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Foreword

The *OECD Review of Innovation Policy in Costa Rica* is part of a series of OECD country reviews of innovation policy.* It was requested by the Costa Rican authorities, and was carried out by the OECD Directorate for Science, Technology and Innovation under the auspices of the Committee for Scientific and Technological Policy (CSTP). Special thanks are due to Vice-President Ana Helena Chacón Echeverría, Minister Marcelo Jenkins (Ministry of Science, Technology and Telecommunications, MICITT) and Minister Alexander Mora (COMEX) for their time and support. The British Embassy in Costa Rica provided generous financial support.

The purpose of this review is to obtain a comprehensive understanding of the key elements, relationships and dynamics that drive the Costa Rican innovation system and the opportunities to enhance it through government policy. More specifically, the review:

- provides an independent and comparative assessment of the overall performance of the Costa Rican innovation system
- recommends where improvements can be made within the system
- formulates recommendations on how government policies can contribute to such improvements, drawing on the experience of OECD countries and evidence on innovation processes, systems and policies.

This review is intended to be relevant to a wide range of stakeholders in Costa Rica, including government officials, entrepreneurs and researchers, as well as the general public. It also aims to use OECD communication channels to provide an accessible and comprehensive presentation of the Costa Rican innovation system and policy to a global audience.

A draft version of the overall assessment and recommendations was presented for peer review to the Working Party for Innovation and Technology Policy (TIP) of the CSTP in June 2016.

The review was led by Gernot Hutschenreiter, Head of the Country Innovation Policy Reviews Unit (OECD). The report was drafted by Giulia Ajmone Marsan and Pluvia Zuniga (Directorate for Science, Technology and Innovation, OECD) with contributions from Daniel Malkin (Consultant to the OECD) and inputs from Stephany Scotto (Junior Consultant to the OECD) under the supervision of Gernot Hutschenreiter. Yana Vaziakova (Directorate for Science, Technology and Innovation, OECD) provided statistical support and web-based research.

The review draws on the results of a series of interviews with a wide range of major stakeholders of the Costa Rican innovation system during a fact-finding mission to Costa Rica in January 2016. A background report, served as preparation for the OECD fact-finding mission. The background report was commissioned by the Costa Rican

* www.oecd.org/sti/innovation/reviews.

authorities and prepared by Ricardo Monge-González (Associate Professor of Economics at the Instituto Tecnológico de Costa Rica and Director of CAATEC Foundation), with the support of the Inter-American Development Bank and complemented by experts from the MICITT. It contains a broad range of valuable information that is drawn upon in this report.

The review has benefited from comments and additional information received from stakeholders in Costa Rica, distinguished experts in the field and the TIP peer review – in particular the two peer reviewers: Aldo Aldama (Permanent Delegation of Mexico to the OECD) and Robert Kerger (Ministry of Higher Education and Research, Luxembourg).

The review owes much to the support and co-operation of the Costa Rican government officials, in particular David Bullón (Director of Innovation, MICITT and delegate to the TIP) and Tatiana Vargas (Advisor OECD Affairs, COMEX) who provided background information and organisational support throughout the review, including for the OECD fact-finding mission. Federico Torres Carballo (Director of Research and Technological Development, MICITT), Yarima Sandoval (Director of Human Capital for Science and Technology, MICITT), Diego Vargas Pérez (Statistician, MICITT and delegate to the OECD Working Party of National Experts on Science and Technology Indicators) provided information on policy programmes and budgets as well as science, technology and innovation indicators. Gustavo Crespi and Betsy Murray (Inter-American Development Bank) provided valuable comments on drafts of this report. Many of the stakeholders met with during the fact-finding missions also provided valuable comments and data, and were instrumental for the preparation of this report.

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Acronyms and abbreviations

ANII	National Research and Innovation Agency *Agencia Nacional de Investigación e Innovación*
APL	Local Productive Factors (Brazil) *Arranjos Productivos Locais*
BERD	Business expenditure on research and development
CINDE	Investment Promotion Agency *Coalición Costarricense de Iniciativas de Desarrollo*
CITA	National Centre for Science and Food Technology *Centro Nacional de Ciencia y Tecnología de Alimentos*
CNI	National Innovation Council *Consejo Nacional de Innovación*
COMEX	Ministry of Foreign Trade *Ministerio de Comercio Exterior*
CONACYT	National Council of Science and Technology *Consejo Nacional de Ciencia y Tecnología*
CONARE	National Council of Rectors *Consejo Nacional de Rectores*
CONESUP	National Council of Private Higher Education *Consejo Nacional de Enseñanza Superior Universitaria Privada*
CONICIT	National Council for Scientific and Technological Research *Consejo Nacional para Investigaciones Científicas y Tecnológicas*
CRC	Costa Rican colon (currency)
ECI	Economic Complexity Index
ECTI	State of Science, Technology and Innovation *Estado de la Ciencia, la Tecnología y la Innovación*
EFQM	European Foundation for Quality and Management
FDI	Foreign direct investment
FEES	Special Fund for Higher Education *Fondo Especial para la Educación Superior*
FINADE	National Development Trust
FORINVES	Research Risk Fund
FTZ	Free trade zone

GDP	Gross domestic product
GERD	Gross expenditure on research and development
GMI	Inter-ministerial Cabinet for Innovation (Uruguay) *Gabinete Ministerial de Innovación*
GVC	Global value chains
HE	Higher education
INA	National Training Agency *Instituto Nacional de Aprendizaje*
INTA	National Institute for Innovation and Technological Transfer in Agriculture *Instituto Nacional de Innovación y Transferencia de Tecnología Agropecuaria*
IP	Intellectual property
ISIS	Import substitution industrialisation strategy
ISO	International Organisation for Standardisation
IT	Information and telecommunications
LAC	Latin America and Caribbean
MEIC	Ministry of Economy, Industry and Commerce *Ministerio de Economia, Industria y Comercio*
MEP	Ministry of Public Education *Ministerio de Educación Pública*
MICITT	Ministry of Science, Technology and Telecommunications *Ministerio de Ciencia Tecnología y Telecomunicaciones*
MIDEPLAN	Ministry of Planning and Economic Policy *Ministerio de Planificación Nacional y Política Económica*
MNE	Multinational enterprise
NSTS	National S&T System
PCCI	Presidential Council on Competitiveness and Innovation
PINN	Programme of Innovation and Human Capital for Competitiveness
PISA	Programme for International Student Assessment (OECD)
PLANES	National Plan of Public Higher Education *Plan Nacional de Educación Superior*
PMR	Product Market Regulation
PNCTI	National Science, Technology and Innovation Plan *Plan Nacional de Ciencia, Tecnología e Innovación*
PPP	Public-private partnership
PROCOMER	Costa Rican Export Promotion Agency *Promotora del Comercio Exterior de Costa Rica*

PROPYME	Support Program for Small and Medium-Sized Enterprises
R&D	Research and development
SATE	Technological and Business Assistance System (Mexico) *Sistema de Asistencia Tecnológico Empresarial*
S&T	Science and technology
SBD	Development Bank System
SINAES	National System of Accreditation of Higher Education *Sistema Nacional de Acreditación de la Educación Superior*
SME	Small and medium-sized enterprise
STEM	Science, technology, engineering and mathematics
TEC	Technological Institute of Costa Rica *Instituto Tecnológico de Costa Rica*
TiVA	Trade in value-added
TTO	Technological transfer office
UNA	National University *Universidad Nacional*
UNED	State Distance University *Universidad Estatal a Distancia*
UTN	National Technical University *Universidad Técnica Nacional*
USD	United States dollar (currency)

Executive summary

Costa Rica – a successful economic transformation

Costa Rica's successful economic performance and social achievements realised over the last decades are widely acknowledged. Gross domestic product per capita has steadily increased at higher rates than in most Latin American countries as Costa Rica has evolved from a rural and agriculture-based economy to one with a more diversified structure integrated into global value chains. The process of opening up to international trade and attracting foreign direct investments (FDI) that started in the early 1980s has contributed largely to this evolution, boosting exports and labour force utilisation.

Virtually universal healthcare, pension and primary education systems have led to high literacy rates, relatively low infant mortality, long life expectancy (close to 80 years) and low poverty by Latin American standards. Costa Rica has also built a world-renowned green trademark and a strong eco-tourism industry based on good management of natural resources focusing on the protection of its biodiversity and renewable energy sources. These achievements are reflected in well-being indicators, which are comparable to or even above the OECD average in several dimensions.

Foster innovation to boost productivity

In spite of these achievements, challenges remain. Costa Rica needs to address the important productivity gap that persists between the export-oriented sector led by multinational enterprises (MNEs) and the non-exporting sector, which is mainly composed of domestic firms. Although economic activity in the free trade zones remains strong, FDI is still weakly connected to local firms and exports continue to be concentrated within foreign-owned firms.

Despite a number of successes, productive linkages between MNEs and domestic firms remain underdeveloped, reflecting a mismatch between the demand from MNEs and competencies in local businesses. The majority of domestic small and medium-sized enterprises (SMEs) still need to develop their absorptive and innovative capacities to access and adopt new technologies and knowledge and become advanced actors in technological and non-technological innovation in the future. The lack of qualified science and technology personnel (in particular at graduate and technician level) represents a serious obstacle to the development of such activities. These barriers need to be overcome to fully integrate the majority of domestic firms into global value chains and maximise the benefits of this integration.

To achieve this, business innovation policy needs to be embedded in a broader innovation and entrepreneurship policy agenda which targets domestic firms through a range of customised programmes, from the provision of managerial services to that of seed capital and new technology-based enterprises.

Strengthen the long-term commitment to science, technology and innovation

Current programmes in support of science, technology and innovation (STI) are too small to have a sufficient impact and trigger a change in Costa Rica's innovation capabilities. Moreover, the already limited resources are distributed across many funding programmes and instruments, further reducing the scale of each individual programme.

Costa Rica would benefit from developing a medium- and long-term strategic framework to increase financial support for STI, especially with respect to business innovation programmes. Such a framework should be aimed at helping to consolidate and mobilise under-utilised funds, but will also require new sources of funding. An increase in financial support should, however, be conditional on effective reforms of STI governance, institutions, programmes and implementation mechanisms, as outlined in the following paragraphs.

Strengthen policy coherence and implementation

The Costa Rican STI system is characterised by a high degree of fragmentation and weak co-ordination among key actors. The current institutional setting offers limited opportunities for the coherent implementation of a comprehensive long-term national STI strategy which is needed to improve the performance of the innovation system and align its actors to shared policy objectives.

One way to promote horizontal co-ordination among policy actors would be to establish a new encompassing innovation agency. Such an agency should consolidate and merge similar funding programmes (e.g. for business innovation and upgrading, entrepreneurship, industry-science linkages, connecting SMEs to MNEs) currently spread across different ministries to gain scale and impact. These streamlined programmes should be complemented where necessary in order to build a portfolio of instruments of adequate scale. The agency should be guided by clear governance rules and formal co-ordination mechanisms. It would help establish synergies across the design and implementation of different programmes and be in charge of the monitoring and evaluation of the programmes it finances.

Strengthen the contribution of public research to innovation

The five public universities and some leading institutions in the heterogeneous private university sector actively contribute to the Costa Rican research eco-system. However, notwithstanding the excellence of some university research centres and laboratories, scientific quality is lower than in comparable Latin American countries.

Costa Rica has much to gain from developing modern funding mechanisms and steering the research system towards better quality and overarching national goals and priorities. In contrast to international developments, the share of institutional ("block") funding in Costa Rica's public universities has remained very high. While individual institutions have developed mechanisms to monitor researchers' activity, there is no national framework to evaluate public research actors in a consistent, comparable and independent manner.

Costa Rica could benefit from international good practices. Many countries across the world, including emerging economies, have established professionalised research funding agencies (often referred to as "research councils") responsible for the allocation of

competitive funding for research, as well as agencies in charge of the external evaluation of universities and public research institutes. These developments have been motivated, among others, by an increased emphasis on research excellence and relevance.

Improve the information base for science, technology and innovation policy making

Reliable and up-to-date information is instrumental to sound policy making. A reliable qualitative and quantitative information base of STI indicators is necessary to assess the overall performance of STI systems and that of their components, as well as their evolution over time. The production of standardised indicators, such as those developed by the OECD and UNESCO, which allow relevant international comparisons, is therefore an important task that administrations in charge of STI policy must support, adequately fund and for which they must ensure quality control.

Costa Rica's official research and development (R&D) statistics and indicators (in particular business R&D statistics) are not currently comparable with those for OECD countries. They raise questions of reliability and lack important information that is relevant to assess the performance of the STI system, its evolution over time, and the nature and intensity of interactions measured by funding flows.

Chapter 1.

Overall assessment and recommendations

This chapter presents an overall assessment of Costa Rica's innovation system and policy, reflecting the key findings of the review. It identifies strengths and weaknesses and key issues for innovation policy, and develops specific policy recommendations for improving Costa Rica's performance in science, technology and innovation.

Achievements and challenges

Costa Rica's successful economic performance and the social achievements it has realised over the last three decades are widely acknowledged. Gross domestic product (GDP) per capita has steadily increased at rates higher than in most Latin American countries as the economy has evolved along its development path from a rural and agriculture-based economy to a more diversified one integrated into global value chains. The process of opening up to international trade and attracting foreign direct investment (FDI) that started in the early 1980s has contributed largely to this evolution, boosting exports, employment and output while increasing the well-being of people.

In terms of social achievements, progress has been made at several levels. Virtually universal healthcare, pension and primary education systems have led to relatively low infant mortality, long life expectancy (close to 80 years), a high literacy rate and low poverty by Latin American standards. Costa Rica has also built a world-renowned green trademark and a strong eco-tourism industry based on good management of natural resources focusing on the protection of biodiversity and renewable energy sources. These successes are reflected in well-being indicators for Costa Rica, which are comparable or even above the OECD average in several dimensions.

Despite this progress, important socio-economic challenges remain. Inequality is rising, economic growth is slowing and burdens on public finance have been growing. Budgetary pressures are more persistent and have particularly worsened since the global financial crisis. The business sector shows features of a dual economy in which most of the productivity increase remains concentrated in the export-oriented sector. Overall productivity growth has decreased and the productivity gap with emerging economies and OECD countries is widening. This situation, combined with a deficient infrastructure for transport and logistics, and energy costs which are higher than regional competitors, compromises the future competitiveness of the country.

Other important challenges for future growth and well-being are the growing risks related to climate change and natural disasters (e.g. *El Niño*) and preserving Costa Rica's natural environment and rich biodiversity, which is a major richness for eco-tourism and research today. The global trend of reshoring by multinational enterprises (MNEs) – which may also affect Costa Rica – might impact on growth prospects through FDI.

A successful economic transformation …

The Costa Rican economy has undergone important changes in policy and structure over time. After the failure of the import-substitution model in fostering domestic industrial development and the global crisis of the 1980s, the country adopted a new economic paradigm based on global economic integration. By the early 1990s, Costa Rica had started to see the benefits of this new outward-oriented model of development, and became one of the leaders in the region in terms of market openness and liberalisation.

The export-led growth model anchored on fiscal incentives granted through free trade zones (FTZs) was highly effective in attracting multinational activity in advanced manufacturing sectors – starting with Intel's greenfield investment in an assembly and test plant in 1997 – and contributed largely to employment, economic growth and macroeconomic stability. The attraction of FDI was also favoured by human capital, particularly at early stages of the model. This strategy progressively led to a higher diversification of the export basket reflected in an increased importance of high-technology

intensive electronics products (semi-conductors and computer devices by Intel) and more recently of new manufacturing goods such as medical devices and instruments.

Manufacturing (gross) exports have expanded dramatically, from 29.8% of the total value of exported goods in 1980 to 57% in 2015. Goods exports grew at an annual growth rate of 6.7% between 1980 and 2015, while services exports did so at a rate of 9.2% between 1999 and 2015, inducing the structural transformation of the economy. Overall, the trend has been towards upgrading in global value chains (GVCs), from textiles to electronics and medical devices. In more recent years, a different and new structural transformation has been taking place with the relocation of volume-based manufacturing operations to Southeast Asia and the People's Republic of China (hereafter "China") in the wake of Intel's global restructuring and the rise of exports of business services, in particular (knowledge-based) informatics and information services.

While initially FDI promotion was not oriented towards the attraction of specific sectors and industries, Costa Rica has subsequently targeted knowledge-intensive activities and is currently focusing on three main sectors: advanced manufacturing, life sciences and services.

…and the imperative for change to boost productivity and well-being

In spite of these achievements, Costa Rica has not been successful in reversing the structural productivity divergence that persists between the export-oriented sector (led by multinational activity in the manufacturing sector, and encompassing as well strong agricultural activities and high value-added services) and the non-exporting sector – which is mainly composed of domestic industries (some agricultural activities, basic manufacturing and non-tradable services). Although economic activity in the FTZ remains strong, FDI remains weakly connected to local firms and manufacturing exports continue to be concentrated within foreign-owned firms. Despite a number of success stories, productive linkages between MNEs and domestic firms remain underdeveloped, reflecting a mismatch between MNEs' demands and competencies in the local business sector.

The productivity lag is particularly acute among micro firms and small and medium-sized enterprises (SMEs). The great majority of domestic SMEs lack the innovative and absorptive capacities to access and adopt new technologies and knowledge, restricting therefore the process of endogenous technological change and the possibilities for firm internationalisation and GVC integration. Some exceptions stand out from these trends, notably an increasingly dynamic services sector, where sophisticated business services and informatics together account for 45% of the total sector. Tourism accounts for another 45%.

Costa Rica suffers from a weak renewal capacity of the business sector as reflected in moderate new firm creation in recent years. According to the *Global Entrepreneurship Monitor* (2014), the rate of new businesses established decreased from 4.8% to 2.5%; more than 46 000 entrepreneurs discontinued their business between 2012 and 2014. This is a major handicap for recovery as entrepreneurship is critical for the renewal of productivity growth and employment.

As a result of these structural deficiencies, Costa Rica has been encountering difficulties to return to the economic dynamism and high growth achieved in the past. The recovery after the 2009 crisis has been less vigorous than before and accompanied by higher unemployment rates. In addition, inequality has been increasing. Today the richest

10% of the population earns 32 times the income of the poorest 10% – which is far greater the ratios registered in OECD countries. This context is accompanied by growing burdens in public finance. Budgetary pressures are more persistent and have particularly aggravated since the crisis.

Given that spillovers are not automatic and a set of conditions is required for the domestic economy to benefit from knowledge transfer and local embedding of FDI, the productivity divergence issue raises the question of the role and effectiveness of technology and business innovation policies (ranging from research and development, technology diffusion and firm upgrading, to entrepreneurship and value-chain development) supporting the local productive transformation and sustainable global economic integration.

