so as to include as potential beneficiaries all sizes of firms, not only SMEs.

4.1.5 Other Sources of Funding for Innovation Activities

There are other sources of funding available in Costa Rica for innovation activities: these include angel capital, seed capital and the stock market, two of which are not exclusive to SMEs.

[16] In Chile, a project on innovation can receive up to US$870,000, while in Panama this amount can be up to US$250,000 and in Uruguay up to US$400,000.

Angel capitalists: Yo Emprendedor (YE), a private program (to be described in more detail later) has undertaken two important initiatives to make funds available for innovative activities: the *Business Plan Competition* and *Finance*.

Business Plan Competition: In 2008 YE created the *Business Plan Competition*, which has allowed consolidating the entire entrepreneurial ecosystem in a single event, aims to give entrepreneurs exposure and visibility through the media, and promotes interaction with judges, investors, mentors, NGOs, and technical assistance organizations, among others. The Competition has consistently grown, not only in the number of projects received, but also in terms of categories, awards, regions, and especially in the quality of projects and depth of the training that competitors receive without cost.

The Business Plan Competition is a national call for projects generated by college students, business schools, researchers, professionals, and anyone who wants to start their own business and who requires funding, advice, and support. The main requirement every entrepreneur must meet to participate in the call is to have a creative and innovative project. To achieve its purpose, YE has alliances with the government, banks, research centers, and the private sector.

Its objective is to increase national knowledge about the need to create both more and better new firms. All this helps to increase the promotion of economic mobility and facilitate dialogues between entrepreneurs and public and private economic agents.

The competition seeks to create enriching experiences for participants, aimed at facilitating access to feedback, tools, contacts, and potential investors. In the case of finance, the aim is to encourage the creation and promotion of sources of capital for early-stage businesses. In Central America there are very few existing sources of capital for entrepreneurs, because of a lack of culture on the subject in the public and private sectors, and YE is constantly working with both sectors to develop financial mechanisms and to make them available to entrepreneurs. With the public sector, it has contributed to the creation of venture capital programs, while with the private sector it works in the promotion and networking of angel investors and private equity funds.

Seed capital: The shortage of venture capital is obvious in Costa Rica, where only businesses in the ICT sector have access to such resources. The WEF's Global

Competitiveness Index ranks Costa Rica 10th among the countries of the American continent in the availability of venture capital and 72nd worldwide. In 2008, the Costa Rican authorities promulgated the law of the Development Banking System, or SBD (Law No. 8634), through which the National Trust for Development (FINADE) was created, "which may provide resources to promote and encourage the creation, reactivation and development of businesses in diverse economic sectors, using models of seed and venture capital" (chapter III, Article 16).

In 2012, the SBD created a public seed capital fund (FCS), the first of its kind in Costa Rica. MEIC is in charge of the management of the fund. The main objective of the FCS is to support technology-oriented startups in conducting R&D and in commencing operations. Between 2013 and 2014, the FCS financed 48 projects undertaken by private firms and supported by incubators/accelerators (Auge, Parquetec, Parque la Libertad, UNA INCUBA, and Carao Ventures) (Table 4.5). The projects financed during these two years were concentrated in five specific areas: digital technologies (23), biotechnology (13), clean energy (7), new materials and nanotechnology (4), and electromechanical (1). The emphasis on digital technologies is consistent with the growth of this sector in the Costa Rican economy in recent years. The total amount of resources allocated during these two years through the FCS to support the above projects was US$2.3 million—approximately US$48,000 per project. This amount is slightly higher than what is awarded in other Latin American countries such as Chile and Uruguay for the development of new ventures.[17]

[17] In Chile the maximum amount is US$40,500, while in Uruguay the maximum amount is US$25,000 (see Monge-González and Rodríguez-Alvarez, 2013).

Table 4.5 Costa Rica: Projects Financed by the Seed Capital Fund, 2013–14

Categories	Projects financed	
	2013	2014
Digital technologies	20	3
Clean energy	6	1
Biotechnology	11	2
New materials and nanotechnology	3	1
Electromechanical		1
Total	**40**	**8**

Source: Sistema de Banca para el Desarrollo.

Stock market: According to Condo, Sanz, and Williamson (2005), a major constraint to encouraging greater financing for Costa Rican companies is the underdevelopment of the capital market, which limits options for selling or capitalizing companies. The National Stock Exchange (BNV) has been promoting a project to develop the Costa Rican Stock Market through the creation of the Alternative Market for Shares (MAPA), which aims to facilitate access to capital as well as offering an alternative for institutional and sophisticated investors.

MAPA is intended to facilitate access to capital for private companies with high potential for growth, whether they are in an early stage of development or intend to develop new products that are complementary to other existing products. It offers private venture capital, and there are no restrictions on the size, operations, or country of registration of the company funded. This market offers institutional and sophisticated investors a new option: to join new projects with a high potential for growth and high risk, but it also offers founders or other initial investors the opportunity to exit once the company attains a higher level of development.

The BNV organized MAPA around a contractual structure. In addition, because it is a market for private stock, it is not subject to the supervision of the national Stock Market regulator (SUGEVAL). MAPA negotiations are the responsibility of the parties involved, who must inform customers before negotiations take place.

A MAPA contract incorporates the figure of a sponsor, an independent expert who collaborates in maintaining the quality and credibility of the market. The sponsor must comply with two functions: i) to assist the company in the process of admission and ensure the quality of information they provide investors, and ii) to monitor the company to verify its

compliance with its obligations once it becomes part of the MAPA. Each company must have a sponsor with prior approval by the BNV.

Being a high-risk market imposes two restrictions: first of all, it is only accessible to sophisticated investors (investors with $1 million in financial assets or the capacity to assume the risks of MAPA), and second, it will only be accessible to investors to whom the sponsor provides a key for the Web site. Only companies supported by the BNV will have access to MAPA, and these will also have to comply with contractual provisions and operational performance standards, which will limit the participation of smaller companies. Companies interested in joining must undergo an evaluation of eligibility by the sponsor, at a minimum cost of $5,000.

MAPA has funded only two companies so far. The first was Ad-Astra Rocket, a company dedicated to the development of plasma-propelled rocket technology, an area with important implications in the aerospace field. The other company, Spoon, dedicated to the sale of haute cuisine, entered into crisis and was acquired by another company, whereupon it ceased to participate in MAPA.

4.1.6 Perceived Obstacles to Investment in Innovation

Table 4.6 presents data on the main obstacles to investment in innovation cited by firms in national innovation surveys from 2006 to 2011. The answers are presented for two groups of companies: those that do not innovate and those that have. In the first group the most important obstacles at the enterprise level are skills shortages, market structure, difficulties of access to finance, small market size, and ease of imitation by others. At the macroeconomic level, the two main obstacles are lack of public policies to promote science and technology, and the high costs of training.

Table 4.6 Costa Rica: Perceived Obstacles to Investing in Innovation Activities

Obstacles to innovation	Firms that did not innovate				Firms that innovated			
	2006/2007	2008	2009	2010/2011	2006/2007	2008	2009	2010/2011
At the firm level								
Skills shortages	25.0	26.5	43.3	43.4	27.8	44.8	26.6	28.3
Organizational rigidity	29.2	14.3	28.8	28.9	21.0	24.5	21.2	20.7
Fear of failure of innovation	29.2	8.2	17.8	17.3	13.1	21.9	14.5	20.7
From the market								
Small market size	37.5	40.8	47.4	39.7	29.5	43.2	55.8	32.1
Market structure	41.7	44.9	47.4	41.4	32.4	45.3	50.0	35.8
Difficulties of access to finance	37.5	53.1	45.2	40.9	29.0	54.9	42.3	35.8
Limited possibilities of cooperation with other companies or institutions	37.5	28.6	37.6	37.8	28.4	48.0	36.6	32.1
Ease of imitation by others	41.7	32.7	41.4	38.9	27.0	41.1	42.3	28.3
Macroeconomic								
Insufficient information on markets	12.5	22.5	33.2	30.8	28.7	31.4	30.8	26.4
Insufficient information technologies	4.2	16.4	27.7	24.1	27.8	30.0	28.9	23.5
Lack of public policies to promote S & T	25.0	36.7	36.4	36.4	23.0	42.9	32.7	32.1
High costs of training	16.7	38.7	41.9	35.9	21.6	46.5	28.8	34.0

Source: MICITT (2013).

In the case of innovative firms, the main obstacles cited are at the market and macroeconomic levels. At the market level, the most significant obstacles are market structure and difficulties of access to finance, whereas at the macroeconomic level the most significant obstacles cited are high costs of training and lack of public policies to promote science and technology.

4.1.7 Innovation in Service Firms

According to the survey of innovation in the service sector, a significant number of these firms in 2011 and 2012 indicated that they had carried out innovative activities (87.2 percent). Like manufacturing firms, service companies innovated mainly in the areas of products or services (68.3 percent) and processes (55.7 percent). The innovations were novel mainly within the companies themselves and in the domestic market, not in international markets. This result could indicate that these businesses generate marginal rather than radical innovations (MICITT, 2014).

The factors that service companies most frequently cited as hindering their investment in innovative activities were ease of imitation by third parties (82 percent) and shortage of trained staff (67 percent). Other adverse factors were problems with the intellectual property system and poor access to funding sources. With respect to this last point, only 17 percent of all companies surveyed claimed to know about PROPYME funds, which can

be used to finance innovation in Costa Rica. Of all companies, only 3 percent presented projects to PROPYME and only 0.4 percent accessed funds. The companies that did not win funding indicated that their project proposals were either rejected for not complying with all requirements or that they no longer needed it when the funding was finally approved. These two results indicate that Costa Rican authorities involved with PROPYME should review both its procedures and response times to requests. This result is especially important considering that PROPYME has had positive impacts on some firms' performance (Monge-Gonzalez and Rodriguez-Alvarez, 2013).[18]

Among the most important activities carried out to generate innovations, service companies in Costa Rica conducted training (71.4 percent), internal R&D (57.2 percent), purchases of hardware and software (53.6 percent), purchases of capital goods (48.9 percent), and recruitment of existing technology (48.1 percent).

Finally, in terms of links with different actors in the innovation system, service companies do not differ much from those in manufacturing. They report having relationships primarily with suppliers (45.9 percent), clients (35.2 percent), universities (30.3 percent), and consultants (28.4 percent).

4.2 Public and Private Research Institutions

Vestergaard and Diaz (2007) argue that the University of Costa Rica has the greatest research capacity in the country, with a network of 64 laboratories that carry out research activities and provide scientific and technological services in areas such as molecular and cell biology, atmospheric chemistry, food and materials technologies, and structural models. In 2010, 27.4 percent of UCR researchers had doctoral degrees (Estado de la Nación 2010). In the period 2007–09, the three main areas in which projects were carried out were basic sciences (29.4 percent), agriculture (23.4 percent), and health (15.6 percent) (Estado de la Nación, 2010).

In their study on national innovation systems in Central America, Padilla, Gaudin, and Rodriguez (2012) find that in Costa Rica there are research centers in various areas, and highlight the capacities that have been developed in agricultural technology, food, and biotechnology at the National Center for Science and Food Technology (CITA) and the National Center for Biotechnology Innovation (CENIBIOT). These centers often have advanced scientific equipment, international partnerships, and links with businesses; they

[18] According to the authors, PROPYME's beneficiaries performed better than other firms in terms of labor demand and their probability of exporting.

also provide services to public and private entities (IDB/CTCAP, 2011). Within universities, there are units and research centers that also specialize in agricultural technologies, food and biotechnology (for example, the Biotechnology Research Center of the Instituto Tecnológico de Costa Rica).

There are also public research laboratories associated with ministries: these often focus on issues of national priority under the government's agendas. For example, the ministries of agriculture and health commonly have laboratories for monitoring and supervision of activities in areas such as microbiology, biological waste, and disease control and prevention.

Linking universities and research centers with the private sector focuses on training and human resource flows to businesses, as mentioned previously, within a predominantly weak interaction framework. The sales of services and technical assistance also take place to a lesser extent. Conducting joint research projects occurs sporadically, although there are technology transfer offices (TTO) to disseminate and commercialize research results, though these efforts have not had significant effects.

Research activities at universities and research centers often lack specific market-oriented targets, and are thus disconnected from the needs of the productive sector. The knowledge generated by research is often very theoretical (*know-that*), while the productive sector mainly needs practical and applicable knowledge (*know-how*). While this does not imply that basic research should be downplayed, it should be complemented by efforts to develop practical and commercial applications with direct impacts on the economic and social development of Costa Rica (Padilla, Gaudin, and Rodriguez, 2012).

In general, there are few resources devoted to research. The number of teachers who undertake research activities is low, and resources for research represent a small part of the total budget. There are cases in which high-level infrastructure is available, but most research laboratories are not often adequately equipped. Besides the lack of funds, many times researchers must devote a significant number of hours to teaching; lack of staff does not allow researchers to conduct long-term research and limits their ability to link with other actors in the system, particularly in the productive sector (Padilla, Gaudin, and Rodriguez, 2012).

4.3 Institutions of Higher Education

This section discusses the most important characteristics of Costa Rica in the areas of human capital formation, investment in R&D performed by institutions of higher education, and technology transfer from these institutions.

4.3.1 Human Capital Formation

In spite of having a healthy and relatively well-qualified workforce, Costa Rica faces important challenges in the field of human capital formation—specifically, low coverage in secondary and university education. In fact, although the secondary completion rate only reached 65 percent in 2012,[19] other countries with similar population and/or human development indices have 100 percent coverage.[20] Moreover, enrollment in Costa Rica at the university level is approximately half of what the country should have if it is to maintain its level of human development and achieve greater economic development.[21]

To meet those challenges, Costa Rican authorities have launched a promotional campaign for all secondary school students, including financial incentives for their families, so that students will not drop out of school before they finish 11th grade.[22] Similarly, there is a need to revise the existing scholarship system to finance university education for students with scarce resources. During the Chinchilla-Miranda Administration (2010–14) expenditure on education was increased from 6 percent to 8 percent of GDP.[23]

For more than 30 years Costa Rica has been building a comprehensive educational system that emphasizes information and communications technologies (ICTs) in the curriculum. The authorities have been making a tremendous effort to ensure that educational facilities produce properly skilled knowledge workers and professionals who can contribute to the country's development and its entry into the knowledge-based economy. Beginning in 1988, they designed and launched an Educational Computing Program (ECP) through an alliance between the Ministry of Public Education and the Omar Dengo Foundation in the country's elementary schools, covering a total of 57 educational centers and 61,570 students (Monge and Chacón, 2002). This program was

[19] The lower secondary completion rate is the percentage of children who are completing the last year of lower secondary education. It is calculated by taking the total number of students in the last grade of lower secondary education, minus the number of repeaters in that grade, divided by the total number of children of official completion age (source: World Bank).

[20] This is the case for Chile, Finland, and Korea.

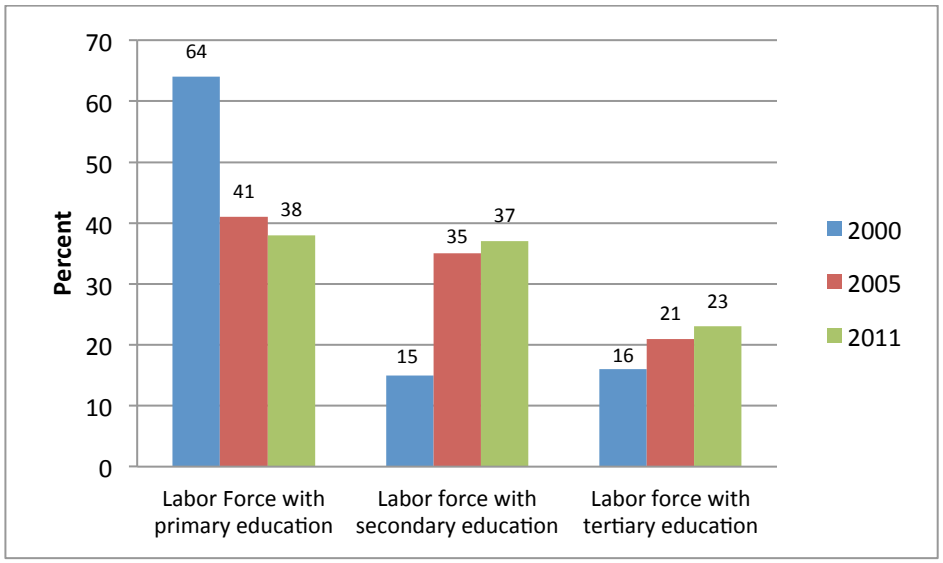
[21] According to a study by the Costa Rica-USA Foundation for Cooperation (2006), Costa Rica has a little more than 40 percent enrollment in tertiary education, while it needs twice as many students enrolled at this level.

[22] See the National Plan for Development 2006-10 (www.democraciadigital.org/articulos/2007/2/1007-plan_nacional_de_desarrollo_2006_2010_jorge_manuel_dengo_obregon_.html)

[23] According to current Costa Rican legislation, the government must assign at least 8 percent of its GDP per year to education.

intended to develop certain key abilities in children so they could take better advantage of ICTs to succeed in the modern world. By 2006, this program had reached 665 educational centers and 316,488 students; that is, 53.4 percent of all children enrolled in elementary school. In 2002, the ECP began in secondary schools, reaching 197 educational centers and 130,615 students in 2006,[24] or 69.9 percent of those enrolled in secondary education. Figure 4.2. presents data that demonstrate substantial improvements in the academic level of the Costa Rican workforce in the recent past. In the year 2000, 64 percent of the labor force had completed primary education, 15 percent secondary education and only 16 percent had a university degree. This situation has changed for the better over the past decade: by 2011 the percentage of workers who had completed secondary education had more than doubled (37 percent) and the percentage with a university degree increased significantly (23 percent).