The strategic importance of innovation for Costa Rica

Mobilising innovation as driver of productivity growth …

To successfully avoid a "middle-income trap" and reverse the advance of disparities, it is fundamental for Costa Rica to revitalise business and institutional conditions for productivity growth. In this context, improving the innovation performance of the business sector is central and entails creating favourable framework conditions. Innovation is a broad concept that includes not only the generation and commercialisation of new-to-the-world ideas but also the diffusion and adoption of existing new-to-the-firm knowledge by all firms, adapting that knowledge to local context in the form of new products, processes, and organisational, marketing and business models. At the firm level, innovation leads to a more efficient use of resources in ways that also better meet changing consumer needs and should also enhance employment opportunities, notably through new product innovation.

For a country like Costa Rica it is indispensable to facilitate and create the necessary capabilities to identify, absorb and adapt new technologies through international technology transfer and gradually strengthen the capabilities to generate new technological solutions for the country. This is not an automatic process. Business innovation depends on a range of factors: the ability of firms to learn and build capacities based on existing and new global knowledge (skilled managers and workers coupled with ease of access to learning from more advanced technologies embedded in global goods and services, physical capital and talent), and the ease of appropriation of innovation returns (related, among others, to the protection and enforcement of intellectual property rights).

The technology frontier is moving fast and many countries in Latin America and the OECD are addressing the productivity challenge through enhanced investments in knowledge and innovation. Many are engaged in long-term commitments in terms of resources and actions to support such developments. Missing the opportunity to catch-up through innovation and global integration (as both are intertwined) risks widening the productivity gap *vis-à-vis* emerging countries from the region and beyond (e.g. Southeast Asian countries), as well as dynamic OECD economies.

Further delaying innovation efforts – and the building of institutional frameworks that support them – carries the risk of continuing to miss opportunities to fully appropriate the benefits from FDI and failing in attracting knowledge-intensive MNEs. It is time now for Costa Rica to rethink the current eco-system for innovation and enhance the role of technology and innovation in addressing its national development goals.

… and for tackling societal challenges

Innovation is also key for social advancement, which is at the heart of Costa Rica's agenda. New technologies – such as information and communication technologies (ICT) – provide valuable instruments to enhance social inclusion through applications in areas such as education, healthcare and more transparency in the provision of public services. Enhancing innovation capacity is also fundamental for addressing the societal challenges Costa Rica is facing, such as the environment and energy efficiency as well as preserving biodiversity.

Major challenges in science, technology and innovation – brief diagnostics

Costa Rica's innovation system has several strengths that could be leveraged to mobilise innovation opportunities. The country disposes of a sound and stable macroeconomic environment, a diversified export base – whose technological and knowledge assets could better spill over to the economy at large – and strong global economic integration with a solid base of MNE activity. In addition, the country has succeeded in the promotion of tourism, and the strong country branding has shown its results in this regards. Costa Rica has a favourable geographical location that should further favour regional integration not only with North America but also regionally (Central America) and beyond. The diversification of exports towards European and Asian destinations has been growing.

However, the Costa Rican innovation system remains underdeveloped, highly fragmented and its actors have generally weak capabilities to fulfil their role. Public funding for technology and business innovation has traditionally been weak. Funding of public research has suffered from a lack of a unified approach and focus and is not subject to regular national independent external evaluations. Weak institutions and governance mechanisms continue to dissuade the articulation and implementation of effective policies and the proper interactions required in modern national innovation systems. More fundamentally, the high level of autonomy of key agencies and institutions could inhibit substantial policy action and the margin of manoeuvre for ministries to build a consistent national-level science, technology and innovation (STI) policy. This problem is particularly acute in the public research sector. Other very important weaknesses are the underdevelopment of statistical infrastructure for STI policies, which is hindering accountability and evaluation of policy impact, and therefore policy learning and adjustment.

The lack of articulated policies and weak funding commitments to STI reflect the general lack of attention given to innovation and the potential strategic role that these resources could have played and could play today in the generation of competitive advantages and maximising the benefits of Costa Rica's economic development model. For instance, the innovation system has (with some exceptions) neglected the development of application-oriented research and technology institutions with a sectorial focus – which were launched in most Latin American and Caribbean (LAC) countries during the 1960s and 1970s. Today their quasi-absence hinders the possibilities for advancing mission-oriented research and addressing technology diffusion concerns in key sectorial areas and industries.

Costa Rica has a literacy rate of 97.4%. Its commitment to education is shown by high levels of public spending on education, around 8% of GDP, a figure above the OECD average. Yet there is scope for improvement in the quality of secondary education and its performance in the areas of mathematics and science as reflected in the low scores

in the OECD Programme for International Student Assessment (PISA) (see Chapter 3 for a more detailed discussion). The country recognises the challenge in this area and the need to step up efforts to meet the demands of business.

The mismatch between the demand for and supply of human capital and relevant skills is among the major obstacles to innovation and competitiveness in Costa Rica. In terms of tertiary graduates in science, technology, engineering and mathematics (STEM), the average in OECD countries is around 25%, but emerging countries such as China and India have higher rates: in China 40% of university graduates are STEM graduates while in India the corresponding figure is 35%. According to data from the Inter-American and Ibero-American Network of Science and Technology Indicators (Red de Indicadores de Ciencia y Tecnología, RICyT) for Costa Rica, in 2013, the percentage of graduates in the areas of natural and exact sciences, engineering and technology, medical science and agricultural sciences was 29%, below the LAC average of 38%. According to these data, the share of university graduates in Costa Rica in the fields of engineering and technology are considerably below the LAC average (6% in Costa Rica against around 15% in the LAC area). In addition, the number of PhD graduates in Costa Rica is extremely low. According to the report *Estado de la Ciencia, Tecnología y Innovación*, only 18% of researchers have a doctorate degree. Costa Rica also suffers from brain drain and weak interaction with foreign talent, including highly skilled Costa Ricans living abroad. In addressing the skills gap, the country also needs to address the lack of equivalency in education and implement a system of recognition of qualifications in order to facilitate the interaction between foreign experts and national companies in innovation projects.

Costa Rica is not investing as much as major emerging economies and OECD countries in several critical areas of innovation, including R&D, other intangible assets, and most importantly, in technology adoption – of both hard and soft technologies (e.g. organisational skills and adoption of international management practices). The ratio of R&D expenditures over GDP in Costa Rica,[1] estimated at 0.56% in 2013, is on par with that of other countries in Latin America that enjoy a similar level of development (e.g. Chile, Mexico, Uruguay), but it has stagnated in the last years. This is about a quarter of the average in OECD countries. At the same time, the business sector's contribution to R&D is particularly weak. Investment in other key forms of intangibles for innovation such as ICT and software spending appear higher than in other LAC countries (as a share of GDP); these are five to ten times lower than in OECD countries. An analysis of R&D statistics revealed, however, that methodologies are not fully in line with OECD standards and therefore R&D indicators should be interpreted with care.

In terms of STI outcomes, apart from the trade performance achievements related to FDI and the consequent diversification of exports discussed above, Costa Rica shows low levels of performance in most indicators related to knowledge and technological production. Publication activity is lower than in a number of comparable countries in the region and far below the OECD average. Indicators of intellectual production such as patents or industrial designs show that Costa Rica performs well below other LAC and OECD countries. Patenting numbers by domestic residents are also extremely weak. Residents from countries with similar populations, such as Panama and Uruguay, produce twice as many patents as do Costa Ricans. In terms of trademarks (per population), Costa Rica ranks better than most LAC countries but still far from the OECD average. In terms of "soft" technology adoption, however, Costa Rican firms display a lower propensity to acquire, for instance international certifications (e.g. ISO 9001 or 14001) than other LAC countries such as Argentina, Chile, Colombia or Uruguay.

Obstacles to innovation appear markedly more accentuated for SMEs than for large companies. Several funding programmes for SMEs exist but lack scale. According to the national innovation survey, obstacles to innovation reported by firms include: market structure and difficulties of access to finance, while the most significant obstacles cited are high costs of training and lack of public policies to promote STI.

Table 1.1 summarises a strengths, weaknesses, opportunities and threats (SWOT) analysis of Costa Rica's research and innovation system.

Table 1.1. **SWOT of Costa Rica's innovation system**

Strengths	Weaknesses
– Geographical location favourable to value-chain integration with North America – Sound and stable macroeconomic environment – Strong base of multinational enterprises in advanced manufacturing industries and offshore and information services industries – Diversified export base – Multiple international trade agreements – Strong country branding – Strengths in certain industries (agro-industry; specialised manufacturing; medical devices, aerospace; digital economy; eco-tourism) – Strong commitment to invest in education – Outstanding biodiversity resources and strong attention to environmental protection – Quality of human capital – Broader conception of innovation, including social innovation	– Weak priority given to science, technology and innovation (STI) in national priorities as reflected in low levels of budgets allocated to research and innovation by relevant ministries – Institutional overlaps and legal/regulatory constraints hindering policy effectiveness in STI and leading to fragmentation – Ineffective governance practices, including weak co-ordination mechanisms and a legalistic approach to policy measures – Inefficient procedures in the allocation of funding through STI programmes – Weak accountability of institutions/programmes in STI policy; insufficient monitoring and evaluation – Underdeveloped statistical infrastructure to inform and benchmark STI policy – Large unbalance between institutional and competitive funding of university research – Absence of intermediary institutions for technology diffusion and business innovation, except for the agro-bio industry – Weak absorptive capabilities of the domestic business sector (low investments in R&D and technology adoption) and weak linkages between industry and academia – Increased mismatches of supply and demand of skilled personnel and weak vocational training – Weak enforcement of the legal framework for intellectual property rights
Opportunities	**Threats**
– Efforts to develop research capacities and skilled personnel in areas related to foreign direct investment – Support of multilateral financial institutions (e.g. Inter-American Development Bank, World Bank) – Nascent technology transfer offices at higher education institutions – Raising the quality of public sector research – Further develop the national quality system and improve its usage by domestic companies – Capitalise on the comparative advantage for research on biodiversity and the environment – Consolidating rising knowledge-intensive industries (e.g. software) and offshore services as part of global value chains – Social and inclusive innovation projects – Addressing societal challenges (e.g. energy efficiency, environment, health).	– Shortage of highly skilled personnel – Risk of diminishing relative attractiveness for high-tech FDI and reshoring of MNEs – Institutional stalemates impairing reform and policy streamlining – Risk of capture of new policy initiatives by inefficient institutions – Entrenchment behind vested interests (public and private) – Excess of legalistic culture hindering policy actions and actual implementation – Persistent lack of co-operation between actors – Increasing gaps between MNEs and domestic firms

Key issues and recommendations

While many areas need to be addressed to improve the effectiveness of the national innovation system and effectiveness of pertinent public policies, the following strategic lines of action are critical for improving innovation capacity and policy effectiveness for innovation in Costa Rica (Table 1.2).

Table 1.2. **Main challenges and priority actions**

Main challenges	Priority actions
Ascertain credible long-term commitment to science, technology and innovation (STI) and more effective governance in policy making.	– Develop a financial strategy for the medium and long term to help strengthen STI in line with Costa Rica's socio-economic challenges. Increased funding should be conditional on governance reforms of STI policy and institutions. – Institutionalise the Competitiveness and Innovation Council and task it with preparing and updating the long-term evidence-based strategic plans, provide it and its sub-committees with adequate budgets, in line with its obligations. Ensure that the council's proposals are reflected in the budgetary allocation process. – Improve policy making and its accountability through enhanced statistical information for STI policies, and mandatory monitoring and evaluation of funding programmes.
Address the institutional rigidities and inconsistencies of the legal and regulatory framework which are hampering the optimal functioning of the main policy actors (e.g. overlapping functions between ministries and operating agencies; weak steering capacity of ministries).	– Revisit the current legal and regulatory frameworks with the aim to separate policy design and oversight from policy implementation. – Overcome duplication and overlapping of functions to enable long-term strategic policy decisions. – Revisit legal frameworks for higher education to strengthen accountability and performance-based steering mechanisms. – Establish a single innovation agency consolidating the current innovation programmes spread across different ministries and adopt governance and management in line with good practice. – Introduce a performance-based funding component in institutional funding of research and education at universities.
Articulate a national business innovation policy addresses which domestic firms' demands and their needs for catching-up, new sources of growth and the exigencies for global integration.	– Enhance the innovation capabilities of small and medium-sized enterprises (SMEs) through technology diffusion schemes at a larger scale, for instance, through associative technology extension/upgrading programmes for groups of SMEs and/or clusters/industries. – Establish a new programme for capability upgrading of SMEs and their productive integration with multinational enterprises and supporting knowledge transfer activities through tripartite partnerships (multinational enterprises, SMEs and the government). – Enhance industry-science collaboration through collaborative research and an increased role of applied research institutes, including those within universities in both research and technology transfer.
Strengthen human capital and skills for innovation.	– Strengthen technical education and implement a broad programme to increase the supply of science and engineering graduates and technicians in line with industry demands (e.g. involving financial support and scholarships, promotion campaigns, and job placement). – Continue to invest in education and focus on improving the quality at all levels as a pre-condition to increase the number of STEM (science, technology, engineering and mathematics) graduates.

The need for a long-term and credible commitment to research and innovation

The first policy challenge for Costa Rica in enhancing innovation capacity and performance is to ascertain credible long-term commitment to research, skills, technology diffusion and innovation, and more effective governance in policy making. This will require developing a financial strategy for the medium and long term to help strengthen innovation capabilities in line with Costa Rica's socio-economic challenges. This could entail mobilising underutilised funds and assigning a percentage of taxes to innovation

investments from growing sectors (e.g. tourism). Very importantly, an increase of public funding should be conditional on governance reforms of STI policy and institutions.

Costa Rica is investing too little in innovation, not only technological innovation (and supportive mechanisms and institutions), but also non-technological forms of innovation and technology diffusion processes which are key to catching-up and moving up the development curve. Although investments in science, education and training exist and seem higher than the regional average of investment in some cases, the lack of a national unified approach and limited correspondence with societal demands in several of these areas indicate that the impact of such efforts might be limited. There is a large scope to improve the direction and impact of these efforts to better leverage innovation opportunities and address needs for knowledge for competitiveness and development.

Address governance deficiencies: The need for a unified approach and institutional efficiency

Today policy making and effectiveness in the area of STI are severely affected by a lack of a unified approach and institutional rigidities that preserve fragmentation (in national policies and resources), weak co-ordination among the main policy actors, and a lack of consistent and consolidated policy actions for research and innovation that could more effectively address system-level challenges. This situation results in weak influence and little margin of manoeuvre of national policies for research and innovation, and very limited power in steering and monitoring by pertinent ministries.

Addressing these governance deficiencies is a fundamental pre-condition for effective public policies and future actions as foreseen in national development strategies. As long as these deficiencies remain unaddressed, any increase in public funding for any of the pertinent parties as well as the adoption of new policy actions risk to be ineffective given the potential misallocation of resources allowed by the current legal and governance frameworks.

Institutional rigidities and a fragmented public administration

According to the OECD Public Governance Review of Costa Rica, Costa Rica has a fragmented public administration, characterised by an important number of autonomous agencies or subsidiary bodies of central government ministries and a large institutionally decentralised sector (e.g. semi-autonomous and autonomous agencies, state-owned enterprises). In many policy areas and agencies, accountability mechanisms are lacking, or when they do exist they are insufficiently transparent and reported to society. The steering and co-ordination capacities of the central government or ministries in charge of policy design and implementation involving autonomous agencies are therefore limited.

These institutional and governance specificities also exist in the domain of STI policy. Costa Rica's effectiveness in STI policy is severely hindered by fragmentation in policy execution and institutional settings, limiting coherence and direction in research and innovation policy by the Ministry of Science, Technology and Telecommunications (MICITT) and its agencies. Institutional rigidities loom large due in large part to inconsistency in the legal and regulatory frameworks governing the main agencies and research institutions, which in turn exacerbates the issue of resource fragmentation and weak co-ordination. The high level of autonomy of certain institutions (e.g. the National Council for Scientific and Technological Research)[2] and constitutional laws allowing direct appropriation of budgets by universities has contributed to a lack of a unified and concerted approach in the area of research and innovation resulting in isolated actions. In

the case of universities, a high level of autonomy prevails regarding the implementation of the Special Fund for Higher Education (Fondo Especial para la Educación Superior, FEES) funds, which is the largest component for funding public research. While each university defines its own criteria to allocate research grants, the research system suffers from the lack of a unified, independent and external national monitoring and evaluation framework, which hinders policy learning based on information about how resources are being used and what impact they are having on both research quality and society.

High-level co-ordination for policy formulation

Costa Rica has a history of initiating planning and consultation processes in the area of STI, dating back to the creation of the Incentives programme in 1988. The "Siglo XXI Strategy" initiative in 2004 benefited from a wide consultation process. This exercise was repeated in 2010 to nourish the National Science, Technology and Innovation Plan (PNCTI), which is a legal obligation to be carried out at the beginning of each new administration. The PNCTI is prepared under the aegis of the MICITT and involves a large number of stakeholders from the government, public agencies, research centres, and higher education and business sectors as well academics.

The National Innovation Council (formerly known as the Presidential Council on Competitiveness and Innovation, PCCI) was created in 2009 under presidential decree to lead the articulation of a vision, diagnostics and the formulation of policy strategies based on stakeholder consultations. This institutional design coupling a government-level STI cabinet and a high-level body made up of stakeholders entrusted with consensus building around STI policy orientations was inspired by best practice models of governance implemented in a number of OECD countries, including Chile and Mexico. The council initiated first steps to improve policy formulation and raise awareness of the necessity for inter-ministerial co-ordination.

However, the council has encountered difficulties in the delivery of its tasks: it has yet to define a consensual strategic vision informing the policy-making process nor has it established formal analytical exercises supporting policy formulation. In addition, apart from its low resource endowment, neither the MICITT nor the council have been empowered to play an effective leading role in fostering inter-ministerial co-ordination in STI policy.

In 2014, two tripartite subsidiary councils were created under the aegis of the PCCI: a Competitiveness Council and an Innovation and Human Talent Council.

Recommendations

- Task the National Innovation Council to prepare and update at regular intervals long-term, evidence-based strategic plans to be submitted to the government and parliament for discussion and approval.
- Task the council to develop an information base and mechanisms that allow it to form a consensual diagnosis on competitiveness and STI issues and to produce evidence-based recommendations. The technical unit should be strengthened and staffed with experts from academia, the private sector and think thanks.
- Provide the council (and its constituent committees) with an adequate budget and staff to fully deploy its responsibilities and tasks over the administration period.

- In line with the recommendations of the *OECD Economic Survey* (2016), reunify the PCCI with the two subsidiary councils and streamline its composition. Ensure that the council's priorities are reflected in the budgetary allocation process.

The MICITT's steering role

The MICITT's share in the central government budget is among the smallest across ministerial departments. The portion of the budget devoted to STI activities fluctuated between USD 5 million and USD 7 million (including operating costs), or 0.010% and 0.018% of GDP over the last five years(0.12% of the total government budget). The paucity of resources available for policy measures raises issues of critical mass and fragmentation of policy (e.g. in the case of the Programme in support of SMEs, PROPYME)[3].

The MICITT's role in steering the STI system is also constrained by limiting institutional settings and legislative provisions. Despite the establishment of inter-institutional co-ordination bodies, the steering and co-ordination capacity of ministries in charge of policy design and implementation is often limited by the status of the autonomous agencies involved in policy delivery. For example, budget appropriations devoted to funding S&T related institutions and/or channelled to CONICIT for the implementation of the Incentives Fund and PROPYME programmes are mostly determined by past legislation that bind the ministry.

As a result of institutional overlaps and legal confusion, the MICITT has not been empowered to exert its steering and co-ordinating role over STI policy entrusted by law (Law 7169). The MICITT has very little margin of manoeuvre to define policy initiatives in the STI area or to orient the allocation of funds in support of research or innovation activities, and even less so on the resources allocated to them. The largest share of public R&D expenditures is managed by the autonomous public university system. The main area where the MICITT can exert a steering role is the preparation of the PNCTI. The limited steering capability of the MICITT is not new: the need to overcome these issues and address the ineffectiveness of CONICIT has already been raised by other policy assessments and programmes in the past.

The Ministry of Education also encounters similar difficulties. Given the constitutional provisions that grant a broad autonomy to the state universities and guarantee their endowment with public resources through FEES, the Ministry of Education does not have any institutional oversight or funding responsibility over higher education institutions (HEIs). The only role it plays is an arm's-length regulatory one through its Minister's chairmanship of the executive board of the National Council of Private Higher Education (Consejo Nacional de Enseñanza Superior Universitaria Privada, CONESUP). This council can authorise not only the creation of new private universities but the opening of new curricula as well. Such a regulatory power is legitimate but the ministry should ensure that, given the importance of skilled human capital development, it be exerted efficiently, avoiding potential conflict of interests and without undue delays suffered by private universities.

The current institutional settings that frame STI policy making are the result of an evolution characterised by *ad hoc* legislative stacking giving rise to a variety of funds managed by ministerial departments, autonomous agencies or financial institutions with overlapping responsibilities.

Costa Rica has a high propensity to launch new institutional initiatives through the legislative process or presidential decrees that include earmarked appropriations with a long lifetime without sunset clauses.[4] In addition, these laws are often created without sufficient consideration of how the proposed activities will be funded and without an exhaustive revision of existing laws to avoid creating ambiguities, duplicities and inconsistencies. The Incentives Fund created with its own annual endowment was established in the framework of Law 5048 that created CONICIT back in 1972. Law 7169, which created the MICITT in 1990 and the amendments that followed did not fundamentally alter the provisions of Law 5048 and a large share of CONICIT's earmarked appropriations are allocated through the MICITT's budget. Yet the MICITT does not have a strong influence on the amounts of transfers to CONICIT or how these funds are used, but instead provides suggestions to CONICIT at the beginning of each year in regards to how grant funds should be managed. The MICITT also provides recommendations over the allocation and prioritisation of funds. Overall, the MICITT's steering capacity is partial which, combined with the larger scale of funds directed through FEES, results in a fragmented research policy approach. In addition, the use of earmarked funds as a main funding source may be in detriment of improving the performance of the whole system (e.g. research excellence in the case of universities). If some legislative initiatives were well founded in the past, current settings are no longer appropriate to the formulation and effective implementation of policies in line with the challenges highlighted above. Fragmentation of policy implementation among different agencies should be curtailed to foster synergies among components of generic support programmes and avoid duplication, low critical mass and risks of windfall profits by potential beneficiaries.

Recommendations

- Redefine the MICITT's mandate and resources in accordance with the scope of the policies that it can effectively formulate and steer and whose implementation it can oversee.
- Revisit current legal frameworks and fully empower the MICITT in its steering, monitoring and co-ordination capacity in the field of research, technology and innovation.
- Reallocate CONICIT's funding responsibility to the MICITT and in the longer term, to a professionalised research funding agency.
- Counterbalance the operational autonomy of attached organisations by sufficiently strong accountability requirements set by the steering ministry (or executive body).

Agency-level co-ordination

One way of fostering policy co-ordination at the implementation stage is through agency-level co-ordination. There is evidence in OECD and emerging countries of a growing movement to establish lead organisations for innovation policy. Italy and South Africa have recently reformed or established new agencies dedicated to innovation, while Australia, Denmark, the Netherlands and Turkey have sought to bring several innovation system functions together in newly consolidated ministries of innovation.

The proposal for the creation of a new Agency for Development and Innovation for the joint implementation of productivity and innovation programmes in support of SMEs is a reasonable step towards improving policy effectiveness and impact. Improving co-ordination at the agency level (and at the programme level) would help establish synergies, increase outreach through joint promotion and follow-up of firms, and thereby increase the impact of public policies – as the influence of one is reinforced by the other.[5]

The operating model could follow two possible mechanisms. One is the example of Uruguay with the National Agency for Research and Innovation, which brought together different policy programmes for business innovation and science – absorbing funding programmes for research from the National Council of Science and Technology (CONACYT). A new role was defined for CONACYT and it is now dedicated to policy awareness and promoting dialogue. A second operating model consists of having two individual agencies, one consolidating business innovation agency (promoting business innovation, entrepreneurship, firm upgrading and other productivity-enhancing programmes, including industry-science collaborative schemes for innovation) on the one hand, and a professionalised research funding agency on the other hand. Examples of this model include CORFO and CONICYT from Chile, or Tekes and the Academy of Finland from Finland, among others.

Given the current stage of development and the important governance reforms needed in Costa Rica regarding research and innovation policy and institutions, it may be advisable to establish a single innovation agency (along the lines of the above-mentioned proposal) without research funding responsibilities. In a second stage (in the medium or long run), once governance and regulations, including public research funding mechanisms, have been revisited and reformed, the creation of a new professionalised research funding agency could be considered. The professionalised research funding agency should be based on a new design and research strategy, governance and steering mechanisms, and adopt new management and evaluation standards (including steering committees, international evaluation panels and third-party periodical evaluations, among other international standards).

The executive board of this new agency would be constituted by ministers or vice-ministers from relevant ministries (the Ministry of Economy, Industry and Commerce; the MICITT; the Ministry of Agriculture and Livestock; and the Ministry of Foreign Trade). The agency would enjoy autonomy with a private law status to facilitate the flexible management of resources and personnel and would be committed to carry out regular evaluations. A fundamental step in engaging in such an initiative is to actually increase funding to such programmes as their current status and scale are quite limited.

In deploying this effort, there are, however, some issues to consider. The foreseen multi-ministry governance should entail clear rules and mechanisms for co-ordination, otherwise this arrangement risks adding a layer of complexity and becoming a costly interactive process which delays policy actions. Achieving synergies and joint impact will also depend on having more homogeneous practice in terms of promotion, implementation, and monitoring and evaluation, in line with international standards in programme implementation.

Recommendations

- Establish an innovation agency and adopt clear governance rules and formal joint co-ordination mechanisms in policy promotion, evaluation and follow-up of firms to ensure policy synergies and maximise impact. This innovation agency should

consolidate (and merge) similar funding programmes (e.g. for business innovation, upgrading, entrepreneurship and other productive development support programmes) to gain in scale and impact.

- Develop cross-departmental processes, from R&D programme definition to participation in evaluation panels, joint tools for promotion and communication campaigns, and programme evaluation.
- Establish a clear role and task commitments for the inter-ministerial co-ordinating group (executive board). Examples include: Irelands' Interdepartmental Committee for Science Technology & Innovation or the Netherlands' Interdepartmental Committee for Science, Innovation and Informatics.

Boost business innovation and absorption capacity, particularly in small and medium-sized enterprises

The level of market-driven innovation activity in Costa Rica's domestic business sector is low. The domestic business sector exerts little demand for R&D or R&D-based services from local universities and other (public) research institutions. MNEs also have a weak propensity to undertake R&D activities (although actual data on this are unavailable), and to engage with domestic research and technology institutions. This suggests little demand from domestic sources of knowledge for a variety of reasons (reliance on corporate sourcing; linkages to knowledge centres abroad; perception, quality, compatibility of domestic offers). Innovation activity is essentially concentrated in large (mainly foreign-owned) enterprises, and a few dynamic sectors in agro-industry and advanced manufacturing industries, such as medical devices, aerospace, renewable energy, software and design services.

Important binding constraints to firm productivity growth and innovation for both domestic and MNEs include *inter alia*: 1) a shortage of skills, especially in terms of engineers and technicians; 2) weak innovation capacity of domestic firms and limited linkages between the private sector and national technology infrastructure and knowledge institutions; 3) financial constraints (access to finance); and 4) onerous labour and tax regulations. This situation, combined with a deficient infrastructure for transport and logistics, and the high costs of energy (higher than regional competitors), compromises future competitiveness.

The low absorption capacity of domestic firms and incentives for MNEs to continue importing (FTZ) are amongst the main factors discouraging local linkages and spillovers from FDI. Among the most important factors in this regard are: 1) the inability of SMEs to comply with MNEs' quality standards, production volumes and delivery times, and other requirements; 2) limited access to finance and technical support for upgrading, innovation and integration with MNE operations; and 3) a shortage of skills in areas such as science, engineering and design. The Costa Rican export sector, and especially the chains operated by MNEs in Costa Rica, has few domestic linkages compared to Brazil, Mexico, Asia-Pacific and Europe.

In principle, the presence of globally competitive companies creates an opportunity for smaller companies, mostly domestically owned, to tap into global demand and benefit from the technology transfer that can accrue from working directly with world-class firms. Over the past 15 years, a series of domestic stakeholders – in particular the MICITT and the Costa Rican Export Promotion Agency (PROCOMER) – have been

working to increase the proportion of suppliers that are able to establish linkages with large exporters.

A very important challenge for Costa Rica is to increase the participation of domestic businesses, primarily SMEs, in the process of exporting in medium- and high-technology industries, and more generally in innovation activities. In principle, exports in medium- and high-technology industries indicate a more knowledge-based economy and more innovation, although this inference is weakened when exports have low domestic value added as is the case, for example, for some "high-technology" assembly operations. This latter reservation is relevant in the case of Costa Rica. Statistics indicate a good exporting performance; for instance, the total share of both medium- and high-technology exports in total exports of industrial products of Costa Rica is similar to those of Ireland and Malaysia, and much higher than those of Colombia.

In terms of public policy, the main mechanisms for business innovation are the PROPYME fund, the Development Bank System (SBD) credit lines (and non-financial support) (although the SBD more fundamentally promotes different forms of financial needs, not only finance for innovation) and the Linkages programme (formerly called Costa Rica Provee) to facilitate matchmaking and supply linkages. Both the PROPYME fund and the Linkages Programme, however, have been operating with very little funding, and it has not been until recently that collaboration started between the two agencies. The former encountered difficulties in ensuring demand and for long time had restrictive requirements and burdensome operation, which most likely further contributed to the weak involvement of SMEs. Other funding mechanisms are currently being defined with the aim to broaden the policy mix.

Putting in place the conditions for the emergence and strengthening of a virtuous circle of linkages between innovative SMEs and MNEs is required to counter the risk of a widening gap between a mainly inward-looking low-productivity domestic SME sector and a dynamic FDI sector. Innovation policy aimed at strengthening innovation capabilities in domestic firms – starting with "soft" technology adoption and firm upgrading (e.g. managerial skills, quality systems and standards, etc.) can be an effective means as it contributes to maintaining and strengthening attractiveness for high-tech and high value-added FDI in a more competitive global environment.

Given the lack of absorptive capacities of a large majority of SMEs and the quasi-absence of technology diffusion institutions and upgrading support mechanisms, business innovation policy must be embedded into a broader innovation and entrepreneurship policy agenda with a diversity of customised programmes, from the provision of managerial services to that of seed capital and new technology-based enterprises.

Recommendations

- Consider technology diffusion schemes at a larger scale, for instance, through associative technology extension/upgrading programmes for groups of SMEs and/or clusters/industries. This could take the form of competitive funding of innovation programmes (e.g. for two years) to be implemented with associated (public or public/private) technology service providers. Examples include: the United Kingdom's Manufacturing Advisory Service and the United States' Manufacturing Extension Partnership.
- Building on PROCOMER's Linkages Programme and the PROPYME joint pilot programme, consolidate a new programme for capability upgrading of SMEs and business linking to global value chains (demand-side innovation policy) as

required for productive integration and knowledge transfer activities between MNEs and domestic suppliers (both potential/new and existing). The programme could take the form of a competitiveness-enhancing programme in value chains integration and supplier development.[6] It could have three variants: services, agriculture and manufacturing.

- Promote and engage in medium-term public-private partnerships linking research institutions and the business sector through specific industry or cluster-oriented innovation agendas. Examples include: Colombia's collaborative schemes of COLCIENCIAS, Spain's Feder-Interconnecta programme or Sweden's Innovation Cluster programme (e.g. in terms of good practice for network governance and strategy articulation).
- Consider introducing easy-to-access and process support schemes (with small funding amounts) to promote basic forms of innovation in firms, such as access to business services for upgrading and firm consulting assistance. Examples include: the productivity voucher programme (a reimbursable grant after invoice and pre-qualified supplier identification) from SPRING Singapore office (for firm diagnostics and business services), Chile's Technical Assistance Fund or innovation voucher schemes in Europe.

Foster human resources for science, technology and innovation

In Costa Rica, the offer of tertiary education programmes is concentrated in social, educational and economic sciences. In 2011, these disciplines offered more than 60% of degrees. According to the Estado de la Ciencia, la Tecnología y la Innovación, those working in science and technology tend to have spent a greater number of years in education, speak a second language, earn higher salaries and a high percentage is covered by social security. However, the share of graduates and postgraduates in science and engineering remains below the average in Latin American and Caribbean countries. Each year very few students get a PhD degree: according to the Estado de la Ciencia, la Tecnología y la Innovación, only 18% of S&T personnel in the CONCIT registry had a PhD degree, a figure that increases to around 20% when considering researchers in the public university system only (according to data provided by universities for the year 2015[7]).

The lack of qualified S&T personnel (graduates and technicians) represents a serious bottleneck for the development of innovation in firms. The business sector reports a mismatch between supply and demand for qualified human resources, from specialised technicians up the ladder of qualification to engineers and holders of master and doctorate degrees. The lack of skilled human capital in S&T is particularly pronounced as far as it concerns technicians. Between 2010 and 2012 the share of specialised technicians over total graduates decreased by 11%. The low number of technicians is partly the result of the lack of attention given to technical education since the 1990s, as public policy privileged tertiary academic education. Since 2009, new programmes for technical education have been developed. It has, however, not been enough to meet the demand from industry.

The low level of skills for STI is exacerbated by the fact that many young skilled Costa Ricans leave the country to study or work abroad. Many of the skilled Costa Ricans expatriates work or study in areas which are deemed critical for the country's future development, including science, biology and mathematics, or technology and engineering.

According to a survey carried out for the Estado de la Ciencia, la Technología y la Innovación, less than half of the Costa Rican scientists and engineers abroad (55%) are considering to return to Costa Rica in the next few years and approximately one-third (32%) are not considering coming back at all.

The lack of skilled personnel for STI in not a new problem and Costa Rican authorities developed initiatives to tackle it as far back as 1990, when Law 7179 for the Scientific and Technological Development was passed. This law established, for the first time, a framework of incentives (primarily monetary) for Costa Rican researchers that is still in place today, even if they were progressively reduced in the 2000s. At the same time, in the early 1990s, Costa Rica managed to secure a USD 34 million loan from the Inter-American Development Bank (the so-called joint BID/CONICIT/CONARE loan) with the aim, among others, to invest in human capital for STI.

More than 30 years later, the situation has progressed, but the lack of skilled human capital is still a crucial issue for the development of a mature innovation system. To address this problem, a new loan from the Inter-American Development Bank was approved in 2013: it allocated USD 23.5 million to the development of human capital over the five-year period from 2014 to 2018. Programmes that can be financed include: 1) postgraduate scholarships in Costa Rica or abroad, in priority areas as defined in the PNCTI; 2) talent attraction to foster the development of innovation projects in enterprises; and 3) specialised reskilling professional training for innovation projects. Additional measures for the development of human capital for STI include the scholarship system of the Incentive Fund, but it is only deploying a limited amount of funding (less than USD 1.5 million a year in 2014 and 2015).

Skills mismatch and the limited availability of skilled human capital for STI have a number of adverse effects. First, the attraction of the best-qualified personnel by MNEs, which are able to offer higher wages, leave most domestic enterprises short of personnel capable to support the development of innovative activities. Second, some MNEs have encountered difficulties to move away from standardised manufacturing to engage in higher value-added activities, such as advanced design or IT service provision. Third, there is a shortage of highly qualified researchers in both the private and the public (mainly HEIs) sectors. It is important to stress that there is a paradox regarding skills mismatch. While there is a lack of very high-skilled workers in MNEs that are required to perform advanced R&D activities, most workers in MNEs are overqualified for the jobs they are fulfilling.

Among the main obstacles to fostering the supply of skilled personnel with STEM qualifications are: 1) regulations that hinder rapid accreditation of curricula and programmes in private universities; 2) inertia in allocation of funding among established university departments that work against a dynamic accreditation of new programmes; 3) regulations that affect the adaptation of the National Training Agency (INA; in regards to a well-performing institution) to rapidly evolving demands, in particular as concerns the recruitment of instructors and teaching schedules; 4) a lack of a dual education apprenticeship system; 5) a lack of programmes supporting postgraduate internships in enterprises as they exist in numerous OECD countries; 6) obstacles to transition public vocational colleges to HEIs.

A prolonged mismatch between the supply and demand of medium- and high-skilled personnel could have very negative effects both on upgrading the innovative content of MNEs' activities and on the very competitive advantage Costa Rica has to attract high value-added MNEs. The availability of highly skilled personnel and technicians is also a

prerequisite to the development of absorptive capacities of domestic SMEs necessary to enhance their innovation potential and develop linkages with MNEs.