Figure 4.2 Costa Rica: Educational Levels of Labor Force
(in percent)



Source: World Bank, World Development Indicators.

Despite the country's high rate of enrollment in tertiary education (greater than 40 percent[25]), students are not graduating with degrees in the fields with the fastest growing demand by companies. More than 70 percent of all students graduate with degrees in the social sciences and education, while fewer than 13 percent graduate with engineering and

[24] According to figures provided by the Omar Dengo Foundation.
[25] According to official data from Ministerio de Educación Pública.

technology degrees. This is mainly due to limited supply-side capacities stemming from a lack of infrastructure and faculty. In fact, only 1.1 percent of the professionals in these fields hold graduate degrees, and Costa Rica's scientific community has limited capacity to train engineers and technology experts (Monge-González and Tacsir, 2014).

OECD (2012) highlights that although the country produces relatively high-quality graduates, there is significant misalignment between the supply of graduates by area of specialization and the skills required by industry. For example, Costa Rica's PhD graduates stand out in their preference for the social sciences; of the 93 PhDs granted by Costa Rica in 2000-2002, all except one were in the social sciences. During 2007-2009, Costa Rica more than doubled the number of PhDs awarded, but the more technology-related disciplines were still rare: only 2 percent of the total graduates were in natural sciences, and no PhDs were granted in engineering and computer sciences.

According to Monge-González and González-Alvarado (2007), public and private universities awarded a total of 265,824 diplomas during the 1990–2004 period, which represents 6.2 degrees awarded per 100 people. Furthermore, the authors note that since 1997, private universities have conferred more diplomas than public universities. In fact, beginning in that year, the number of diplomas awarded by public universities has shown a tendency to remain stable. An important factor that might explain this situation is that the budgets of public universities did not increase in real terms during these years. As a result, in spite of a considerable increase in applicants for ICT-related careers, public universities can only accept, at a maximum, about 10 percent of these applicants.[26] Another point to consider is the lack of qualified university professors, which makes it difficult to meet the demand for education in these areas.

With regard to the diplomas granted by universities in Costa Rica, the authors found that the greatest number were in the areas of economic sciences (71,427), education (84,725), and social sciences (38,926). The number of diplomas granted during the 1990-2004 period in Computer Sciences and Electrical and Electronic Engineering were 10,645 and 2,578, respectively; this means that of all diplomas granted by Universities, both public and private, only 5 percent are in these disciplines. On the other hand, the same authors point out that when considering the 10 careers with the greatest number of diplomas awarded, business administration, elementary education, and law are the three degrees most sought after by students in Costa Rica. In the area of engineering, only computing

[26] For instance, in 2001 the Costa Rican Technological Institute received 2,400 applications for admission to the computer sciences program; however, only 170 students were admitted (7 percent of the applicants).

and industrial engineering appear among the top 10 careers, in seventh and 10th place, respectively. Careers such as electronics and electrical engineering do not even appear in this list, although they are vital to make the transition to a more innovative economy, especially in high-technology sectors. In fact, the five careers with the greatest number of diplomas conferred between 2001 and 2004 (business administration, elementary education, law, preschool education and nursing) represent 55 percent of the total number of diplomas awarded, and none of them can be classified as related to or strategic for Costa Rican high-technology sectors.

This situation has not changed in the more recent past, at least in the public universities, which have the best scientific infrastructure. The percentage of students in basic sciences, computing and computer science, and engineering careers is still very low, just 30 percent (Table 4.7).

Table 4.7 Costa Rica: Enrollment in Public Universities, 2011

Areas of study	Tuition	%
Arts and Literature	5.887	7%
Basic sciences	6.820	8%
Health sciences	7.040	8%
Social sciences	31.463	36%
Computing adn computer science	7.829	9%
Education	13.619	16%
Engineering	11.019	13%
Natural resources	2.974	3%
Total	**86.651**	**100%**

Source: Consejo Nacional de Rectores (CONARE)

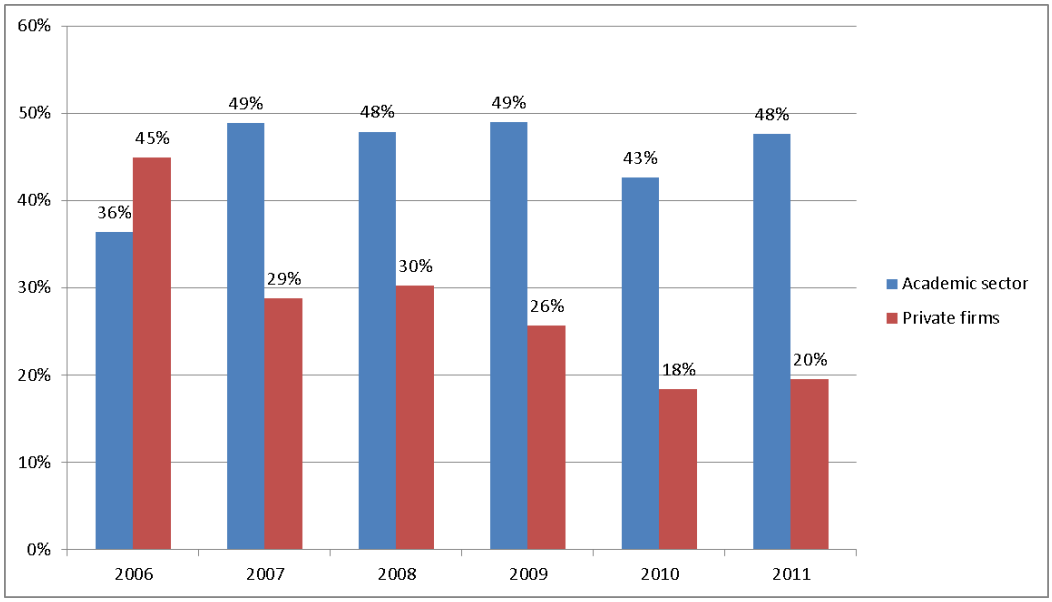
4.3.2 R&D Conducted by Higher Education Institutions

The academic sector is the main source of investment in R&D in Costa Rica, with almost half of the total funds invested in this area (Figure 4.3). This result contrasts with the share of private sector investment in R&D, which is smaller and decreasing.

The academic sector has almost doubled investment in R&D over the past five years in Costa Rica, from US$56.9 million in 2008 to US$102.6 million in 2012 (Table 4.8). The University of Costa Rica is the institution with the largest share of investment in R&D (62

percent), followed by the National University of Costa Rica (15 percent), the Technological Institute of Costa Rica (6 percent), and the UNED (2 percent).[27]

Figure 4.3 Costa Rica: Academic and Private Sector Participation in R&D Investment



Source: Appendix 2.2 from Innovation Survey 2010-2011. Ministerio de Ciencia, Tecnología y Telecomunicaciones.

Table 4.8 Costa Rica: Academic Sector´s Investment in R&D, 2008–12

Year	Millions of US$
2008	56.90
2009	77.90
2010	77.00
2011	88.40
2012	102.60

Source: Ministerio de Ciencia, Tecnología y Telecomunicaciones

Less than one fifth of the total R&D projects implemented by universities in Costa Rica between 2006 and 2010 are linked to the private sector (Table 4.9). In other words, it seems that most of the R&D undertaken by the academic sector does not respond to the necessities of private companies.

[27] These data come from MICITT.

Table 4.9 Costa Rica: Relative Importance of R&D Conducted by Universities and Linked to Private Companies, 2006–10

Year	Ongoing projects	Linked with private companies	Relative Share
2006	1608	264	16.4%
2007	1629	262	16.1%
2008	1817	281	15.5%
2010	2192	313	14.3%

Source: Innovation surveys, Ministerio de Ciencia, Tecnología y Telecomunicaciones.

4.3.3 Technology Transfer from Universities

Technology transfer from higher educational institutions to the private sector seems to be very weak, if one takes into account that less than a third of manufacturing companies interviewed in innovation surveys have indicated some type of relationship with universities.[28] Additionally, the companies that reported having some type of relationship with universities said they received mainly information (36.1 percent), training (39.2 percent), R&D services (6.2 percent), and other services (18.5 percent).[29]

4.4 Intermediate Institutions

4.4.1 Entrepreneur Ecosystem Developer: the Yo Emprendedor Program

YE has its origins in the Link-Inversiones program, which started in 2007 as an initiative sponsored by the Multilateral Investment Fund (MIF) of the IDB and the Corporación Andina de Fomento (CAF, now the Development Bank of Latin America). In 2008 Mesoamerica, a private venture capital fund, adopted the program, and it evolved into an entrepreneur ecosystem developer that seeks to generate conditions that assist in the creation and growth of businesses.