Recommendations

- Strengthen and improve the technical education system by diversifying the offer of technical education programmes and designing incentives for potential students. Strengthening technical capabilities within INA and making it more responsive to skill enhancement in priority areas, and investing in the development of technical colleges as well as fostering internships in enterprises can help in this respect.
- Identify and resolve weaknesses in the secondary education system, paying special attention to STEM skills in order to narrow the gap with OECD countries. Eliminate barriers to the offer of new STI curricula in HEIs both in the public and private higher education system to more rapidly meet the need of the private sector.
- Implement a strategic long-term programme to increase the supply of science and engineering graduates as well as a plan for their prompt placement in the business sector. Such a comprehensive programme should address: funding support to strengthen S&T education programmes and timely opening of new curricula, scholarships and international mobility, promotion campaigns, and industry placement. An example is Brazil's strategic programme to increase the number of S&T graduates and the quality of university students.
- Attracting foreign talent and tapping into global STI networks is vital for small countries. Costa Rica needs to invest in schemes to attract foreign skilled human capital for STI, connect with skilled Costa Ricans living abroad, and strengthen linkages between national researchers and Costa Ricans living abroad. In doing so, it should also take into consideration the international mobility of students and researchers.[8]

Strengthen the contribution of public research to innovation

Several universities actively contribute to the Costa Rican research eco-system (the five public universities and some leading institutions in the heterogeneous private university sector). According to the Estado de la Ciencia, la Tecnología y la Innovación, the strongest areas in academic research are bio-chemistry, genetics and medicine. However, these areas are not national strategic priorities. In addition, scientific production and quality is significantly lower than the OECD average. Emblematic is the case of agricultural sciences, where Costa Rica's scientific production has decreased and is not influential in terms of scientific impact. International co-publishing is increasing and the strongest international ties in research are with the United States, Spain, Mexico, Brazil and Germany.

Funding and evaluation of public universities

Public universities in Costa Rica are fully independent organisations. They receive block funding via FEES that is transferred directly from the government. The allocation of funding to the public university Council of Rectors (Consejo Nacional de Rectores, CONARE) is expected to approach 1.5% of GDP. R&D expenditures, which are

distributed to the five public universities using fixed shares, account for approximately 15% of FEES.

The share of institutional (or "block") funding in total state higher education institutions' investment in R&D was close to 90% in 2013, which is very high by OECD standards. This share has even increased over recent years at the expense of competitive funding and revenues for the sale of technological services and intellectual property. The only competitive funding comes from CONARE's Special Fund and from CONICIT's programmes – which are very small compared to the FEES budget and actual R&D financing in universities. Together, the MICITT and CONICIT competitive funding of research projects amounts to around USD 0.5 million per year, compared to public HEIs' R&D expenditure of USD 91.5 million in 2013.

Contrary to the practice in many OECD countries, there are no centralised national external independent mechanisms to evaluate researchers in public universities in Costa Rica. An assessment is carried out by each institution individually and in most cases scientific productivity, collaborative research, commercialisation of research results and technology transfer are not rewarded. Researchers do not always perceive, or in some cases even lack, the incentives to patent or engage in the provision of technological service activities. They are also often reluctant to abandon wage premiums associated with full-time academic activity, even when they have research results that could give rise to patents and/or the creation of spin-offs.

The current system has evident limitations. On the one hand, the low share of competitive funding based on performance criteria and the lack of centralised independent external evaluations[9] have adverse effects on the overall quality of research in universities (notwithstanding the excellence of some of their research centres and laboratories). Unless additional budgetary resources can be mustered apart from those transferred through FEES and those already allocated to the Incentives Fund, the current system is an obstacle to the development of steering mechanisms of public research actors towards overarching national priorities and common goals,[10] of collaborative research with businesses and of mission-oriented competitive programmes.

Many OECD countries, especially those with advanced innovation systems, increasingly use performance-based and competitive funding for public research. While institutional funding provides stability and a basis for strategic planning of long-term research activities, performance-based and competitive funding provides incentives for HEIs to raise the quality and societal and economic relevance of their research and innovation activities. It helps to reward well-performing institutions and researchers and creates good conditions for research careers.

To effectively manage the allocation of competitive funding for research, many OECD countries have established national research councils (or similar research funding agencies), which are in many cases also responsible for the evaluation of public sector research institutions (universities and public research institutes [PRIs]). The establishment of these councils or agencies has been the consequence of the increased emphasis on research excellence and relevance. Typically, research funding organisations are publicly funded bodies responsible for co-ordinating and funding the overall system and particular areas of research. The development of a performance-based public research system in Luxembourg (see Box 4.2 in Chapter 4) over the last decades provides an interesting comparison for Costa Rica.

The budget of these research funding organisations may come from specific governmental departments or directly from legislative bodies. A research council's main task, generally, is to organise project-based funding for research as a peer review-based competition for PRIs, individual researchers or groups. Since their establishment, in many countries their role has become more complex and it often includes additional tasks related to steering public research actors towards public policy priorities and the promotion of structural change via programme funding.

Public research institutes as a way to strengthen private-public collaboration in research and innovation

While universities are powerful actors in the Costa Rican innovation system, the role of PRIs is underdeveloped. There are some exceptions, however. Private, or in some cases semi-private, organisations associated with leading traditional sectors of the economy (including coffee, bananas, pineapple, sugarcane and livestock) have developed research units or centres responsible for research, technology transfer and technical assistance to upgrade and make these sectors more productive. Some centres are equipped with labs for analysis and testing and often assist firms in the relevant sectors in fields related to genetics, biotechnology, weather and climate change-related applied research.

Apart from the above-mentioned organisations which operate in leading traditional sectors, interactions between public universities and the business sector are weak and have not evolved considerably over the last decades: for example, according to a survey carried out by the Estado de la Ciencia, la Tecnología y la Innovación, the Universidad de Costa Rica, the largest university in the country, established only 9% of its contractual research collaboration with Costa Rican firms in 2012. This share has not progressed since the 1970s. The Universidad Estatal a Distancia reports that in 2012, 12% of its projects were elaborated together with the business sector. There are, however, a few notable exceptions: some of the research labs and research centres within public universities appear to have developed linkages with the business sector (especially in the agro-food and biotech sectors), both domestically and internationally.

As a way to strengthen public-private collaboration in research and innovation, Costa Rica could consider the further development of PRIs with the mandate to address specific challenges in industry or technology sectors by establishing partnerships with relevant business partners. In recent years, these types of strategic and challenge-oriented public-private collaborations in STI have emerged in many OECD countries (such as innovation alliances in Germany or the Top Sector policy in the Netherlands). They are generally aligned with national innovation strategies and priorities.

Commercialisation of public research is weak

As is the case in many Latin American countries, the commercialisation of knowledge has only belatedly been acknowledged as an important mission of the HEIs. Despite the recent creation of technological transfer offices (TTOs) in all public (and some private) universities, the relationships with the enterprise sector, apart from the agricultural one, remain weak. The TTOs have not yet stabilised their model: they are still in an experimental stage regarding the management of patents and licensing agreements.

Public research infrastructure needs investments

There are concerns about the status of S&T infrastructure in Costa Rica's public universities and research labs. According to a survey of the Estado de la Ciencia, la Tecnología y la Innovación, more than half of the research unit respondents reported a

lack of adequate equipment for research. The most affected units appear to be in the natural sciences. In addition to lagging investments in research infrastructure and its maintenance, the practice of use-sharing of research infrastructure is not well developed or incentivised among research organisations.[11]

Recommendations

- While preserving the pegging of FEES to GDP as a stable funding mechanism of public research, it is also important to gradually rebalance research funding allocation mechanisms by moving towards greater shares of competitive funding. This shift could involve the allocation of part of the FEES budget for R&D to mission-oriented research programmes by means of competitive grants to raise the quality and societal and economic relevance of public research and innovation activities.
- Consider the introduction of performance-driven criteria in the allocation of institutional funding (taking inspiration from the United Kingdom's Research Assessment Exercise for example) and the definition of key performance metrics. The latter should look beyond scientific publication indicators and include more broadly educational and quality achievements, industry-science interactions and societal impact.
- In the longer term, consider the establishment of a professionalised research funding agency responsible for allocating competitive project-based funding and evaluating public research actors.
- Consider developing and extending the role of applied research institutes. This may involve the creation of new public research centres or units with a clear mandate to collaborate with and support firms in R&D and innovation activities. These units or centres could be established as local centres or virtual networks of researchers from both public and private organisations.
- Invest in research infrastructure and its maintenance as a means not only to promote scientific excellence but also to promote inter-organisation collaboration within public research institutions and with the private sector.

Improve the information base for science, technology and innovation policy making

Reliable and up-to-date information is key to sound policy making. A reliable qualitative and quantitative information base of STI indicators is necessary to assess the overall performance of STI systems and that of their components as well as their evolution over time. The production of standardised indicators, such as those developed by the OECD and UNESCO, which allow relevant international comparisons, is therefore an important task that administrations in charge of STI policy must support and adequately fund and for which they must ensure quality control.

Costa Rica's system of STI statistics and indicators was developed by the MICITT relatively late, in 2006. It has been commonly used by international organisations in their assessments and international comparisons without questioning its reliability. However, a closer look at statistics and indicators published annually by the MICITT raises problems of reliability, international comparability and lack of important information, which are all

relevant for assessing the performance of the STI system, its evolution over time, and the nature and intensity of interactions measured by funding flows.

The main apparent shortcomings include: the fact that business R&D statistics are not comparable with those of OECD countries; official innovation surveys and the R&D business survey prioritises the collection of innovation data and as a consequence the available R&D indicators are limited and do not provide any information on sources of funds or types of R&D; limited information on R&D expenditures by sector of performance and by source of financing; lack of information regarding MNEs' R&D expenditures; limited availability of data on research personnel in the enterprise sector.

This issue is notably important in the context of Costa Rica's accession to the OECD, as member countries are expected to provide reliable, internationally comparable and timely statistical information in response to questionnaires sent out by the Organisation.

Recommendations

- Move towards the development of an information system consistent with the scope and reliability of the OECD Main Science and Technology Indicators.
- STI indicators will require periodical updates and methodologies in line with OECD guidelines, and the quality of surveys (sampling and coverage in innovation and R&D surveys) will need to be improved.

Develop the use of monitoring and evaluation for policy learning

Effective monitoring and evaluation is crucial for demonstrating accountability in public spending and legitimising government intervention in support of STI. At the same time it is indispensable for policy learning and, consequently, for improving policy design. The leading innovation-intensive OECD countries have a long-standing tradition of monitoring and evaluation of STI policy. There has been a trend in these countries towards a greater use of more rigorous techniques to assess and improve accordingly policies to support innovation.

In Costa Rica, monitoring and evaluation of STI policies are still weakly developed. This is not specific to STI policy but rather reflects a more general lack of monitoring and evaluation of public policy, as observed by the recent OECD Public Governance Review of Costa Rica: "… while Costa Rica formally established a national monitoring and evaluation system about two decades ago (SINE), it still has not made the shift from a process-oriented towards a result-oriented monitoring and evaluation culture". As a matter of fact, the monitoring which is inscribed in the national STI plans (PNCTIs) only concerns process performance indicators such as the number of projects to be supported in each programme or the number of scholarships to be granted. However, the MICITT does not define the nature of the outputs or outcomes expected from support policies and therefore cannot expect CONICIT, the implementing agency for some of its policies, to collect information about such outputs or outcomes and evaluate them *vis-à-vis* unstated objectives.

Recommendations

- Develop data and evaluation strategies as a prerequisite for launching programmes. Include an explicit monitoring mandate in the management mission of policy-implementing agencies.

- Set up mechanisms for policy learning to ensure that the findings from evaluations feed back into policy making.

Reinforce framework conditions for innovation and entrepreneurship

Costa Rica's framework conditions for innovation and productivity growth have improved over time but there is much scope for further progress. Costa Rica performs relatively well in many aspects of the business environment, particularly in well-known areas such as trade and FDI policy regulations – in which it is outperforming its peers and the average regulatory conditions in Latin American countries.

There remain, however, critical areas that deserve attention. These include fostering competition – which is a key aspect to incentivise innovation, especially in highly concentrated markets – and removing barriers to entrepreneurship. According to the 2016 *OECD Economic Survey of Costa Rica*, these two areas (jointly with infrastructure) are key domains requiring policy reform to boost productivity growth and innovation.

Research concurs that competition is central to innovation, even if discussion is still underway about the precise circumstances under which competition yields the greatest effect.

Competitive product markets force companies to increase labour and multifactor productivity. In Costa Rica, competition is weak and the role of state-owned enterprises is pervasive in many sectors. According to OECD's system of Product Market Regulation indicators, regulation in Costa Rican product markets is stringent. Restriction in the form of state controls and barriers to entrepreneurship are especially high. State controls are particularly binding because of government involvement in the network sector, poor governance of state-owned enterprises and extensive price controls. Detailed recommendations are discussed in the *OECD Economic Survey of Costa Rica*.

In terms of entrepreneurship, high barriers relate to the license and permit system, administrative burdens for sole proprietors of firms, antitrust exemptions and barriers in the network sector. Regulations regarding business registration and insolvency systems need to be updated to facilitate the entry and exit of firms – which allows for a more effective allocation and shifting of resources in the economy. According to the World Bank *Doing Business Indicators*, in spite of improvements, the ranking of ease of business remains lower than other emerging economies in Latin America such as Chile, Colombia and Mexico. The legal and regulatory framework for public-private partnerships (PPPs) needs to be revised. Although the PPP system has been established, its performance has been problematic. Deficiencies identified in the PPP system include an inadequate methodology for identifying PPP projects, poor co-ordination among the distinct public actors, and an absence of substantive regulations necessary for the full operation of the system.

Limited access to finance remains a serious handicap to both business competitiveness and innovation – as indicated in the National Innovation Survey and the World Bank Enterprise Survey. Inefficiencies and lack of competition in the banking sector, especially between public and private banks, as well as regulatory flaws contribute to high interest rate spreads between loans and deposits in local currency hampering credit provision. In addition, growing fiscal deficits affect the costs of finance via higher interest rates for medium- to long-term lending. This situation discourages the already limited access to finance for innovation and productivity projects particularly regarding capital and technology equipment acquisition. To begin to address these issues, the

Ministry of Culture and the Ministry of Foreign Trade are working with different stakeholders to develop a methodology to assess the financial value of companies' intellectual property assets, with the aim to ease the access to credit for innovative firms.

Finally, it would be worthwhile to treat R&D capital expenditures as investment to which favourable depreciation schedules apply.

Recommendations

- Give the competition commission more independence and eliminate antitrust exemptions.
- Improve the corporate governance of state-owned banks and enterprises by adopting the OECD *Guidelines on Corporate Governance of State-Owned Enterprises*.
- Revise the legal and operational framework for PPPs in line with international standards.
- Improve the regulatory framework and streamline procedures for firm creation.
- Consider revising the accountability terms for R&D expenditures as capital investment with more favourable depreciation treatment.

Notes

1. It has to be noted, however, that there are concerns regarding the reliability of Costa Rica's R&D statistics. See Box 3.2 for a description of the issues.
2. Consejo Nacional para Investigaciones Científicas y Tecnológicas (CONICIT).
3. Programa de Apoyo a la Pequeña y Mediana Empresa (PROPYME).
4. The share of earmarked expenditures in budget outlays is very high, as more than half of central government spending is constrained by constitutional and legal provisions, such as the target of allocating 8% of GDP to public education or agreements between the Treasury and autonomous institutions.
5. According to the last update (December 2016), it seems that the proposal for the creation of a single innovation agency (FOMPRODUCE) has been suspended as several actors found that this initiative was not politically viable. This situation, however, does not alter the recommendation presented here given the pertinence and need for co-ordinated efforts through an innovation agency for Costa Rica.
6. The capability upgrading programme for productive integration could take the form of a competitive matching funding scheme (with co-financing from both SMEs and MNEs). This programme could co-finance SMEs' diagnostics and upgrading activities required for productive integration as well as development and test-bedding of innovative solutions between MNEs and at least one SME. Upgrading activities could take the form of training, quality certification and standards, technology

adoption (e.g. including quality systems and managerial skills), or even joint R&D and product development. Examples include: Singapore's Partnerships for Capability Transformation (PACT) and its Infocomm programme, Chile's Supplier Development Programme, and the European Union's Quality Excellence Model.

7. According to data provided by the Instituto Tecnológico de Costa Rica, around 27% of its research staff has a PhD. The Universidad de Costa Rica reports that 29% of its research staff has a PhD.

8. One of Brazil's major programmes (*Ciênciasemfronteiras*) emphasises international mobility of university students to expose students to upfront education and S&T developments abroad. The programme, created in 2011, seeks to boost S&T graduates' capabilities (and interest in S&T) while promoting the internationalisation of Brazilian science and technology through the international mobility of students. Since 2011, the programme has benefited more than 78 000 students.

9. Each university has its own criteria to allocate research funding to its staff. However, there is no national external mechanism to evaluate research proposals or the relative funding allocation provided to them.

10. Even if there is a (non-binding) commitment from public HEIs to take the PNCTI sectoral priorities into account in the programming of their research activities.

11. According to data provided by the Universidad Técnica Nacional, it devotes 0.18% of its budget to the acquisition of scientific and technological equipment (2015 data). The Universidad de Costa Rica reports that in 2016 it devoted approximately 2% of its budget for the equipment of laboratories and research.

Chapter 2.

Macroeconomic trends and framework conditions for innovation in Costa Rica

This chapter discusses Costa Rica's social and economic performance and framework conditions for innovation. The first part presents macroeconomic developments and sketches salient features of the Costa Rican economy, patterns of structural change and productivity-related developments. The second part looks at the current state of framework conditions as they relate to entrepreneurship and innovation. The final sections deal with intellectual property rights and infrastructure, which are important to enterprise and innovation systems in a variety of ways.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Introduction

Over the past three decades Costa Rica has achieved high growth in real gross domestic product (GDP) per capita (although it has slowed down since 2013). During this period, the country has evolved from a rural and agriculture-based economy to one with manufacturing and increasingly services activities linked to global value chains. During the 1980s the country started opening up to international trade while attracting foreign direct investment (FDI), providing an export platform. This market opening process contributed to the diversification of the country's productive structure and boosted its exports (Monge-Gonzalez, 2016; OECD, 2016a).

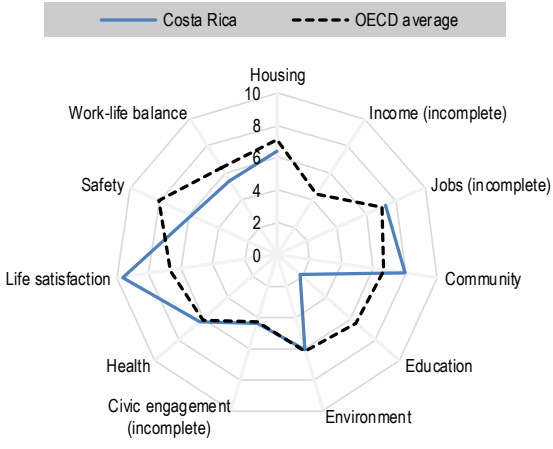
Yet in spite of sustained economic growth, productivity – as measured by total factor productivity and labour productivity – has not improved significantly. Growth has been mostly driven by factor accumulation, i.e. by increasing the inputs of labour and capital, with weak improvements in the efficiency of their joined use as reflected in total factor productivity. The Global Competitiveness Index shows that the country dropped from 34th to 54th position between 1999 and 2016.

Well-being and socio-economic achievements

Costa Rica has experienced strong economic performance, which has contributed to raising living standards and increasing well-being. The important achievements in universal healthcare and strong public investment in education have led to a relatively low infant mortality rate, a long life expectancy (close to 80 years) and low poverty rates by Latin American standards. Costa Rica has also introduced a successful and sustainable use and management of natural resources. These important achievements are reflected in its well-being indicators (Figure 2.1), which are comparable or even above the OECD average in several dimensions.

Figure 2.1. **Well-being indicators for Costa Rica are comparable with the OECD average**

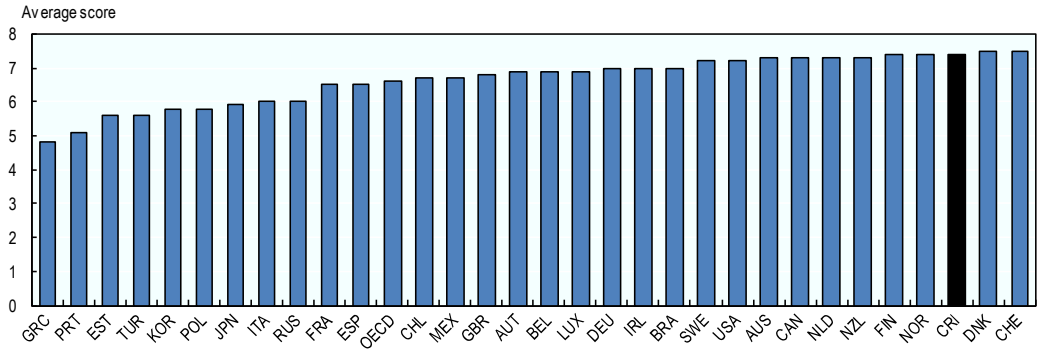
Better Life Index approximation (preliminary and incomplete), 2015



Source: OECD (2016a), *OECD Economic Surveys: Costa Rica 2016: Economic Assessment*, http://dx.doi.org/10.1787/eco_surveys-cri-2016-en.

Costa Rica ranks above the OECD average in the life satisfaction and community dimensions, indicating high quality of life standards and an important social support network (Figure 2.1). It ranks close to the OECD average in health and environment, while there is a large gap with OECD countries concerning education and safety. Figure 2.2 shows that Costa Rica ranks above the OECD average and some Latin American countries (Brazil, Chile and Mexico) in the Life Satisfaction Index, with an average score of 7.4, in contrast to an average of 6.6 for OECD countries.

Figure 2.2. **Life Satisfaction Index average score, 2014**



Source: OECD (2016a), *OECD Economic Surveys: Costa Rica 2016: Economic Assessment*, http://dx.doi.org/10.1787/eco_surveys-cri-2016-en.

Recent macroeconomic trends

As in many other countries, the recent global financial crisis has had a negative impact on Costa Rica. Economic growth slowed in 2008, and the economy went into recession in 2009. Although GDP growth has resumed, it has been weaker, with a fragile labour market with high unemployment and informality. The closing of the Intel plant and the *El Niño* phenomenon have also had negative consequences, on exports and in the agriculture sector, respectively (OECD, 2016a). Nonetheless, recent data show that the country achieved important GDP growth in 2016: 4.3% (Banco Central de Costa Rica, 2016). National authorities expect GDP growth to reach 4.1% in both 2017 and 2018 (Banco Central de Costa Rica, 2016).

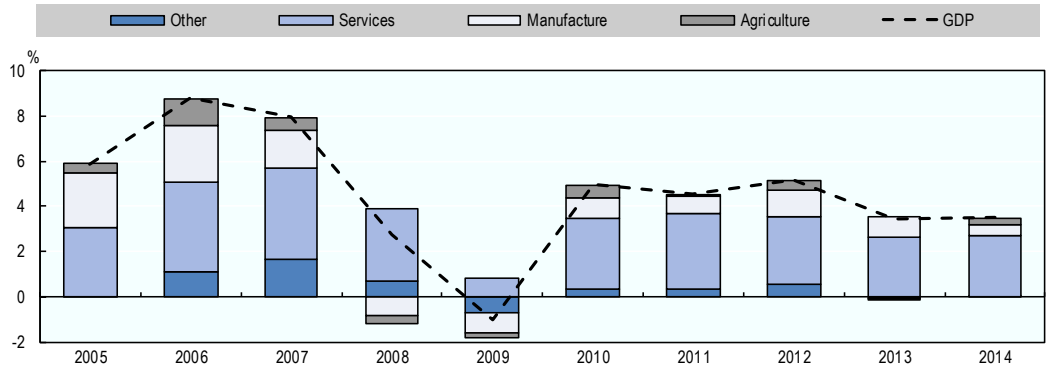
According to recent data from the Central Bank of Costa Rica,[1] the composition of GDP has changed. While in 2013 services accounted for 50.9% of GDP, in 2016 they represented 51.9%. The share of agriculture and manufacturing continues to decrease in national GDP. In 2013, the agriculture sector accounted for 5.1% of GDP while in 2016 it only accounted for 4.6%. The manufacturing sector follows the same trajectory, representing 14.9% of GDP in 2013 and 13.6% in 2016.

Inflation has been decreasing since 2009, and even turned negative in mid-2015. This decline reflects falling commodity prices, spare capacity in the economy as well as an exchange-rate appreciation. Low inflation has fostered households' purchasing power, thus increasing private consumption.

The government budget deficit is expected to reach 5.1% of GDP in 2016 and to exceed 5% of GDP in 2017, based on existing policies. The increase of public deficit is mainly explained by the increase of government spending, largely due to the rising public sector wage bill. Public debt has rapidly increased, from 28% of GDP in 2009 to over

40% in 2015. The government is aware of the fiscal challenge and is currently working to bring the budget back to a medium-term sustainable path (OECD, 2016a).

Figure 2.3. **Sectoral contribution to real gross domestic product in Costa Rica**



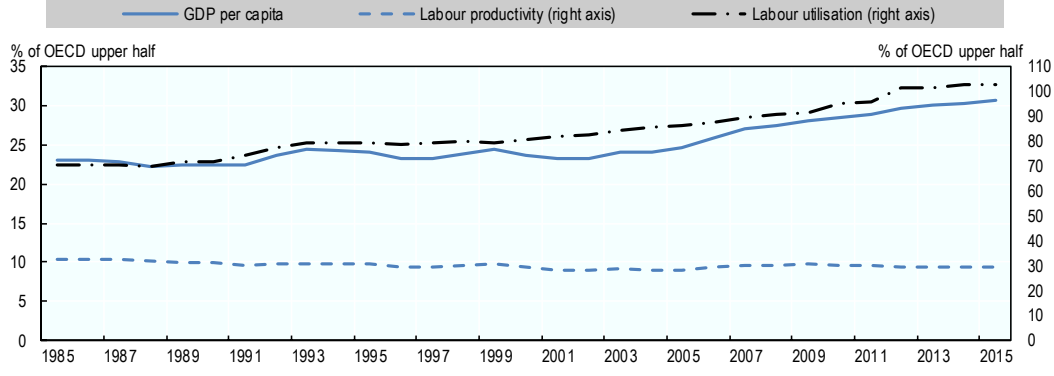
Source: OECD (2016a), *OECD Economic Surveys: Costa Rica 2016: Economic Assessment*, http://dx.doi.org/10.1787/eco_surveys-cri-2016-en.

Productivity growth and economic convergence

Productivity is widely recognised as a key driver of long-term and sustainable economic growth and the major source of differences in GDP per capita across countries. Innovation, based on the creation, absorption and implementation of new ideas and technologies, increases the value of production by means of quality increases and new product offers and makes production itself more efficient, for instance through process and organisational innovation. It is crucial that innovation benefits all firms (from small to larger ones) to raise average productivity.

Although Costa Rica's living standards have improved over recent decades, productivity growth has been very stable (Figure 2.4). Even though Costa Rica has narrowed the gap regarding labour utilisation and GDP per capita, labour productivity has stagnated at around 30% of the labour productivity average of the more advanced OECD countries. Since the early 2000s, potential output growth has declined by nearly 1 percentage point, to about 4%, as employment growth has fallen (OECD 2016a).

Figure 2.4. **Productivity and GDP per capita in Costa Rica, compared to OECD upper half**



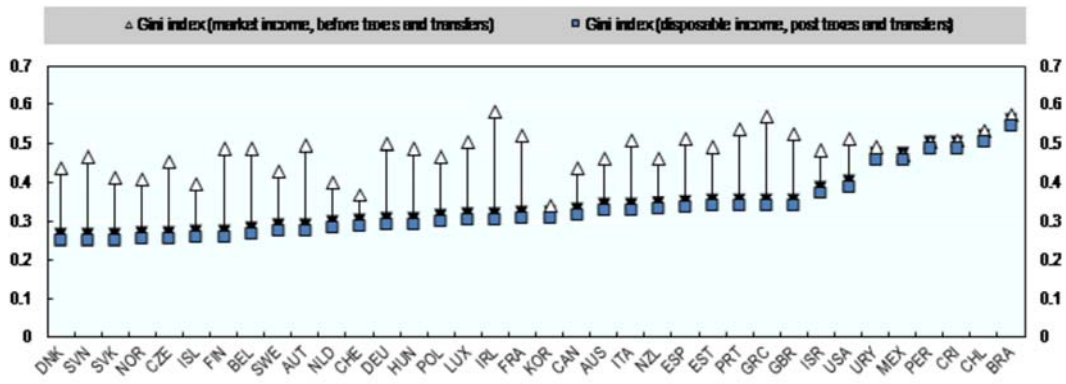
Source: OECD (2016a), *OECD Economic Surveys: Costa Rica 2016: Economic Assessment*, http://dx.doi.org/10.1787/eco_surveys-cri-2016-en.

Inequality and socio-economic trends

Economic growth as measured by GDP can no longer be the unique goal of public policy and can also not be an end in itself. OECD governments are increasingly focusing on inclusive growth as a way to improve the living standards of all groups of society. Innovation tends to increase aggregate incomes, thus having a positive impact on living standards, but can also contribute to growing income inequalities, as some firms and individuals may benefit more than others from the process of creative destruction and technological change. At the same time, innovation is a key driver to address social challenges, including those related to health and the environment (OECD, 2015b).

Despite Costa Rica's important socio-economic achievements, it still exhibits important inequality and wealth concentration. Inequality has increased since the mid-1990s (Figure 2.5) to high levels by Latin American as well as OECD standards. As observed, since the beginning of the 2000s, on average Latin American countries have sustainably decreased their Gini coefficient (a measure of wealth concentration), while that for Costa Rica has increased over the same period.

Figure 2.5. **Rising inequalities**



Source: OECD (2016a), *OECD Economic Surveys: Costa Rica 2016: Economic Assessment*, http://dx.doi.org/10.1787/eco_surveys-cri-2016-en.

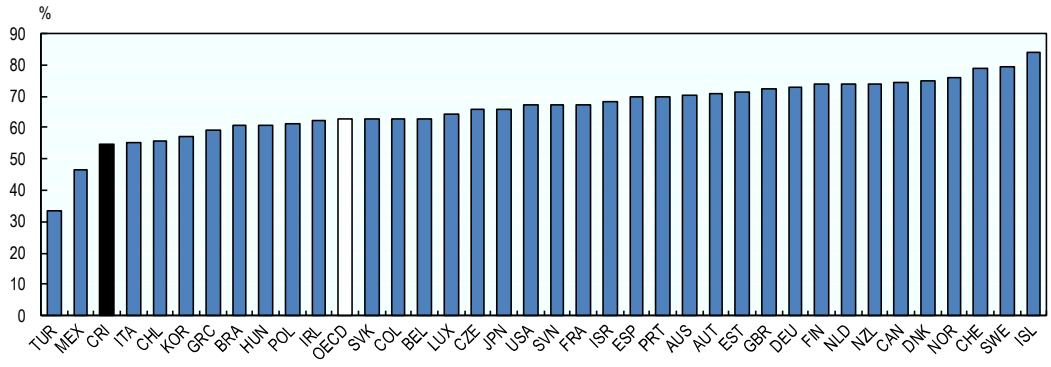
Furthermore, over the last two decades poverty rates have stagnated; in 2015, 22% of households were poor with 7% of households affected by extreme poverty (OECD, 2016a). Likewise, labour market indicators have deteriorated. The unemployment rate increased between 1990 and 2015 as well as in comparison to the OECD and Latin American averages. The country's labour market is characterised by duality: the traditional sectors employ low-skilled and low-paid workers while the exporting sectors mainly operating in the free trade zones employ high-skilled workers.

Women face higher unemployment rates, and their participation in the labour market still remains low, with only nearly half of working-age women in employment (Figure 2.6). The labour force participation rate of women in Costa Rica (54.6%) is below the OECD average of 62.8%. Moreover, youth unemployment rates are high, reaching 24% (OECD, 2016a). Strengthening the participation of these groups in the economy would contribute to decreasing the poverty rate.

The informal nature of business activities generally translates into fewer opportunities for businesses to acquire and generate knowledge. Informality, for instance, makes contract enforcement, the protection of inventions and access to public services more

difficult for firms (OECD, 2015a). The informal sector in Costa Rica, although smaller than in other Latin American countries, is still very high by OECD standards. It has been increasing rapidly in the past years, contributing to the increasing inequality trends. This is the opposite of what has occurred in many Latin America countries which have managed to decrease the informal sector in the past decade, as well as reduce inequalities.

Figure 2.6. **Women's labour force participation rate (15-64 year olds), 2014**

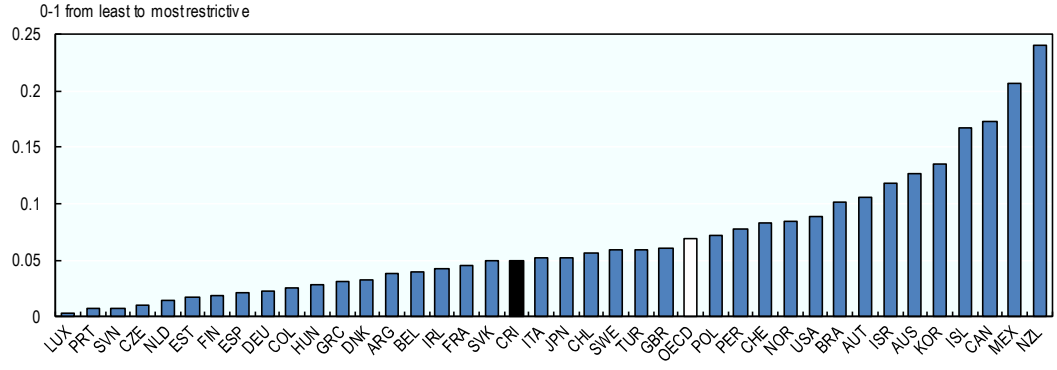


Source: OECD (2016a), *OECD Economic Surveys: Costa Rica 2016: Economic Assessment*, http://dx.doi.org/10.1787/eco_surveys-cri-2016-en.

The role of foreign direct investment

Over the past three decades Costa Rica has been successful in attracting FDI due to its friendly FDI regime. It ranks rather well in the OECD FDI Regulatory Restrictiveness Index (Figure 2.7), performing better than the OECD average and ahead of some Latin American countries such as Mexico and Chile, but worse than other regional countries such as Argentina and Colombia.

Figure 2.7. **The FDI Index**

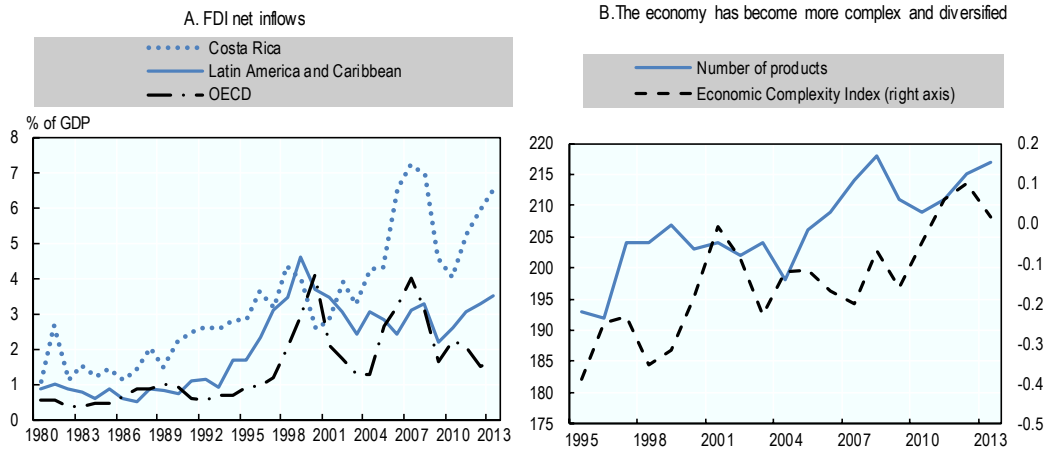


Source: OECD (2016a), *OECD Economic Surveys: Costa Rica 2016: Economic Assessment*, http://dx.doi.org/10.1787/eco_surveys-cri-2016-en.

Costa Rica's FDI inflows (as a percentage of GDP) rapidly increased in the 1990s and 2000s, as seen in Figure 2.8. FDI and free trade zones (FTZs) have played a central role in its export-oriented development model. The attraction of FDI was also favoured by

human capital, particularly at early stages of the model (Rodriguez-Clare et al., 2001). FDI inflows have fostered the shift from low value-added sectors to medium and high value-added ones, such as advanced manufacturing and services. This process has allowed the country's economy to become more the complex and diversified (Figure 2.8). Between the mid-1990s and 2014 the share in exported goods of firms located in FTZs (mostly foreign firms) substantially increased.