YE is a nonprofit organization that seeks to develop entrepreneurs and an appropriate ecosystem to facilitate the creation of new businesses in Costa Rica and Central America as a means of social development, and as a revenue generator that formalizes the economy, contributes to the reduction of poverty, and increases equality of opportunities.

To grow such an ecosystem, YE developed a model based on five work areas: *Encourage, Educate, Visualize, Finance, and Connect.*

[28] This percentage ranges from 25.7 percent in 2006 to 30.7 percent in 2010.
[29] This result is only available in the 2006 survey.

- *Encourage*: YE works to promote entrepreneurial culture in the general population and among investors, seeking to raise awareness on the subject and position it as a real alternative in life. Since 2007 YE has hosted the *Global Entrepreneurship Week* (GEW), bringing together both public and private organizations, with a positive impact on thousands of people.
- *Educate*: YE's goal is to provide entrepreneurs with relevant information and easy access to documents, tools, seminars, training, and videos. To achieve this, it developed a program called *Tour YE*, under which workshops and/or conferences to development entrepreneurship are offered. In addition, a virtual site with relevant information will be consolidated.
- *Visualize*: Giving entrepreneurs exposure and visibility through the media, and promoting interaction with judges, investors, mentors, NGOs, and technical assistance organizations, among others, is another strategy of the organization. In 2008 YE created the *Business Plan Competition*, which has allowed the consolidation of the entire entrepreneurial ecosystem in a single event. The competition has steadily grown not only in the number of projects received, but also in the categories, awards, regions, and especially, in the quality of projects and depth of training that participants receive without cost.
- *Finance*: This area focuses on encouraging the creation and promotion of sources of capital for early-stage businesses. In Central America, there are very few existing sources of capital for entrepreneurs, reflecting a lack of culture on the subject in the public and the private sectors, and YE is constantly working with both to develop financial mechanisms and make them available to entrepreneurs. Working with the public sector, it has contributed to the creation of venture capital programs, while it works with the private sector to promote and network angel investors and private equity funds.
- *Connect:* The goal in this area is to create connections between entrepreneurs and local, international, public, and private initiatives that directly or indirectly support the development of new businesses. YE has created a virtual platform called the Virtual Entrepreneur Ecosystem. This tool makes the various initiatives of the ecosystem visible in a single portal as a virtual exhibition ("Expo") in which each organization will have a booth to display its information.

Managing agency: YE belongs to a private venture capital fund (Mesoamérica) which transformed it from a business plan competition to an entrepreneur ecosystem developer that seeks to generate the conditions that support the creation and growth of businesses in Costa Rica and other Central American countries.

Expected outcomes of the Business Plan Competition: YE expects to select an average of 30 projects per year. A panel of experts and potential investors evaluates these 30 projects to choose one for funding from an angel investor network and five for in-kind awards: the clean technology award, the woman's entrepreneurship award, the creative award, the youth award, and the entrepreneurship award.

For the purpose of assessment, the entire set of selected projects can be regarded as beneficiaries, because they pass through the complete process of the Business Plan Competition.

Allocated budget: The total annual budget of the Business Plan Competition is US$6.200, which does not include the awards to winning projects and the cost of other activities carried out by YE.

Number of applicants and beneficiaries: From 2008 to 2013 YE received 1,003 applications and chose approximately 180 projects for later support and presentation before a panel of experts and investors. This means approximately 30 beneficiaries per year.

4.4.2 Incubators and Accelerators

There are 12 organizations registered with the National Network of Incubation and Acceleration (RNLA) that support entrepreneurship in Costa Rica. Of these, five are public organizations[30] and seven private.[31] Most are devoted exclusively to the activities of incubation, both intramural (within-facilities incubation) and extramural. The two oldest organizations are CIE-TEC and Tec Park; most of the others were formed very recently, and there are therefore no studies on their impact in promoting new businesses and innovations. MEIC does not maintain useful information about these incubators/accelerators and their beneficiaries.

[30] Centro de Incubación de Empresas del Instituto Tecnológico de Costa Rica (CIE TEC), Incubadora de la Universidad Nacional de Costa Rica (UNA INCUBA), Incubadora de la Universidad de Costa Rica (AUGE UCR), Universidad Técnica Nacional (UTN), and the Incubadora de Negocios del Colegio Técnico Profesional Regional de San Carlos (COTAI).

[31] Parque Tec, CCCR franquicias (Oficina de franquicias de la Cámara de Comercio de Costa Rica), Parque La Libertad, Carao Ventures S.A., Aceleradora GSI y Pymes de Costa Rica, and the Instituto Costarricense de Investigaciones Clínicas (ICIC).

4.4.3 Special Economic Zones

Costa Rica has three special economic zones (Zonas Económicas Especiales, or ZEEs) created through public–private efforts: a special economic zone in the northern part of Costa Rica created in the year 2001, the special economic zone of Cartago (2008), and the special economic zone of Turrialba (2013). ZEEs embody a strategy of economic and social development that strengthens ties between business sectors, government, and academia, with the aims of improving competitiveness and investment climates, and increasing the number of high-quality jobs in the regions where they operate. All three ZEEs have obtained declarations of public interest from government authorities.

The ZEEs develop and implement strategic plans to attract both domestic and foreign investment, hold meetings to promote linkages among firms, promote the development of free zones, and strengthen the operation of job boards. Each member finances the activities that correspond to participation in the ZEEs. Members of a ZEE include local governments (municipalities), business chambers, utility companies, industrial parks, local firms and MNCs, and technical and higher education institutions.

In the case of the ZEE of Cartago, for example, the Technical Secretariat is the Instituto Tecnológico de Costa Rica, a public university, through its Center for University-Enterprise linkages. Among the most recent achievements of this ZEE are the production of an investment guide and a strategic plan, meetings to promote business linkages, consolidation of job opportunities in the city of Cartago, support for farmers to develop a fair for organic agricultural products (Blue Fair) and the opening of a new industrial park under the "La Lima" free zone regime.

4.4.4 Free Trade Zones and Industrial Parks

Costa Rica has a special Free Trade Zone (FTZ) system regime for attracting both foreign and domestic investment, established by Act 7210. An FTZ is a geographical area within the country in which a group of companies can introduce goods of foreign origin without paying customs duties and taxes.

Companies that may apply for the FTZ system regime are: (a) export services companies, which must export at least 50 percent of their total sales; (b) strategic sectors companies, which must be located outside the Greater Metropolitan Area (GAM); c) scientific research firms, either companies or organizations; and (d) significant suppliers, at least 40 percent of whose sales must be made to FTZ companies.

For firms inside the GAM are granted a 100 percent tax exemption from custom duties on imports/exports, withholding tax on royalties, fees, and dividends; interest income; sales tax on local purchases of goods and services; and stamp duties. Firms can also get a 100 percent exemption for a 10-year period from property taxes, property transfer taxes, and municipal patent licenses (Operating License). In addition, for service projects and manufacturing projects only, firms can get a 100 percent income tax exemption for the first eight-year period and 50 percent for the following four-year period.

Firms outside the GAM a 100 percent tax exemption is granted from customs duties on imports/exports, the withholding tax on royalties, fees, and dividends; interest income; sales taxes on local purchases of goods and services; and stamp duties. Firms can also get a 100 percent income tax exemption for the first 12-year period and 50 percent for the following six-year period.

In addition to FTZs, Costa Rica also offers a wide variety of industrial parks and office centers, both within and outside the GAM. Eight industrial parks for manufacturing firms operate inside the GAM, as well as six industrial parks for service companies. Only three industrial parks operate outside the GAM, where both manufacturing and services companies can be established.

5. THE ROLE OF PUBLIC POLICIES

5.1. Definition of Strategies

Generally speaking, Costa Rica has implemented productive development policies (PDPs) for decades;[32] however, over the past three years, the history of PDPs in Costa Rica has been characterized by significant changes.[33] In this period, the country experienced a radical swift toward export-oriented strategies and a further integration in which the attraction of FDI became the country's development model.

During the 1960s, 1970s, and part of the 1980s, particularly, Costa Rica followed an inward-oriented economic strategy, based on the restriction of imports of goods to protect local industries. These policies created a significant anti-export bias that impeded technological change, production diversification, and the growth of exports to third markets. Together with the international economic problems that occurred at the end of the 1970s (the second oil shock, high international interest rates, and debt crises), these policies led to a deep economic recession in the 1980–82 period, with high levels of inflation and unemployment and poor overall economic performance.