Figure 2.8. **Costa Rica's foreign direct investment inflows and economic diversification**



Source: OECD (2016a), *OECD Economic Surveys: Costa Rica 2016: Economic Assessment*, http://dx.doi.org/10.1787/eco_surveys-cri-2016-en.

According to recent data from the Ministry of Foreign Trade,[2] Costa Rica continues to be an attractive destination for FDI. In 2015 (preliminary data), FDI inflows reached USD 2 805 million, showing an annual variation of 6.8% in respect to 2014. In 2015, they represented 5.3% of GDP.

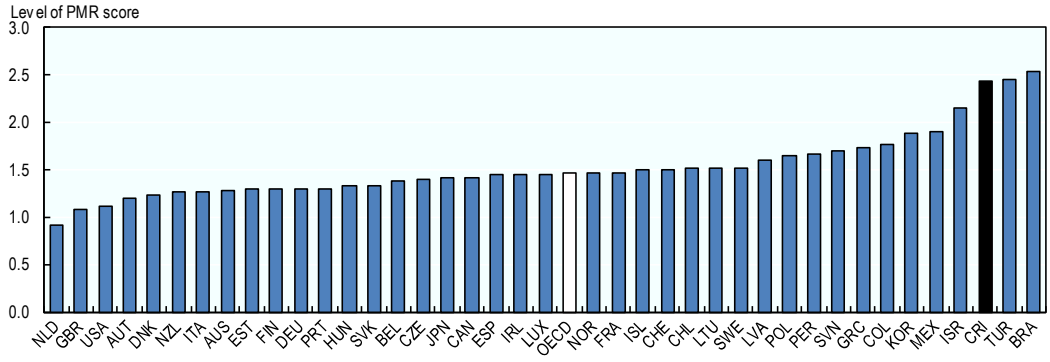
Competition

Strong competition encourages companies to innovate and develop new markets, it stimulates investments in innovation, and supports the process of creative destruction (OECD, 2015c). Although competition policy plays a modest role in affecting basic research and invention, it has a more marked effect on the commercialisation of new science and technology, as well as on efforts to diffuse innovations throughout the economy (Shapiro, 2002).

Competition is weak in Costa Rica and the role of state-owned enterprises is pervasive in many sectors. The OECD Product Market Regulation (PMR) indicator for Costa Rica is significantly above the OECD average (Figure 2.9; OECD, 2016a). Restriction in the form of state controls and barriers to entrepreneurship are especially high. State controls are particularly binding because of government involvement in the network sector, poor governance of state-owned enterprises and extensive price controls. State-owned enterprises play a dominant role in many key sectors of the economy, including electricity, transport infrastructure, banking, insurance and petroleum products. In addition, judicial decisions and sector-specific laws apply to a number of different markets, limiting the scope of Costa Rica's competition laws in those sectors, under the terms and conditions established by law. These include, for example, Law 7818 of 1998,

which grants the Agriculture League of Sugarcane Industry powers regarding the production and commercialisation of sugar produced in Costa Rica.

Figure 2.9. **Product Market Regulation, 2013**



Source: OECD (2016a), *OECD Economic Surveys: Costa Rica 2016: Economic Assessment*, http://dx.doi.org/10.1787/eco_surveys-cri-2016-en.

Access to finance

Access to finance is a necessary condition for the creation of new innovative businesses. Access to finance tends to be particularly critical for young and small businesses as they tend to be more constrained by a lack of internal funding or collateral. Moreover, once successful on a small scale, young and small firms need well-functioning financial markets to help them grow and expand the scale and scope of their innovation activities. An environment in which it is easier for successful firms to grow creates better opportunities to experiment with new solutions and therefore innovate.

In Costa Rica, limited access to finance remains a serious handicap to both businesses' competitiveness and innovation – as indicated in the National Innovation Survey (MICITT, 2014) and the 2010 World Bank Enterprise Survey. Inefficiencies and lack of competition in the banking sector (especially between public and private banks) as well as regulatory flaws contribute to a large interest rate gap between loans and deposits in local currency, hampering credit provision. In addition, growing fiscal deficits affect the costs of finance via higher interest rates for medium- to long-term lending. Intellectual property has not yet been used or formally accepted as collateral, as financial institutions and banks lack a "valid" accounting method to assess its associated value and capacity for financial response. The Ministry of Culture and the Ministry of Foreign Trade are taking initiatives to address this issue in the future.

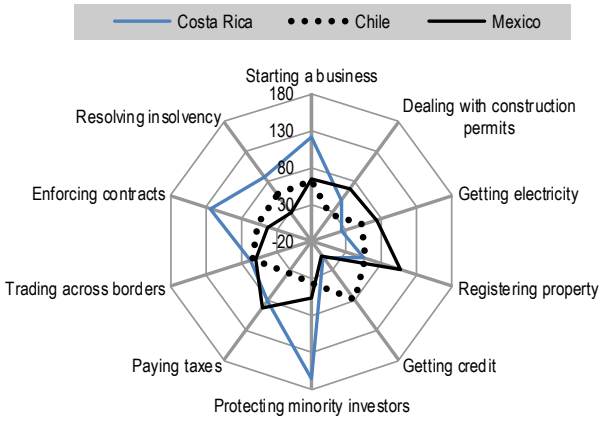
This situation discourages already limited access to finance for innovation and productivity projects, particularly regarding capital and the acquisition of technology equipment. Detailed recommendations are discussed in OECD (2016a).

Doing business environment and entrepreneurship

According to the World Bank Doing Business indicators (2016), in spite of recent improvements, the ranking of ease of business in Costa Rica remains lower than in other emerging economies in Latin America, such as Chile or Mexico (Figure 2.10). Enforcing contracts, starting a business and protecting minority investors are the three areas where

Costa Rica ranks the worst – beyond the 120th place. These are also the three regulatory areas where the gap with the best international practice is the farthest.[3]

Figure 2.10. **Ease of doing business**



Source: World Bank (2016a), *Doing Business* (database), www.doingbusiness.org (accessed in October 2016).

In addition, the legal and regulatory framework for public-private partnerships (PPPs) needs to be revised. A PPP system has been established but its performance has been problematic. Deficiencies identified in the PPP system include an inadequate methodology for identifying PPP projects, poor co-ordination among the distinct public actors, and an absence of substantive regulations necessary for its full operation.

Costa Rica exhibits high barriers related to the license and permit system, administrative burdens for sole proprietors of firms, antitrust exemptions and barriers in network sectors (regulations regarding business registration and insolvency systems need to be updated to facilitate the entry and exit of firms) – which allows for a more effective allocation and shifting of resources in the economy.

A country's entrepreneurial culture is likely to affect the attitude that individuals have towards entrepreneurs, the likelihood of choosing entrepreneurship as a career, the motivation to succeed and start again after a failure, and the support provided to family and relatives planning to set up a business. While, in general, little is understood regarding the interplay between culture and entrepreneurial outcomes, it is probable that societal attitudes play a role.

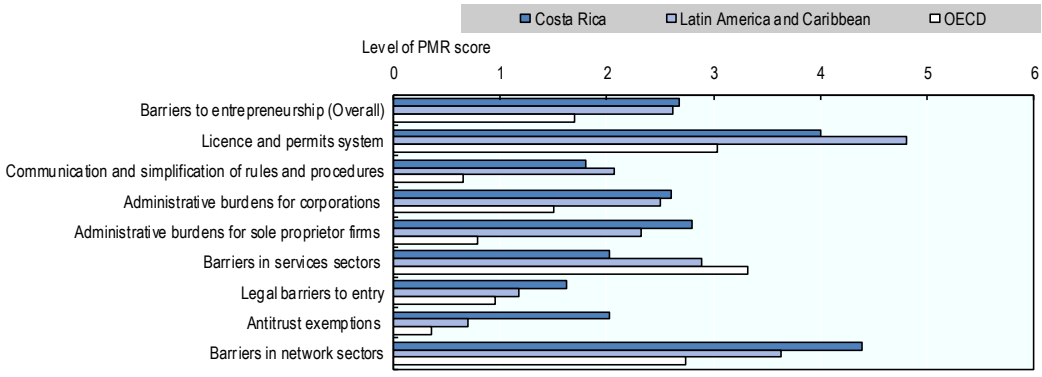
When analysing the Global Entrepreneurship Monitor (2015) it can be seen that Costa Rica still faces several challenges in comparison to Latin American and innovation-intensive countries regarding entrepreneurial attitudes and characteristics (Figures 2.12 and 2.11). The perceived capabilities and opportunities as well as fear of failure are some of the weakest areas for the country. These weak characteristics might be hampering entrepreneurial activities.

Intellectual property rights

Intellectual property rights can play an important role in creating a business environment conducive to investment in knowledge. They can provide incentives to invent in fields relating to technology (patents), business (trademarks), the arts and

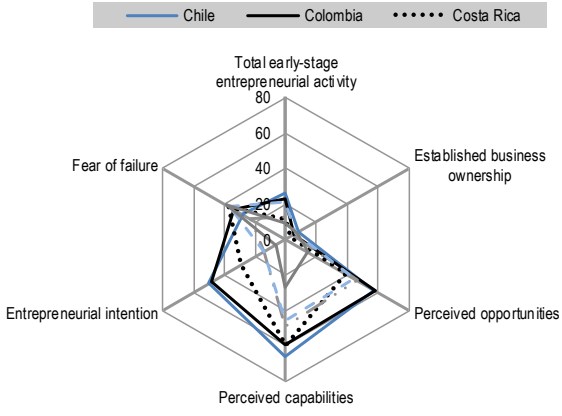
software (copyright), and even a wide variety of traditional sectors (geographical indications). National intellectual property (IP) systems can encourage domestic firms to invent, domestic universities to transfer knowledge, and foreign firms to implement or license out new technology. IP also determines how easily and efficiently domestic actors in the formal and informal sectors can access knowledge.

Figure 2.11. **Barriers to entrepreneurship**



Source: OECD (2016a), *OECD Economic Surveys: Costa Rica 2016: Economic Assessment*, http://dx.doi.org/10.1787/eco_surveys-cri-2016-en.

Figure 2.12. **Global Entrepreneurship Monitor, 2015**



Note: Data for 2015, except for Costa Rica, which are for 2014.

Source: World Bank (2016b), *Doing Business: Measuring Regulatory Quality and Efficiency. Economy Profile 2016. Costa Rica*, http://documents.worldbank.org/curated/en/761611468180883464/Doing-business-2016-measuring-regulatory-quality-and-efficiency-Costa-Rica.

In Costa Rica, the legal framework for intellectual property rights is in compliance with ratified international treaties and trade-related commitments (OECD, 2016a; 2013; 2015a). Law n. 8039 on Procedures on Enforcement of Intellectual Property Rights, passed in 2000, demonstrates the country's commitment to develop a modern IPR framework and implement the provisions of the World Trade Organization's TRIPS agreements (WIPO, n.d.). In 2002, Costa Rica established an inter-institutional commission to promote intellectual property (CIPPI). Several different ministries,

including the Ministry of Science, Technology and Telecommunications (MICITT), are part of this commission. In 2011, with the support of the World Intellectual Property Organisation, Costa Rica developed a national intellectual property strategy. It is amending its patent law and has reinforced prosecution of intellectual property rights violations in the attempt to improve enforcement (OECD and IDB, 2014).

Despite these efforts, however, the protection of intellectual property is a relatively new phenomenon in Costa Rica. For instance, Costa Rican firms exhibit a very weak patenting intensity, which is almost non-existent among indigenous firms. During the OECD mission to Costa Rica carried out for this review, several actors reported a generalised lack of intellectual property culture.

Certification and accreditation procedures

In developing countries, the vast majority of enterprises in low- and medium-technology sectors not only lack endogenous S&T capacity, but also suffer from problems related to poor access to information and application of norms and standards that hamper their ability to innovate, to improve their production processes and to diversify their activities towards increasingly demanding markets. In many of these countries, under one denomination or another, certification and accreditation systems have been created to address these problems and develop S&T capabilities (OECD, 2011).

Costa Rica initiated the development of a national certification and accreditation system in the mid-1990s, under the impulse of the MICITT and thanks to funding from the Inter-American Development Bank. Certification and accreditation institutions in Costa Rica appear to perform better than in other Central America countries, as demonstrated by the fact that often companies located in Central American countries demand the services of Costa Rican institutions. Nevertheless, Costa Rica underinvests in the national certification and accreditation system's equipment and infrastructure.

Furthermore, certification and accreditation procedures as well as metrology practices do not appear to be highly valued by domestic firms (which in many cases consider them a burden rather than an opportunity for upgrading). Most of these services appear to be required only by those Costa Ricans firms that export to those markets where certain certifications and standards are required. Investing in upgrading these services, and in promoting their usage among domestic small and medium-sized enterprises, represents an opportunity to foster the innovative capacity of the domestic business sector.

Infrastructure

Good transport infrastructure can contribute to higher GDP growth and boost productivity by fostering private investment. In addition, a better transport infrastructure may support environmentally sustainable growth. The quality of Costa Rica's transport infrastructure is low, due to important underinvestment, lack of planning and deficiency in long-term planning.

From 2002 to 2013, spending on transport infrastructure averaged 0.8% of GDP, which is slightly below the OECD average (0.94% of GDP). The Costa Rican government is aware of its transport deficiencies and has elaborated the National Transport Plan 2011-35 (MOPT, 2011), aiming for annual infrastructure spending of 3.99% of GDP to 2035. Nowadays, the transport infrastructure planning and decision-making processes are highly fragmented among different ministries and government agencies. One of the most

pressing consequences of this fragmentation is that infrastructure projects are frequently the result of individual institutional efforts rather than a transversal and co-ordinated approach and planning.

According to the World Economic Forum (2015), Costa Rica suffers from poor transport infrastructure (71st place), next to countries such as Ukraine, Jordan and Bulgaria (World Economic Forum, 2015). However, it has to be noted that Costa Rica has improved its position in the ranking since the *2013-14 Global Competitiveness Report*. Costa Rica's Logistics Performance Index (LPI) in 2016 was 2.65 and has decreased since 2010. Comparable countries exhibit a more favourable score: 2.97 for Uruguay, 3.34 for Panama and 3.25 for Chile.

ICT infrastructure – in particular high bandwidth connectivity – affects innovation and broader business outcomes in a variety of ways. Internet usage is associated with superior performance in small firms. Data from France show that Internet-using firms report higher revenue per salaried person, higher value added, superior job creation and a proportionately greater number of registered patents. Evidence from the United States also suggests that small firms that use the Internet have higher revenues than those that do not use it. More generally, ICT infrastructures facilitate innovation by enabling the circulation of data and information, whether publicly or privately generated or funded. In many areas of science, research communities use powerful computing resources across grids to access large datasets for experimental purposes. And ICT infrastructures also facilitate the data-driven delivery of key public services: from the management of smart electricity grids and transport systems to efficiency-enhancing patient data in healthcare (OECD, 2016c).

In Costa Rica, almost 60% of individuals use the Internet (World Bank, 2016d): a share above Mexico (57.4%) and Colombia (56%), but below Chile (64.3%) and advanced OECD countries. Out of 100 people, 11.2 have a fixed broadband Internet subscription in Costa Rica. This share is similar to other comparable Latin American countries like Mexico (11.6) or Colombia (11.2) and slightly below Chile (15.2). It has to be noted, however, that in advanced countries generally, this indicator is around or above 30. Mobile telephone subscriptions in Costa Rica have increased significantly since 2010 and are now above the OECD average and comparable Latin American countries.

Notes

1. http://indicadoreseconomicos.bccr.fi.cr/indicadoreseconomicos/Cuadros/frmVerCatCuadro.aspx?idioma=1&CodCuadro=%20605.
2. www.comex.go.cr/estadisticas/inversiones.aspx.
3. In fact, according to *Doing Business 2016*, only very few areas of this index showed improvements (getting credit, paying taxes and resolving insolvency) between 2010 and 2014.

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Chapter 3.

Innovation performance in Costa Rica

This chapter reviews Costa Rica's aggregate innovation performance relative to OECD countries and Latin American countries with comparable or advanced levels of innovation system development, similar size and geographical proximity. The chapter starts by examining the availability of human capital and skills for science, technology and innovation. It then highlights R&D expenditure trends across institutional sectors (business, higher education and government) and technology transfer and diffusion patterns. The chapter then reviews indicators of innovation output (including bibliometric, high-tech exports, trademarks) to highlight qualitative and quantitative characteristics of Costa Rica's innovation system.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Innovation inputs

The capacity to mobilise resources for innovation significantly varies across countries. Innovation-intensive countries devote important financial and human resources to science, technology and innovation (STI). A holistic assessment of the amount and the characteristics of the financial and human resources available to promote STI needs to take into account a wide range of indicators (Box 3.1) in order to show the relative weight of different actors in the innovation system and the different forms of innovative performance.

Box 3.1. **The OECD Blue Sky Forum 2016: A forward-looking agenda for science, technology and innovation indicators**

Every ten years, the OECD engages the policy community, data users and providers in an open dialogue to review and develop its long-term agenda on science, technology and innovation (STI) data and indicators. This event is known as the OECD Blue Sky Forum, reflecting its intention to provide an open and unconstrained discussion on evidence gaps in science and innovation and on initiatives the international community can take to formulate and address data needs in this area.

The following messages arising from the OECD Blue Sky Forum 2016 are relevant for the debate around the development of STI indicators in Costa Rica:

- The identification of the wide variety of innovation sources and how different actors contribute to them over time. Innovation statistics have to take into account the complementarities of efforts, the complex systems perspective, the flows of knowledge and the time lags before actual impacts can be identified. Several participants of the Blue Sky Forum 2016 pointed out the difficulties in ensuring that investments in R&D lead to economic and social outcomes of interest to national or local policy makers in complex and open systems, calling for the missing elements to be identified and measured in a more objective fashion.
- Need to de-emphasise the focus on indicators and extend the outlook to the entire data value chain, taking into account interdependencies that span the full data cycle and its reuse in different settings, which may include purposes and applications which were not initially intended.
- Data can and do play different roles, from feeding into agenda setting and policy design to implementation and policy evaluation. The business case for data can be more easily articulated if all of these uses can be examined in a holistic way. One possibility in the future is to go beyond the use of STI indicators as pointers to undertake a more systematic use of data for modelling and predicting the evolution of entire STI systems. Data and indicators can be integrated into established modelling tools that are already used to support decision making, for example in models of the economy.
- Qualitative information is increasingly becoming a source of quantitative evidence. Text mining tools, e.g. natural language processing through inductive or deductive methods, underscore the potential to alleviate some of the common challenges facing STI statistics, e.g. survey fatigue and unfit-for-purpose classification systems that are applied differently by human coders, and offer opportunities for generating adaptable indicators. Effective application of these methods relies on fit-for-purpose, high-quality systems to collect qualitative information in a consistent fashion and avoid potential manipulation.
- Better understand the potential and the limitations of alternative metrics to identify the broader impacts of scientific activities. While new models and tools, especially those drawing on social media and "big data" sources, offer great promise and attract a great deal of attention, some participants warned against the hype and asked users to reflect on what they actually measure. Managers of administrative databases become important data quality gatekeepers, but incentives among those who provide the information still matter.