Unlike some other Latin American countries that tended to abandon PDPs in the 1980s in favor of market-based mechanisms, Costa Rica never did so. Instead, the country radically switched the orientation of PDPs to other instruments, sectors, and target markets. Emphasis was placed rather on export-oriented sectors and financial instruments, mostly in the form of tax incentives of different kinds, instead of direct price setting and other similar mechanisms used before the crisis. This new set of policies acted through the provision of economic incentives, with fiscal credits and income tax exemptions conferred on nontraditional exports and export processing zones (EPZs), which in turn were more attractive to FDI.

Parallel to the export promotion strategy of the last two decades, the attraction of FDI has been a pillar for growth (Monge-Gonzalez, Rivera and Rosales, 2010). The creation of CINDE (the Coalición Costarricense de Iniciativas de Desarrollo) at the beginning of the 1980s was a key achievement in this direction. CINDE is a private organization dedicated to attracting FDI and supporting the process of the new export-led economic model. A

[32] This section is based on Monge-Gonzalez, Rivera, and Rosales (2010).
[33] Melo and Rodríguez-Clare (2006) define PDPs as policies that aim to strengthen the productive structure of a particular national economy. This definition includes any measure, policy, or program fort improving the growth and competitiveness of large sectors of the economy (manufacturing, agriculture); specific sectors (textiles, automobile industry, software production, etc.); or the growth of certain key activities (R&D, exports, fixed capital formation, human capital formation).

wide range of industries, including those dedicated to electronic components, electrical equipment, medical devices, software, chemical products, beverages and food preparation, tourism, financial services, and call centers, have been increasingly appearing in the country and attracting significant foreign investment. FDI has followed a clear increasing trend in Costa Rica over the past 25 years, finally reaching a stable 6 percent of GDP (Monge-Ariño, 2011).[34]

Export promotion and FDI attraction are the most relevant policies developed in recent years, but other PDPs have also been implemented. One example is PDPs targeting SMEs. During the Rodríguez-Echeverria Administration (19982002), awareness of the need for a new type of industrial policy for SMEs (as well as the need to coordinate multiple programs in many different organizations) led to the creation of the Programa Impulso, an attempt to integrate diverse programs, including:

- Programs to create linkages between high-tech multinational companies (MNCs) and local firms (Costa Rica Provee)
- Programs that provided financing and credit for SMEs (BN Desarrollo)
- A program promoting R&D and other innovation activities (PROPYME)
- Programs that provided technical assistance and worker training (at the National Technical Institute –INA- and MICITT
- Technical assistance programs directed by the Ministries of the Economy and Agriculture
- Deregulation and business creation and promotion (red-tape reduction and regulatory improvement programs), administered formally by MEIC, but in practice directly connected to the Office of the President.

However, the policies so far have fallen short of overcoming some aspects of what could be called the structural duality of the Costa Rican productive environment. On one hand, MNC subsidiaries operate at the edge of the productive frontier, though constrained by lack of sophistication in the business environment and lack of specialized human capital. All of this hinders the efforts of MNCs to move to more complex activities in the country. On the other hand, domestic SMEs struggle to improve their technical and managerial capabilities that will not only allow them to be active suppliers of global firms but innovators in their own right.

[34] Monge-Ariño (2011) notes that FDI has remained above its long-term average (3 percent) during the years in which the WTO rules have been in force.

When Monge-Gonzales, Rivera, and Rosales (2010: 7) studied whether PDPs in Costa Rica in the past few decades have responded to market failures, they concluded:

> "(…) for the most part, government failures rather than market failures have been the main justification for PDPs. Even in the presence of market failures, the instruments applied in the policy design are not necessarily the most efficient (according to economic theory), but rather the most politically feasible options (lower political cost)."

The extent of the challenges faced by the country in terms of competitiveness and innovation (see Monge-González and Hewitt, 2008; Crespi, 2010; Crespi and Tacsir, 2012) suggest that current PDPs are of limited effect in addressing key issues related to the improvement of the business climate and productivity growth. Moreover, PDPs in Costa Rica have emphasized selected interventions, narrow sector policies, and targeted instruments, instead of targeting basic requirements and creating market conditions to improve competitiveness.

Costa Rica has been shifting gradually toward a more selective policy approach to FDI as a way to overcome this duality: targeting certain knowledge-intensive sectors, including knowledge processing services, medical devices and life sciences, advanced manufacturing and (more recently) clean technologies. Prioritizing knowledge-intensive FDI in Costa Rica means focusing, on the one hand, on attracting new companies operating in these fields while creating the conditions to support the upgrading of those operating in the country. At the same time, it is necessary to deepen current efforts toward policy coordination to increase incentives for innovation in domestic SMEs.

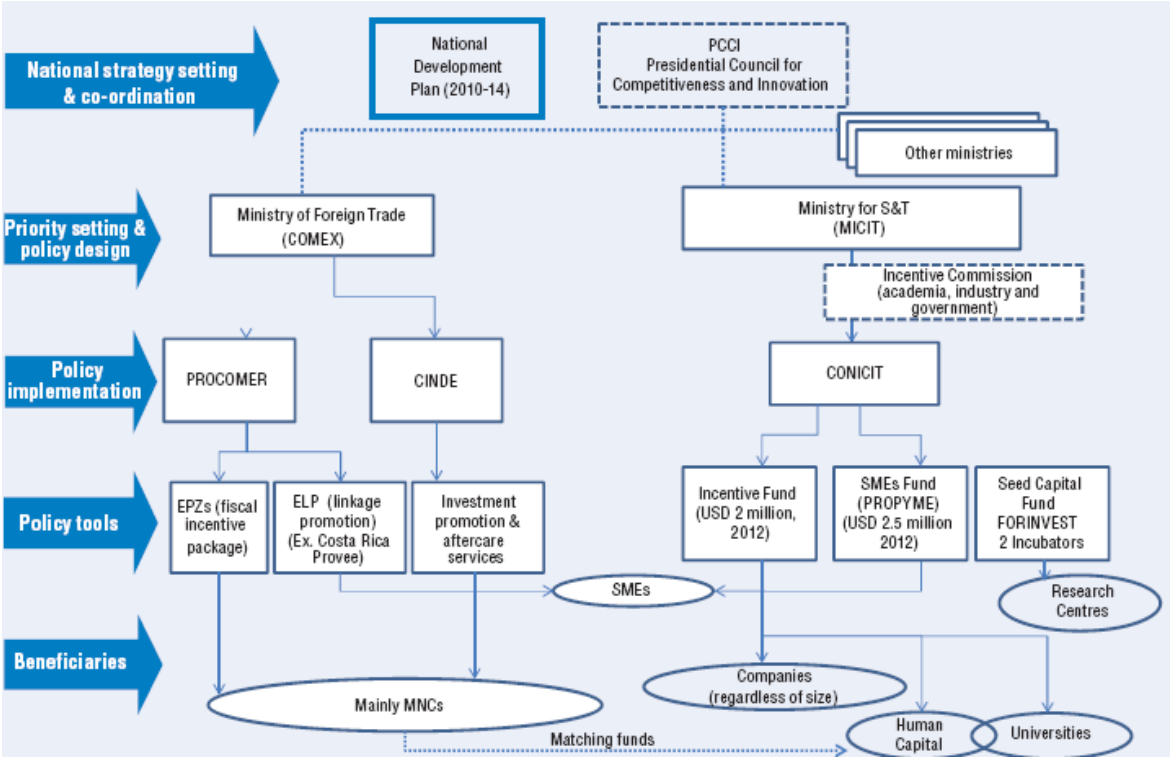
With respect to this last point, during the Chinchilla-Miranda Administration (2010-14) the authorities clearly perceived that Costa Rica faced a serious challenge when implementing a comprehensive and consistent portfolio of productive development policies. Different agencies were responsible for different domains in science, technology, and innovation, and the relative influence and capacities of the different agencies and ministries might therefore bias policy design. In this situation, the authorities considered that Costa Rica required a more coordinated approach that took into account the requirements of both attracting FDI attraction and creating a sustained impetus in promoting the endogenous capabilities of domestic firms (through supplier development programs and on their own) and in the creation of new firms.

As one of the few Latin American countries with a ministry in charge of science, technology, and innovation, Costa Rica is in a strong position to align innovation and FDI

promotion policies (OECD, 2012). However, the vastly different budget allocations between the foreign trade ministry (COMEX) and its science, technology, and innovation counterpart (MICITT) undermine their potential collaboration. In fact, MICITT has the smallest budget of any ministry in the country.