Source: OECD (2016e), "OECD Blue Sky 2016: Towards the next generation of data and indicators: Main issues raised and possible implications for OECD".

Despite some limitations in measurement and international comparability (Box 3.2), data highlight the moderate innovation activity in Costa Rica. The challenges in STI capabilities mainly concern increasing the availability of skilled personnel and matching them with business demands (technicians and engineers in areas relevant to the economy, as well as advanced human capital), increasing business participation in innovation activities, and improving innovation performance in terms of intellectual production and its translation into value added and sophistication of the economy.

Box 3.2. **R&D indicators for Costa Rica: A caveat**

A reliable qualitative and quantitative information base of science, technology and innovation (STI) indicators is necessary to assess the overall performance of STI systems and that of their components as well as their evolution over time. The production of standardised indicators, such as those developed by the OECD and UNESCO, which allow relevant international comparisons, is therefore an important task that administrations in charge of STI policy must support, adequately fund and for which they must ensure quality control.

Costa Rica's system of STI statistics and indicators was developed by the Ministry of Science, Technology and Telecommunications (MICITT) relatively late, in 2006.[1] It has been commonly used by international organisations in their assessments and international comparisons without questioning its reliability. However, a closer look at statistics and indicators published annually by the MICITT raises questions of reliability, international comparability and lack of important information (such as metadata and explanatory notes), which are relevant for assessing the performance of the STI system, its evolution over time, and the nature and intensity of interactions measured by funding flows. The main apparent shortcomings include:

- Business R&D statistics for Costa Rica are not comparable with those for OECD countries, as they do not fully meet OECD standards. Substantial changes to the current survey instrument are therefore required to make such statistics fully comparable.
- The official innovation and R&D business survey prioritises the collection of innovation data and consequently the available R&D indicators are limited and do not provide sufficient information on sources of funds or types of R&D. In addition, there is a general lack of information regarding the R&D expenditures of multinational enterprises.
- Limited availability of data on research personnel (researchers and support technicians involved in R&D activities) in the enterprise sector makes it difficult to assess the possible shortage of skilled personnel that could engage in innovation projects that require research capacities and to monitor the impact of policies aimed at increasing the supply of such personnel.

As a consequence, R&D statistics and figures in this chapter (which are all from official national and international sources) need to be compared and interpreted in light of these considerations.

Note: The above-mentioned issues and their possible solutions have been the object of discussion during the OECD Committee for Science and Technology Policy fact-finding mission to Costa Rica, which took place in February 2017 and was carried out in the context of Costa Rica's process of accession to the OECD.

The business sector's contribution to research and development (R&D) in Costa Rica is particularly weak – below the regional average – and this is particularly problematic since the only probable means of increasing total R&D investment is through more active participation of businesses. Costa Rica is not investing as much as major emerging economies and OECD countries in several critical areas of innovation, including R&D, other intangible assets, and most importantly, in technology adoption. Improving technology diffusion (of both hard and soft technologies) and maximising knowledge

spillovers and linkages with global activities (e.g. foreign direct investment and trade), remain important concerns to foster innovation opportunities.

Human capital and skills for science, technology and innovation

To be able to absorb, create and disseminate knowledge, a country needs to have a significant stock of human capital. Skilled human resources are a key element in knowledge-based economies. There are several ways in which human resources relate to innovation that go beyond science and engineering and are linked to the generation of new knowledge (research skills), adopting and adapting existing ideas (e.g. engineering skills), and enabling innovation through the capacity to learn as well as complementing innovation inputs (e.g. marketing and organisational skills). For this reason, it is important to look at different indicators that allow a broad approach of a country's performance in skills and how human resources may enable the innovation process to be observed. Educational coverage (primary, secondary and tertiary school enrolment) and expenditure, the average number of years of attainment, quality, tertiary education attainment, science and technology graduates, are some such indicators (OECD, 2016a, Monge-González, 2016).

The lack of adequate human resources is an important barrier that hampers innovation among firms. In addition, human capital drives productivity growth among economies. Productivity challenges in Costa Rica may be linked to some of its most pressing demands in the education field. Although the country's expenditure on education is very high and advances have been made, it still lags behind some Latin American and OECD countries in terms of access, enrolment, tertiary education graduates and quality of education. Box 3.3 gives an overview of Costa Rica's education system.

Box 3.3. **The education system in Costa Rica**

The education system in Costa Rica consists of four different cycles: preschool, primary, secondary and tertiary education (Álvarez-Galván, 2015).

Preschool education includes two stages: 1) childcare from birth until entry to preschool; 2) mandatory preschool education for children aged at least five years old.

Compulsory primary education is divided into Cycles I and II and goes from 1st to 6th grade. It is part of a general basic education. Children must be at least six years and three months old on the last day of February to enter primary education.

Secondary education goes from 7th to 9th grade and is also part of the compulsory general basic education. It covers the third cycle of medium-level education. Post-compulsory education includes the "diversified education" cycle, from 10th to 12th grade. In this cycle students may choose the academic or arts track (two years) or the technical track (three years). The academic track concludes with the *bachiller* certificate, offering access to higher education. Students in the technical track can sit the *bachillerato* exam in 12th grade or receive a mid-level technician certificate without passing the exam.

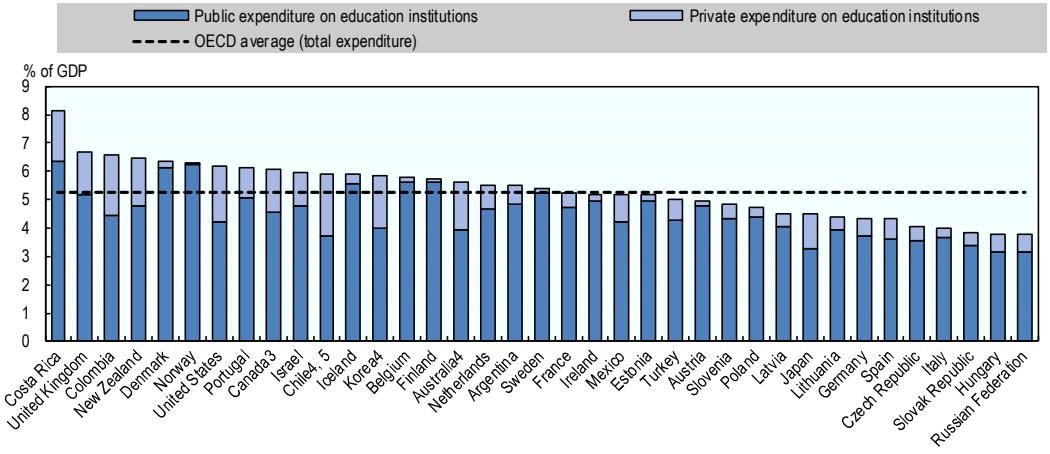
Finally, higher education is offered at university colleges and universities as well as at higher education institutes. The non-university sector offers two- and three-year professional diplomas (60 and 90 credits). A bachelor's degree requires a four-year programme (120-144 credits). The *licenciatura* lasts 5 years (30-36 credits in addition to the university *bachillerato*) and 6 years in the case of medicine and surgery. Masters' degrees last two years while Doctoral academic programmes last at least 3.5 years.

Source: Álvarez-Galván, J. (2015), *A Skills beyond School Review of Costa Rica*, http://dx.doi.org/10.1787/9789264233256-en.

Costa Rica's investment in education

Today, Costa Rica invests large amounts in education, devoting around 8% of its GDP to education, all levels combined (Figure 3.1). In 2013, OECD countries spent an average of 5.2% of GDP on educational institutions. Costa Rica's expenditure is well above the OECD average, as well as above technologically advanced countries such as Norway, the United States and the United Kingdom (OECD, 2016b). The country's expenditure on education is highly concentrated in public institutions, which represented 6.4% of GDP in 2013, compared to 1.8% from private ones. In addition, the country's public and private investment in education is well above the OECD average, of 4.5% and 0.7% respectively (OECD, 2016b).

Figure 3.1. **Public and private expenditure on primary to tertiary education institutions, 2013**



Notes: Public expenditure figures presented here exclude undistributed programmes. Countries are ranked in descending order of expenditure from both public and private sources on educational institutions.

1. Including public subsidies to households attributable to educational institutions and direct expenditure on educational institutions from international sources. 2. Net of public subsidies attributable for educational institutions. 3. Year of reference 2012. 4. Public does not include international sources. 5. Year of reference 2014.

Source: OECD (2016b), *Education at a Glance 2016: OECD Indicators*, http://dx.doi.org/10.187/eag-2016-en.

The country's high investment in education has contributed to its outstanding adult literacy rate. In 2015, 97.6% of its population above 15 years old was literate, above other Latin American countries such as Chile, Colombia and Mexico, and very similar to OECD countries. In this regard, Costa Rica has been very successful in providing its citizens with free and mandatory education. Adult literacy rates by gender have also reached parity; in 2015, 97.7% of females and 97.5% of men were literate (UNESCO, 2016).

In addition, Costa Rica devotes a high share of GDP on primary, secondary and tertiary education per level of education. Costa Rica spends 5.7% of its GDP on primary, secondary and post-secondary non-tertiary education. This share is well above the OECD average, technologically driven economies such as the Nordic countries and Germany, as well as Latin American countries such as Argentina, Chile, Colombia and Mexico.

Costa Rica also presents a very high share of investment in tertiary education, at 2.5% of GDP in 2013, above the OECD average of 1.6%. When analysing the sources of funds, the public sector emerges as an important stakeholder, investing 1.5% of GDP on tertiary

education, while the private sector contributes 1% of GDP. The countries where the largest share of GDP is spent on tertiary education are Canada, Costa Rica and the United States, all close to 2.5% of GDP (OECD, 2016b).

The quality of education

The quality of education is also an important element to take into consideration when assessing human capital and its ability to access and adequately perform in the labour market. Despite Costa Rica's outstanding achievements, some educational issues emerge when taking into consideration secondary education. In this regard, Costa Rica faces the challenge of improving student performance in secondary education. The OECD Programme for International Student Assessment (PISA) is a triennial international survey to assess education systems by testing the skills and knowledge of 15-year-old students. Table 3.1 shows countries' mean PISA scores for 2015 in mathematics, reading and science.

In the 2015 OECD PISA survey, Costa Rican students scored considerably below the OECD average in all three survey areas. As observed in Table 3.1, innovation-intensive countries (Ireland, Korea and Singapore) performed above the OECD average for the three assessed areas, while some Latin American countries (Chile, Colombia, Mexico and Uruguay) and Costa Rica underperformed in all three areas. Chilean and Uruguayan students performed better than Costa Rica's students in mathematics, reading and science. The scores displayed in Table 3.1 are evidence of the existing gaps between OECD countries and Costa Rica.

Table 3.1. **PISA results in mathematics, reading and science, 2015**

Country mean score					
Mathematics		Reading		Science	
Singapore	564	Singapore	535	Singapore	556
Korea	524	Ireland	521	Korea	516
Ireland	504	Korea	517	Ireland	503
OECD average	490	**OECD average**	493	**OECD average**	493
Chile	423	Chile	459	Chile	447
Uruguay	418	Uruguay	437	Uruguay	435
Mexico	408	Costa Rica	427	Costa Rica	420
Costa Rica	400	Colombia	425	Mexico	416
Colombia	390	Mexico	423	Colombia	416

Source: OECD (2016c), *PISA 2015 Results (Volume I): Excellence and Equity in Education*, http://dx.doi.org/10.1787/9789264266490-en.

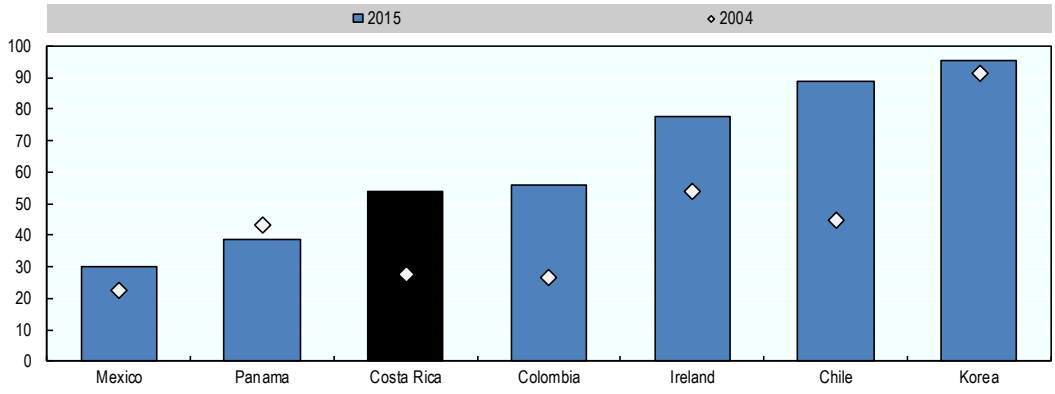
Tertiary education

Tertiary education enrolment can be used as a broad measure of a country's ability to accumulate human capital of potential relevance to innovation. Even though the tertiary enrolment ratio increased in Costa Rica during the 2004-13 period, it is still low compared to innovation-intensive countries such as Korea and Ireland. In comparison with other Latin American countries, Costa Rica also falls behind Chile and Colombia, but presents advantages in comparison to Panama and Mexico (Figure 3.2).

In 2015, 14% of 25-64 year-old Costa Rican adults with a tertiary education had a bachelor's degree or equivalent. This percentage is similar to those observed in other Latin American countries such as Chile (13%) and Mexico (14%), but below the OECD average (16%). However, only 3% of Costa Rica's 25-64 year-olds hold a master's

degree or equivalent, also below the OECD average (12%). Doctoral degree graduates are very scarce in the country (Figure 3.3).

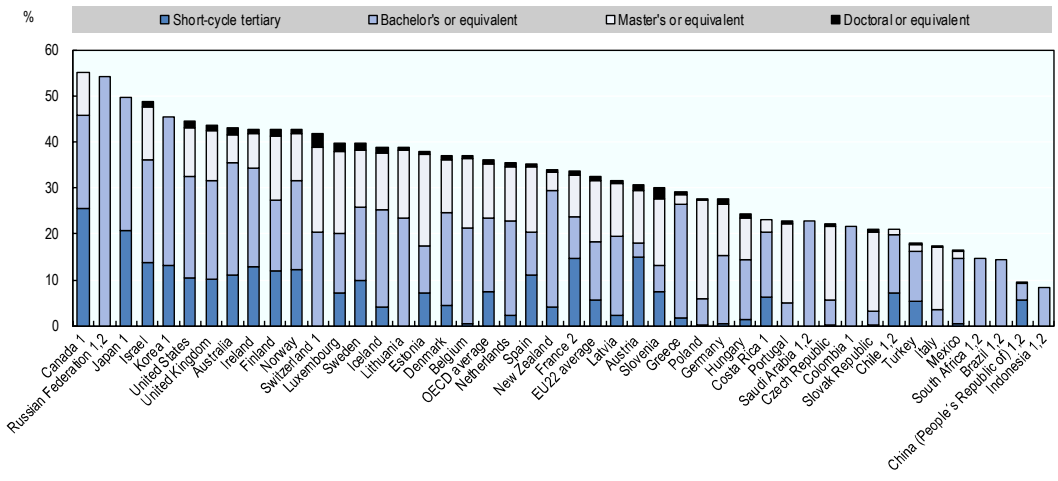
Figure 3.2. **Aggregate gross enrolment ratio in tertiary education**



Note: Data for 2015 for Mexico and Ireland correspond to 2014; data 2015 for Panama and Korea correspond to 2013.

Source: UNESCO (2016), *Education and Literacy* (database), http://uis.unesco.org.

Figure 3.3. **Percentage of 25-64 year olds with a tertiary education, by level of tertiary education, 2015**



Notes: Countries are ranked in descending order of the percentage of 25-64 year-olds with a tertiary education, regardless of the level of tertiary attainment.

1. Some levels of education are included in other. 2. Reference year differs from 2015.

Source: OECD (2016b), *Education at a Glance 2016: OECD Indicators*, http://dx.doi.org/10.187/eag-2016-en.

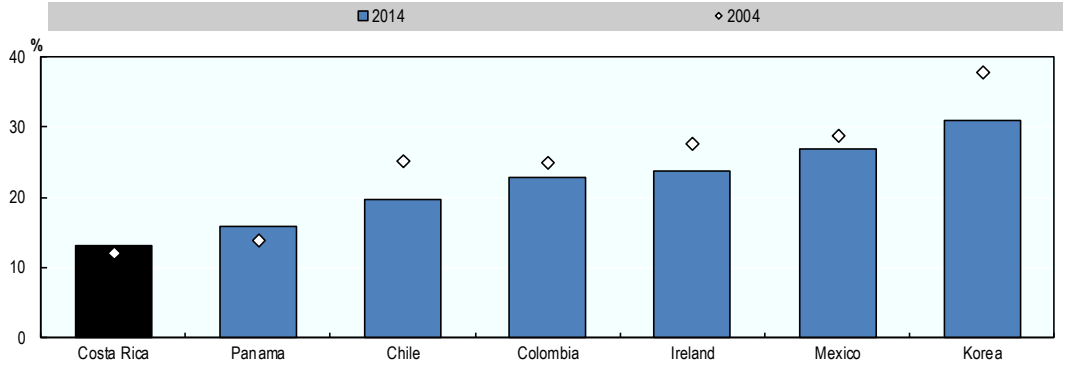
Costa Rica presents a high percentage (51%) of 25-34 year-olds below upper secondary education, which largely surpasses the OECD average (16%), Chile (20%), Colombia (33%) and Brazil (38%). In Costa Rica men present a higher rate (54%) of below upper secondary education compared to women (49%), as is the case in the OECD, on average. This characteristic is also observed in Latin American countries such as Brazil, Colombia and Mexico (OECD, 2016b).