Nevertheless, during that administration the country introduced two major institutional reforms to foster higher levels of coordination among policies for FDI and competitiveness. In 2011, a cooperation agreement increased alignment between COMEX (particularly through PROCOMER, its agency dedicated to developing local suppliers for MNCs), the investment promotion agency (CINDE) and MICITT. This agreement, formalized in an official document, is oriented toward increasing the efficiency and better use of PROPYME funds, the main source of support for technological capacity development and innovation projects in SMEs. Although the agreement is too recent to permit a realistic assessment of its impact, it has—together with the operational rules governing the allocation of funds—permitted the highest historical allocation for R&D and innovation in SMEs, exhausting available funds in both 2012 and 2013. At the same time, it signals the clear recognition of the need for a more integrated policy approach (OECD, 2012). The second reform, the PCCI, was established in 2010, and brings together 10 ministers and the president of the INA who meet on a monthly basis to facilitate policy dialogues and information sharing. Figure 5.1 describes the structure of governance for FDI and innovation policy currently in place in Costa Rica.

Figure 5.1: Governance of FDI and Innovation Policy, Costa Rica, 2011



Source: OECD (2012).

The PCCI includes among its members the President, both vice-presidents, the ministers of MICITT and most other major government ministries, as well as the executive presidents of major government institutions, including the INA–the branch of the Ministry of Labor in charge of technical training), and the Costa Rican Electrical Institute (ICE), the major provider of telecommunications and electric power.

The creation of this Council has provided, for the first time, a forum in which the highest government authorities regularly discuss innovation and its economic impacts. A Technical Secretariat that provides diagnostics assists the PCCI and other information requested by Council members, and which also assisted in the design of solutions in priority areas, while monitoring the execution of policies, plans, and actions related to the promotion of innovation.

The PCCI enables MICITT to systematically align and coordinate its activities at a ministerial level with those of other government agencies in areas related to innovation. Its creation provides a space for policy dialogue and information sharing, but assessing its impact at this point in time would be premature. In addition to coordinating inter-agency activities related to innovation, the Council also provides oversight for MICITT's efforts in

the promotion of science, technology, and innovation, and may provide recommendations and assistance in elaborating plans and policies.

More recently, the current Solis-Rivera Administration has continued to work with the same focus as the previous administration, on policy coordination to increase the incentives for domestic SMEs to innovate. The authorities have revamped the PCCI, creating within it a working group called the Council for Innovation and Talent. The second vice president of the Republic chairs this working group. The ministers of science and technology, public education, labor and social security, and foreign trade, CEOs of public institutions, and representatives of the private sector and academia (public and private universities) are also involved. The PCCI aims to "define a national strategy on innovation, by coordinating public policies and supporting institutions relevant to the implementation of projects concerning the issue."[35]

PCCI continuity is very important to the effort to transform Costa Rica's economy, because this enables a holistic approach and effective coordination of the efforts of all actors involved in innovation processes. Nevertheless, as suggested by the OECD (2012), it is still necessary to strengthen political leadership and horizontal coordination, and to increase the PCCI's diagnostic capabilities. The PCCI's power to elaborate and enforce shared guidelines and priorities needs to increase so that it can foster policy coordination among different sectorial ministries. Although the PCCI seems be endowed with the highest political support, it must be empowered as the policy space for creating consensus on objectives and aligning policy actions.

The PCCI should also be responsible for ensuring implementation and follow-up on decisions stemming from its discussions and deliberations. It should implement a proper mechanism to channel the voices of the private sector and endow it with an agenda for setting priorities and defining action. To achieve this, it would be advisable to improve the PCCI institutional framework according to the recommendations made by Ortega (2013), creating a body responsible for the design, implementation, and monitoring of the required tasks.

In the meantime, Costa Rica should increase its diagnostic capabilities so as to improve priority setting, accountability, and monitoring of outcomes. A useful step in this direction, following the recommendation set forth in OECD (2012), would be to create a small and agile observatory-type institution operating under the direction of the PCCI in

[35] According to a presentation made by the adviser to the Board of Innovation and Talent and the Director of Innovation of MICITT, before the PCCI, in November 2014.

close collaboration with the national statistical office. This institution would be responsible for building an information system centered on production and innovation dynamics, including research centers, universities, and foreign and national companies. The observatory could contribute to investigating market dynamics, including potential misalignments between skills demand and supply.

Costa Rican authorities have published a new National Plan for Science, Technology, and Innovation (PNCTI) for the period 2015–21. This plan focuses on eight enablers for innovation: human capital, financial resources and instruments, intellectual property, scientific-technological equipment, institutional enforcement, international cooperation, networking and multi-technology platforms, and mobilization of creative people. It is also expected to have impacts in six specific areas: education, environment and water, energy, foods and agriculture, health, and global opportunities.[36]

In addition, authorities are beginning the implementation of the Innovation and Human Capital for Competitiveness Program (PINN), funded by a loan from the IDB (Loan Agreement 2852 / OC.CR) to strengthen and support the growth of productivity in Costa Rica.

This loan has three subcomponents related to business innovation and three subcomponents related to development of human talent for innovation. Two calls have already been made for proposals related to a business development component that includes finance certifications (aimed at advancing internationalization), and the adoption of a system of innovation management in the companies themselves.

The implementation of the first component of human capital related to scholarships for masters degrees and doctorates in strategic areas began in the first quarter of 2014. By the first half of 2015, the authorities expect to have at least 20 companies receiving amounts up to $50,000. In 2015, they expect to begin implementing the other two components of business innovation, related to promotion of innovation projects, and encouragement of entrepreneurship, as well as attracting and retraining talent.

5.2 Rationale for Policy Intervention

The two most important policies to promote knowledge absorption, creation, and dissemination in Costa Rica are FDI and a program promoting R&D and innovation

[36] The complete document is available at pdf.crealink.ca/doc/intergraphicdesigns-micitt/plan-nacional-2015-2021/2015022301/#0

activities by private firms; it is therefore important to discuss the rationale for these policies.

5.2.1 FDI and Backward Linkages

The literature indicates that the impact of FDI on host-country economic development depends on associated technological and knowledge spillovers. Knowledge spillovers depend on vertical linkages, worker mobility, and demonstration effects between MNCs and local firms (Smeets, 2008), and in the case of backward linkages, the existence of knowledge spillovers from FDI that generate positive externalities on local industry might justify government intervention. However, success in attracting high-tech FDI does not automatically lead to the generation of knowledge spillovers related to backward linkages. Success in generating spillovers depends more on the MNCs' interest in sourcing inputs in the host country and on the country's capacity for domestic linkage. Therefore, backward linkage development must be approached both from the demand side (MNCs) and the supply side (local firms).

On the demand side, there are various points to consider. First, there is the sophistication of the MNC subsidiaries' productive processes. More advanced processes could create more and higher-value *local* linkages. Second, corporate policies affect the variety, scope, and depth of the activities pursued by the subsidiaries. In many cases, CEOs of new MNC branches do not necessarily pursue linkages with local firms: in the initial stages, facilities construction and operations start-up are central priorities. Similarly, with respect to procurement policy, local procurement managers frequently look for global suppliers rather than local firms, for security reasons (productive process robustness). In addition, local procurement managers usually lack knowledge of local capabilities (high costs associated with the identification of local suppliers). This represents an information asymmetry that limits local linkages (market failure).

On the supply side, local firms may not necessarily be capable of supplying goods and services to MNCs because of a lack of firm-level capacity (entrepreneurship, technology, production scale, manageable risk, and financing). Even when local firms are competitive enough to become MNC suppliers, the host country's absorptive capacity, which depends on local learning infrastructure, institutions, and government policies (Paus and Gallagher, 2008) may impose limits. When the potential for externalities created by FDI are taken into account, it is evident that support for linkages between foreign and local companies can generate positive outcomes. That is, government intervention can increase

the *probability* of realizing those externalities, because these are not automatically achieved unless local suppliers are effectively linked to MNCs.

Costa Rica has been successful in attracting high-tech FDI. In fact, targeting MNCs operating in specific areas reflects the belief that coordination failures impede effective cluster formation. However, the recognition of market failures did not carry over automatically to the development of capacity for linkage. In fact, the complementary policy of fostering spillovers (through the Costa Rica Provee program) has been mostly concerned with information asymmetries, and Costa Rican success has been limited in terms of capturing micro (vertical spillovers) benefits from high-tech FDI. Success in attracting growing amounts of FDI does not automatically lead to the creation of backward linkages and the advantages of knowledge spillovers.

5.2.2 Promoting R&D and other innovation activities

Many countries, prompted by market failures, have been interested in undertaking policies that promote local firms' investment in R&D and other innovation-related activities. When a firm invests in R&D and other innovation drivers, it generates knowledge that can be used by other firms. If a solid structure for enforcing intellectual property rights is in place, monetary investment in R&D becomes the price of knowledge, given that those property rights allow the owner to exclude others from exploiting the new knowledge. However, even when the legal and institutional framework for intellectual property protection is in place, the innovator sometimes cannot fully own the benefits from its investment because of the presence of positive externalities—technological or knowledge spillovers—resulting from the innovation.

Monge-González and Hewitt (2008) note that the basic idea of technological spillovers is that the effects of innovation by one firm tend to spill over into the rest of the economy, mainly to other firms that interact with the innovator (strategic partners, clients, suppliers, and even competitors). This situation occurs when an innovative firm receives private marginal revenues which are less than its social marginal revenues—when the knowledge the firm is generating is spilling over into other firms, thus increasing the benefits to society as a whole beyond a simple increase in the innovating firm's profits. The only way for the innovating firm to obtain some part of the social marginal revenue would be to be paid for the innovation spilling over into other firms.

Another way of viewing knowledge spillovers is simply that the innovating firm is facing a private marginal cost for knowledge production that is higher than the social

marginal cost (the cost that the firm would face if R&D investments were also undertaken by other firms and thus the firm could also take advantage of spillovers from other innovators).

The effects of externalities can be seen either as differences between private and social revenues or as differences between private and social marginal costs, but the outcome is the same: "the innovating firm is investing less in R&D than the socially optimum amount, which, combined with the convenience for other firms of acquiring new knowledge for free, collapses into a generalized underinvestment in R&D [in the country]" (Martin and Scott, 1998: 5). To correct this market failure, government intervention is justified. The question that arises, then, is what type of intervention (PDP) should be used?

The classic theoretical argument is that the government should subsidize the private provision of knowledge, either through tax credits on firms' investment in R&D or grants to create incentives for the private sector to undertake more innovation activities. Subsidies of this kind are permitted by WTO rules, as part of the so-called "green box policies." According to Hausmann and Rodrik (2002), any government subsidy to increase the payoff for innovation should be reduced through time to impose discipline in the use of scarce resources.

In the case of either export-related activities or production for the domestic market, tax credits for R&D investments are an interesting policy tool that may unfortunately generate resistance among developing country governments because of the costs that they entail. Moreover, Martin and Scott (1998) point out that the effectiveness of tax credits may be limited because they do not benefit startups, but rather apply only to R&D investments made by already established companies. This is a serious limitation because, as noted by Monge-González and Hewitt (2008) for the case of Costa Rica, it is new companies (startups) that most frequently introduce new products (innovations) to the market.

Theoretical results from Arrow (1962) and Scherer (1967) suggest that more competition in a market should lead to greater levels of innovation and R&D investment.[37] Policies that promote competition could thus provide incentives for private investment in R&D, because they help to overcome anti-competitive practices by incumbent firms and promote cooperative R&D practices. Trade policies are also of particular interest to developing countries; international trade makes a wider variety of goods available to

[37] This point has been reinforced by Baumol (2002) who claims that firms use innovation as their main approach to competing in markets.

consumers, increasing competition, which creates additional incentives for firms to innovate more.

A final policy recommended by Martin and Scott (1998) to deal with the public nature of knowledge in the particular case of SMEs has to do with government support for capital market development in addition to other nonmarket instruments (such as grants and tax credits). The Finnish Innovation Fund is an important example of how to combine the development of capital markets and the awarding of nonreimbursable public funds to assist the process of innovation, especially by SMEs.[38]

According to Rodríguez-Clare (2004), these policies by themselves will not be as effective as they could be if they were accompanied by a policy of promoting the creation of clusters of innovative businesses in areas where a country has clear comparative advantages. In fact, the author states that the effectiveness of any general policy for the promotion of innovation is weakened by geographic and economic distance between businesses, as well as the fact that some innovations occur in such a way as to minimize knowledge spillovers. Isolated policies (such as subsidizing R&D or research in universities) may therefore produce relatively weak and diffuse results.

From the previous discussion, it is clear that the government has good arguments for promoting SMEs' R&D and innovation activities where market failures impede optimal allocation of resources. The correction of those failures is a necessary condition for improving the technological capabilities of SMEs.

5.2.3 Execution of Innovation Programs

Monge-González and Rodriguez-Alvarez (2013) carried out an impact evaluation of innovation and linkage development programs in Costa Rica – specifically, of PROPYME and CR Provee, two productive development programs (PDPs). The authors found that both PROPYME and CR Provee had positive and significant impacts on SME performance. PROPYME's beneficiaries performed better than other firms in terms of labor demand and their probability of exporting, while firms participating in CR Provee showed higher average wages, labor demand, and chances of exporting than untreated firms. Firms participating simultaneously in both programs performed better in terms of average wages than those that participated only in CR Provee. This result is of special interest to policy makers: it indicates the importance of bundling in the implementation of PDPs. The findings suggest that policies aimed at overcoming the weaknesses of these two programs

[38] See www.sitra.fi/en for more information.

are important to obtain higher real wages, generate more employment, and increase the probability of exporting by Costa Rican SMEs.

In addition to the two programs mentioned previously, and thanks to a US$35,000 loan from the IDB, the Costa Rican government has more resources that enable it to implement other initiatives specifically for promoting innovation, in line with the PNCTI. The following are especially noteworthy: (i) grants to strengthening processes for internationalization and management of innovation, (ii) grants for innovation, (iii) seed capital for technology-based ventures, and (iv) a fund for attracting necessary talent to R&D centers.

6. IDENTIFICATION OF POTENTIAL TARGET SECTORS FOR VERTICAL POLICIES

This section presents a tentative identification of two potential target sectors—groups of firms with certain characteristics—that should be subjected to an in-depth diagnosis in search of primary bottlenecks in innovation. The selection of the target sectors responds to the previous discussion and to interviews with business entrepreneurs and public officials. These cases, presented here in order of priority, come closest to representing "low-hanging fruit" because the country has some experience with each of them. They also show the need for further cooperation between business, government, and academia in support of innovation efforts.

Costa Rican companies in the business services export sector. This new sector's sales abroad have shown very dynamic growth, an instance of clear comparative advantages. It is also a sector with high value added. Within it, the subsector of corporate information technology and information services is especially important. Costa Rican authorities should support this sector through actions that facilitate international trade, as they did successfully in the past with goods.

This is a sector with high potential for export growth and upgrading, and that has already shown interest or action in innovation, but at a less than optimal level. It also has the ability and means to commit time and resources to an in-depth diagnosis in search of primary bottlenecks to innovation and the design of policies to overcome them. The technical challenges and complexity of supporting innovation in this sector are within the scope of capabilities of the public sector. Indeed, some firms have been beneficiaries of public programs that support innovative activities, such as PROCOMER and PROPYME (see Box 6.1). Finally, but no less important, the parameters of product and process innovation offer probabilities of demonstration effects and spillovers to other areas of the economy.

Costa Rican companies currently selling productive inputs to MNCs operating in Costa Rica. These companies are among the most productive in the country and exhibit higher growth rates than otherwise similar companies that are not involved in international trade through linkages with MNCs. Second, they also have the potential to receive more technology transfer and make better use of knowledge spillovers from high-tech MNCs than other local companies do. Third, there is a basic institutional infrastructure that can be improved to provide adequate support to these companies (coordination between PROCOMER, PROPYME, and CINDE). Finally, the country has clearly identified the value

chains in which domestic firms are often involved in the local operations of high-tech MNCs, such as medical devices and aerospace, and in which there are more opportunities for productive linkages (Gereffi et al., 2012).

Box 6.1. Innovating in Animation Services

The company *Morpho Animation Studio* is an exporter of technology services: specifically, it provides animation services to advertising agencies in the United States, which has enabled it to develop an extensive network of contacts worldwide. This company has invested significant human and financial resources during the last few years by creating entertainment products for children 3 to 11 years of age, on the theme of achieving an appropriate balance between the use of technology and the protection of Nature. The company is currently developing a product called "Felix the Robot Adventurer" for this purpose. For this task, the company has managed to obtain financial resources from PROPYME and the Special Fund for the Development of SMEs, which is administered by the Banco Popular. These resources were used to develop the product concept. This small business must primarily finance its activities with its own resources generated from the sale of advertising services to foreign companies, because commercial banks demand guaranties that this firm cannot provide to get a loan. Morpho has worked in this area for more than four years, and presently has a series of 30-minute films to introduce the final product idea, which is to have a series of 78 seven-minute episodes of *Felix the Robot Adventurer*, directed at the Latin American audience, particularly Argentina, Brazil, Colombia, and Mexico. The effort has also benefited in recent years from assistance from PROCOMER to attend prestigious and widely known international exhibitions. Thanks to this support and the company's networking in the United States, it was possible to contact former advisors from Sony Pictures and Disney Pictures, and an academic specialist in child psychology, who have enthusiastically joined in the project. With respect to intellectual property protection, Morpho uses the facilities of the U.S. Library of Congress, the Writers Guild of America, and the Registry of Intellectual Property of Costa Rica.

7. CONCLUSIONS AND RECOMMENDATIONS

This paper has shown the importance of innovation for achieving sustained high economic growth in Costa Rica, as well as a way to reach the country's important social goals. This chapter summarizes the main weaknesses and strengths of Costa Rica's efforts to develop an innovation-based economy, and presents recommendations for achieving this goal.

7.1. Conclusions

The Costa Rican economy is growing mainly based on the accumulation of productive factors (labor and capital) and not by significant increases in the efficiency and productivity with which these factors are used. Furthermore, in terms of productivity (as well as in terms of income per capita) Costa Rica is falling further behind the most technologically developed countries and other emerging-market countries, some of them from Latin America.

The low innovative capacity of Costa Rican firms explains the low level of economic growth in this country; that is, it reflects low productivity. Sustained high rates of economic growth depend not only on accumulation of factors of production, but also on continuous incorporation of technology and knowledge into the production processes—innovation.

The fastest-growing firms in Costa Rica are the more productive ones. Unfortunately, this is a very small group. There exists a wide dispersion in the productivity of Costa Rican companies, both between sectors and between companies of different sizes. In short, the smallest firms show both lower productivity and higher dispersion in productivity.

Given the high relative weight of SMEs in the Costa Rican economy, it is important to support their productivity growth, especially in the case of those with high potential, as a mechanism to increase the productivity of the economy as a whole. Public policies have a very important role in this effort.

Costa Rica's economic development model is based on integration with international markets, so it is important to point out that an exporter or local company linked to multinationals is more likely to achieve high levels of productivity than a local company without access to such catalysts. These results seem to be associated with the existence of technology transfer and knowledge spillovers, thanks to the direct and indirect participation of these domestic companies in international trade.

In short, further promotion of exports and integration of domestic companies into global value chains, and reduction (or even better, elimination) of the principal obstacles to the growth of domestic companies, must be part of an innovation policy agenda that supports growth and employment generation, thus combating both poverty and inequality.

Incorporating technology and knowledge into production processes conditions the efficiency and productivity of factors of production and their returns in economic growth. Thus, the economic success of Costa Rica depends on how well and how soon it can design and implement its innovation policy agenda. The good news is that the country takes definite strengths to its encounter with new opportunities in a globalized world. These strengths include the existence of high-quality human resources, leading universities in science and technology development, the presence of private knowledge-based enterprises, and full support from the central government (especially from the PCCI). However, this paper has also identified significant challenges for Costa Rica, and these must be overcome through a holistic approach and effective coordination of the efforts of all actors involved in innovation processes.

Among the most notable of these challenges are poor networking among R&D centers, higher educational institutions, and industries; dependence on central government budget; and lack of a managerial system for high-tech business development (An, Oh, and Monge-González, 2015). Other obstacles to moving toward an innovation-based economy are the low level of investment in R&D (0.5 percent of GDP), as well as the quality and relevance of such R&D. This is surprising for two basic reasons. First, the social rate of return on investment in R&D is relatively high (34 percent, compared to a 6 percent return on investment in physical capital). Second, because there is significant evidence of a strong relationship between R&D expenditures and a country's TFP, as well as between R&D expenditure and GDP per capita. Indeed, according to Costa Rica's GDP per capita and the social rate of return for R&D investment, the optimal level of this type of investment in this country should be 2.53 percent of GDP—five times more than is actually observed.

Costa Rica also lacks a "culture of innovation"—a climate that produces a collective enthusiasm for creativity, and glorifies productive innovators in the same way that the great artists or great athletes are glorified and that challenges people to take risks without fear of being stigmatized by failure. This lack of innovative culture largely explains the low number of researchers, in per capita terms, working in this country, and it explains why investment in R&D is so low in Costa Rica.

It is important to facilitate the participation of foreign human talent in innovative activities undertaken by firms in Costa Rica. The country needs to improve the system for recognition of qualifications, as recommended by the World Bank (2014), and make it easier for foreign experts and national companies to cooperate in innovation projects. It is equally important to improve the higher educational system: to make it bilingual and encourage higher-level studies by Costa Ricans at recognized universities worldwide, promoting what Oppenheimer (2014) has called "global innovation."

Costa Rica also lacks a sufficient stock of human capital (of scientists, engineers, and technicians) because of deficiencies in coverage and quality of the education system. This situation creates a misalignment between educational specializations and the needs of the productive sector.

Other challenges include low levels of collaboration by universities in innovative activities undertaken by businesses; the lack of a culture of protection for business' intellectual property; SMEs' lack of access to highly skilled workers; and the underdevelopment of financial instruments to support new ventures and innovations.

Limited access to financing innovative activities has two separate origins. First, many companies cannot provide tangible assets as collateral for loans—only intangible ones that are not accepted by banks. Second, the lack of proper balance in public finances drives up the interest rate in the country and creates a crowding-out effect in the private sector. This constitutes a serious problem for encouraging innovative activities, because it implies constrained financial markets for medium- to long term lending, forcing firms to rely on self-financing, which may not be generally available.

7.2. Recommendations

Costa Rica should implement institutional reforms that improve the ease with which innovation can be generated. Following the arguments by Kang and Bullon (2015), these reforms should cover three areas: (i) reinforcing organizations, (ii) formulating policies, and (iii) building governance structure.

All support programs for SMEs should ensure increases in the efficiency of resource allocation from less productive firms to more productive ones. The authorities should promote impact evaluations of programs, and take actions based on the results of these evaluations to eliminate those programs that do not help to improve enterprise productivity, and to strengthen those that do.

Because larger and younger firms lead productivity in the country, Costa Rican authorities should support the efforts of large companies to innovate, and remove obstacles that impede the growth of younger firms. The first objective implies the need for legal reforms to include large firms among beneficiaries of public programs. The second objective implies that public support programs should focus primarily on helping young firms to grow.

Local companies that export or are linked to multinationals are more likely to achieve high levels of productivity than companies that do not have access to this type of catalyst; authorities should therefore work to deepen the process of integration into international markets. To do this, it is important to undertake initiatives that will increase domestic value-added of exports as well as integration of SMEs in global value chains through stronger linkages between SMEs and MNCs operating in the country, as suggested by An, Oh, and Monge-González (2015), which would increase the possibility of technology transfer and knowledge spillovers to domestic firms.

To increase productivity in all types of companies through innovation, it is necessary to increase investment in R&D, as well as in other innovation-related activities. The number of scientists, engineers, and technicians in the country needs to be increased, which involves working simultaneously on two fronts: (i) improving the coverage and quality of the Costa Rican educational system, and (ii) creating a culture of innovation at home.

On the first front, it is necessary to work with both public and private secondary schools and universities to better align curricula with the real needs of the productive sector. Work on the second front could involve coordination of efforts through mass media and social networks to generate a collective enthusiasm for creativity and innovation across the country.

To successfully address the main challenges to becoming an innovation-driven economy, Costa Rica needs a holistic approach and effective coordination of efforts of all actors involved in innovation-related processes. The most appropriate candidate to assume the role of coordinator in these efforts is the PCCI, which, according to the OECD (2012) must strengthen its political leadership and ability to manage horizontal coordination among stakeholders, and work to improve its diagnostic capabilities. To do so, it will be necessary to increase the PCCI's power to elaborate and enforce shared guidelines and priorities that foster policy coordination among different sectorial ministries. Although the PCCI seems be endowed with political support from the highest levels of

government, it must be formally empowered as the policy space for creating consensus on objectives and aligning policy actions.

Furthermore, the PCCI should be responsible for ensuring implementation and follow-up on decisions stemming from its discussions and deliberations. It should identify a proper mechanism to channel the voices of the private sector and endow it with an agenda for setting priorities and defining action. It would therefore be advisable to improve the PCCI institutional framework according to the recommendations by Ortega (2013), creating a body capable of carrying out the specification, implementation, and monitoring of the required tasks.

For better priority setting, accountability, and monitoring of outcomes, strong diagnostic capabilities will be needed. A useful step in this direction, following the recommendation by OECD (2012), would be to create a small and agile observatory-type institution operating under the direction of the PCCI in close collaboration with the national statistical office. This institution would be responsible for building an information system centered on production and innovation dynamics, including information provided by research centers, universities, and foreign and national companies. The observatory could contribute to investigating market dynamics, including potential misalignments between skills demand and supply.

The PCCI's policy agenda should include work on improving the collaboration of universities in innovation activities undertaken by companies; enforcing the culture of protection of firms' intellectual property; strengthening financial instruments to support new ventures and innovations; and facilitating SMEs' access to highly-skilled workers.

It is extremely important to improve access to financing for innovative activities. To this end the PCCI can work on three fronts. First, it should promote the implementation of the Ley de Garantías Mobiliarias, a law that allows firms—especially technology and knowledge-based firms—to offer intangible assets as security for bank loans. Second, the PCCI should work to reduce the cost of funding (interest rates) by improving the balance of public finances. Third, given that Costa Rica has several incubators and business chambers, the PCCI should promote the design and implementation of programs that facilitate entrepreneurs' access to both domestic seed/venture capital and *crowdfunding*. This latter mechanism facilitates entrepreneur fundraising through individual contributions of thousands of small investors through websites (such as kickstarter.com).

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