S&T graduates

Policy makers are particularly interested in the supply of scientists and engineers because of their direct association with technological progress, industrial performance and economic growth. In Costa Rica, university graduates are not satisfying the growing business demand, particularly in the areas of engineering and technology. In recent years, the number of graduates has diminished, and today less than 15% of university graduates have a degree in science or technology (Figure 3.4). Furthermore, this ratio has barely changed over the last decade. In contrast, 22% of students graduating at tertiary level in OECD countries did so with a natural sciences and engineering (NS&E) degree. In addition, the current education system follows a traditional approach in teaching and does not promote "new thinking" or problem-solving learning – which favour creativity and innovation as well as entrepreneurship (Monge-González, 2016).

Female students are underrepresented in certain fields of education such as science and engineering. In most OECD countries, the gender gap has narrowed slightly, with women accounting for 35% on average of all NS&E graduates in 2012, with shares ranging from 14% in Japan to 45% in Italy (OECD, 2015).

Figure 3.4. **Share of science and technology university graduates out of total number of university graduates, selected countries**



Notes: 2002 data for Costa Rica, 2003 for Mexico; 2015 for Korea, 2013 for Panama, 2012 for Ireland and Mexico.

Source: UNESCO (2016), *Education and Literacy* (database), http://uis.unesco.org.

Finally, there are mismatches between the needs of the business sector and the qualifications of the country's human capital. According to the MICITT (2016), small, medium and large firms all consider the lack of qualified personnel as an obstacle to innovation within firms. This mismatch is a common characteristic shared with Latin American economies where the quantity and the quality of human capital represent an important obstacle for the business sector and for the economy as a whole. This skill shortage and mismatch of human capital prove to be an important restriction to foster innovation and increase productivity, challenging growth and hampering inclusiveness in the country.

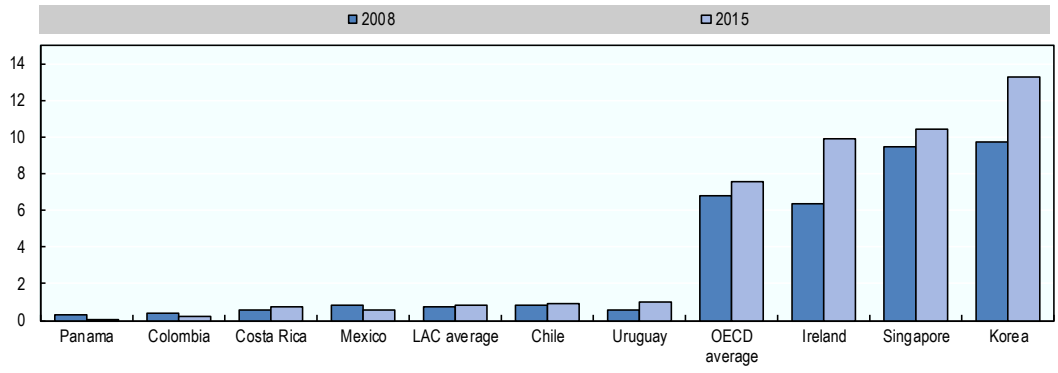
R&D personnel

R&D personnel indicators include researchers and support staff, as well as technicians and managers. The number of R&D personnel over time provides a perspective of the changing nature of countries' R&D activities. As a large portion of

R&D investment goes to the salaries of research personnel, headcounts correlate strongly (albeit imperfectly) with gross expenditure on research and development (GERD). Shifts in the relation between GERD and R&D personnel may indicate a change in policy focus, either towards the improvement of human resource capabilities or towards the development of infrastructures such as laboratories and research centres. Although the number of R&D personnel provides valuable information about the supply of human resources, it does not allow for evaluating the quality of their skills or how these are deployed. As highlighted in Box 3.2, some questions have been raised about the accuracy and international comparability of statistics on R&D personnel for Costa Rica.

The share of total researchers per 1 000 labour force (full-time equivalent) increased in Costa Rica in the 2008-14 period, from 0.58 in 2008 to 0.74 in 2014. Nonetheless, the country remains below the regional average (0.8 in 2014), as well as below other Latin American countries such as Chile, Mexico and Uruguay. Comparing the Latin America and Caribbean (LAC) and OECD averages shows the important gap between advanced economies and developing ones. The LAC average in 2014 was 0.8, which falls considerably below the OECD average (7.49). Furthermore, and as observed in Figure 3.5, when comparing Costa Rica to innovation-intensive countries such as Ireland and Korea (which considerably increased their human capacity building in the analysed period), the existing gap between these economies becomes clear. While Ireland and Korea presented 8 and 13 researchers per 1 000 labour force respectively (full-time equivalent) in 2014, Costa Rica's share was still very low, at only 0.74 for the same year.

Figure 3.5. **Total researchers per 1 000 labour force (full-time equivalents), selected countries**



Notes: LAC: Latin America and Caribbean. 2013 data for Costa Rica, Panama and Mexico; 2014 data for OECD average, LAC average, Singapore and Uruguay.

Sources: OECD (2017), "Main science and technology indicators", *OECD Science, Technology and R&D Statistics* (database), http://dx.doi.org/10.1787/data-00182-en; RICYT (2016), *Indicadores de insumo* (database), www.ricyt.org/indicadores.

The diaspora

The problem of skill mismatches is exacerbated by the fact that many skilled Costa Ricans leave the country to study and work abroad. Skilled Costa Ricans abroad are highly concentrated in areas critical for the country, such as natural sciences (47%) or technology and engineering (40%). Medical sciences (7%) and agricultural sciences (5%) are less affected (Hipatia, 2016). Costa Rican professionals abroad tend to be highly educated (44.5% with a master's degree, 26% with a PhD and 9.4% with a bachelor's degree) and are predominantly located in innovation-intensive countries such as the

United States (37%) or Germany (11%). Many of the skilled Costa Ricans abroad are young (57% between 20 and 35 years old).

According to a survey carried by Hipatia (2016), 55% of skilled Costa Ricans abroad specialising in science and engineering are considering returning to Costa Rica. Most of the Costa Ricans abroad that are considering returning to Costa Rica are young postgraduate students (mostly men in STEM[1] disciplines). However, most of those who are already working abroad are not planning on coming back. The scientific diaspora does not appear to be strongly connected to their Costa Rican colleagues, with the exception of the biological sciences (probably due to the comparative advantage that Costa Rica has to offer in terms of biodiversity). Engineers and technology professionals tend to engage more with the diaspora by means of knowledge and technology transfer initiatives.

Box 3.4. **Innovation activities and their changing nature along the development curve: The relative importance of diffusion and absorption capacity**

In developing countries, innovation is fundamentally based on the acquisition and diffusion of foreign knowledge and technology. This process facilitates "technological" learning which occurs through imitation, adaptation and reverse engineering, leading to different forms of incremental innovation and productivity upgrading. Imitation and technology acquisition have been often found to be more important than R&D and innovation as preconditions for learning and catching up. Unlike developed countries, this process rarely creates radical breakthroughs in scientific and technological knowledge. Technology-lagging firms will look to rapidly improve technical and operational efficiency through technology imports, including disembodied technology (contracting R&D, technical and engineering services, software and hardware, etc.) and embodied technology in foreign machinery and equipment, although the latter has frequently dominated foreign technology acquisition.

Given these particular innovation features, international indicators on innovation performance such as those commonly used in global benchmarking (e.g. Global Innovation Index, the European Innovation Scoreboard, OECD Main Science and Technology Indicators), should be read with care as they may have little relevance for interpreting innovation performance in developing countries. In developing countries (especially in low-income economies), investing in R&D remains prohibited as access to finance is limited and highly costly, economic returns are highly uncertain (due to economic shocks and weak appropriation of innovation returns), and human capital for innovation is limited.

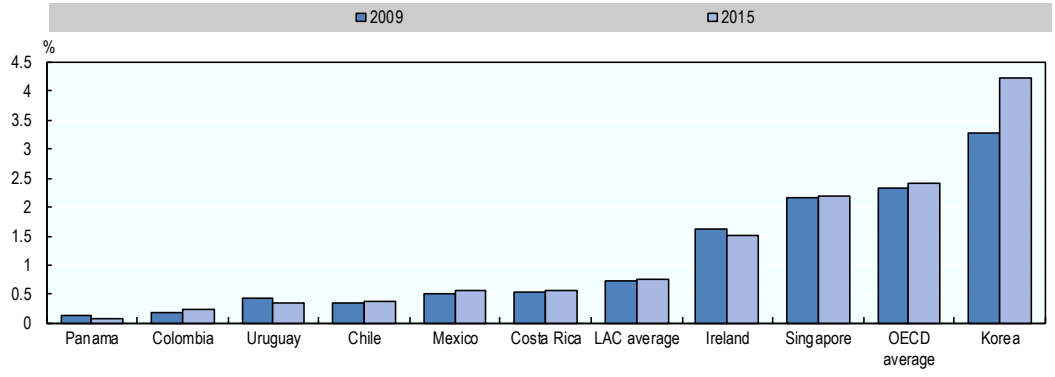
For upper middle-income countries – moving along the development curve – R&D makes sense to start moving from acquisition to generation of national innovation competences and competing in global markets. More fundamentally, having a minimum level of internal R&D is critical to create absorptive capacities to effectively search for, select, assimilate and adopt externally generated technology. Therefore, firms will seek different combinations of internally generated knowledge and technology acquisition in order to innovate. Different externally generated technologies might require locally generated capacities for successful adoption and to begin moving towards more innovative stages.

Sources: Kim, L. (1993), "National system of industrial innovation: Dynamics of capability building in Korea", http://secure.com.sg/courses/ICI/Grab/Reading_Articles/L11_A04_Kim.pdf; Cohen, W.M. and D.A. Levinthal (1990), "Absorptive capacity: A new perspective on learning and innovation"; Ghazinoory et al. (2014), "Measuring innovation performance of developing regions: Learning and catch-up in provinces of Iran", https://www.ceeol.com/search/article-detail?id=341473.

Innovation and R&D investments

Investment in R&D[2] as a percentage of gross domestic product (GDP) is a traditional measure of a country's innovation performance. Costa Rica's GERD as a percentage of GDP slightly increased between 2009 and 2014, from 0.54% to 0.56% (Figure 3.6). Costa Rica's R&D expenditure as a percentage of GDP surpasses other Latin American economies such as Chile, Colombia, Mexico, Panama and Uruguay. However, its expenditure remains below the regional average 0.75% (2014, RICyT data) and further below the OECD average (2.4%) for the same year. Likewise, Costa Rica falls behind innovation-intensive countries such as Ireland, Singapore and Korea (Figure 3.6). Korea's investment in R&D as a percentage of GDP was 7.6 times higher than Costa Rica's in 2014.

Figure 3.6. **GERD as a percentage of GDP, selected countries**



Notes: LAC: Latin America and Caribbean. 2014 data for Singapore, LAC average, Uruguay, Colombia and Ireland; 2013 data for Costa Rica and Panama.

Sources: OECD (2017), "Main science and technology indicators", *OECD Science, Technology and R&D Statistics* (database), http://dx.doi.org/10.1787/data-00182-en; RICYT (2016), *Indicadores de insumo* (database), www.ricyt.org/indicadores.

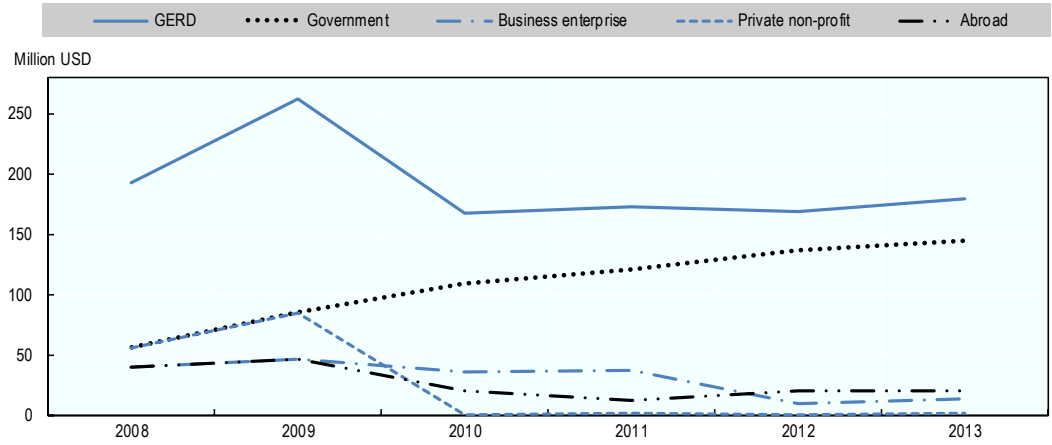
As observed in Figure 3.7, between 2008 and 2013 the amount of GERD financed by industry decreased substantially, from USD 40.1 million to USD 13.7 million. There was a sharp decrease in 2012, since business expenditure on research and development (BERD) fell from USD 36.8 million in 2011 to USD 10 million in 2012. The sharp decrease might be explained by Intel's decline in investment in innovation activities in the period, following the company's decision to transfer part of its activities to Malaysia, which led to downsizing its investments in Costa Rica. Despite this, Intel kept its engineering centre in the country and shifted the focus of its local operation from manufacturing to services.

GERD financed by industry generally emerges as the main source of funding in advanced countries. In developing countries, on the contrary, government is usually the main funding source. This is a shared characteristic of Latin American countries, where the government is the main stakeholder that drives the country's efforts in R&D. In OECD countries with advanced innovation systems, R&D efforts mainly rely on the business sector.

In 2014, GERD financed by industry represented on average 60% in OECD countries, while it accounted for 34% on average in LAC countries. On the other hand, for the same year GERD financed by the government represented 28% on average for OECD countries

and 61% on average for LAC countries. These data are evidence of the lack of engagement in innovation activities that the Latin American business sector usually exhibits. There are many explanations for the weak R&D expenditure of the business sector, including: the weak innovation systems that characterises the region; the poor framework conditions that prevail and hamper firms' innovation engagement (see Chapter 2); and the existence of productive structures that do not necessarily demand the incorporation of science, technology and innovation (OECD/CAF/ECLAC, 2013).

Figure 3.7. **Components of Costa Rica's GERD by source of funding**



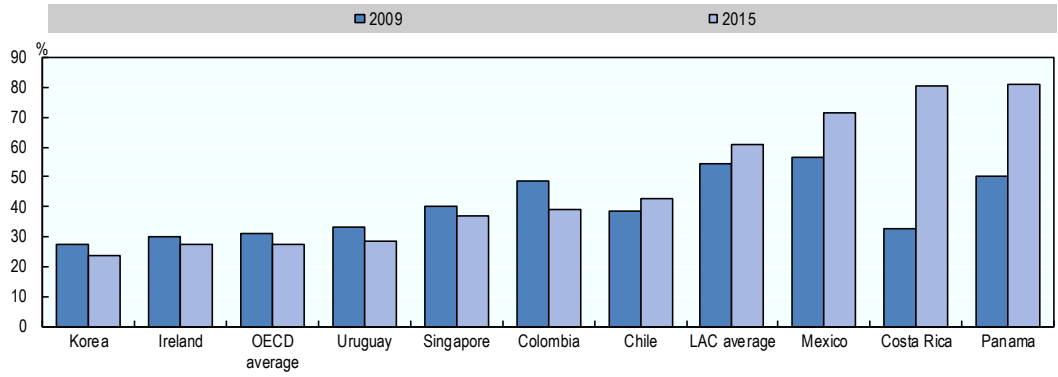
Source: MICITT (various years), Encuesta de Actividades Científicas y Tecnológicas, 2008-2013.

As observed in Figures 3.8 and 3.9, Costa Rica follows the pattern common of countries with an emerging innovation system: the government represented the main source of R&D funding for the 2008-13 period, accounting for 80% of GERD in 2013.[3]

The government's investment in R&D increased in the 2008-13 period, from USD 56.1 million in 2008 to USD 144 million in 2013, which explains the increase of GERD as a percentage of GDP over this period (Figure 3.8). In addition, the gap between government and business sector funding has significantly widened. Government funding represented 30% of GERD in 2008, while business funding represented 20%. However, in 2013 they represented 80% and 7.6% of GERD respectively (Figure 3.9). This evolution evidences not only the importance of the government as the main funding actor within Costa Rica's innovation system but also the detachment and weak engagement of the business sector in innovation efforts, which has continuously decreased its investment in this area. Furthermore, the proportion of GERD financed by the business sector is low compared to other Latin American countries such as Chile, Colombia and Mexico.

This pattern is opposite to the one observed in innovation-intensive countries with developed innovation systems, such as Ireland, Korea and Singapore, where the expenditure on R&D by the business sector evidences a sustained growth. As well, and as observed in Figure 3.9, the business sector funds 75% of GERD in Korea, 53% in Ireland and 54% in Singapore.

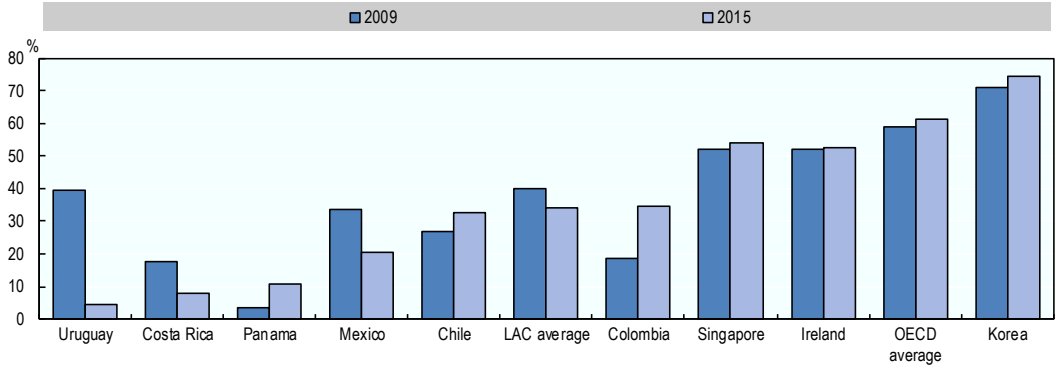
Figure 3.8. **Percentage of GERD financed by the government in selected countries**



Note: LAC: Latin America and Caribbean. Data for Ireland, OECD average, Uruguay, Singapore, Colombia, LAC average, Costa Rica and Panama corresponds to 2014.

Sources: OECD (2017), "Main science and technology indicators", *OECD Science, Technology and R&D Statistics* (database), http://dx.doi.org/10.1787/data-00182-en; RICYT (2016), *Indicadores de insumo* (database), www.ricyt.org/indicadores and data provided by the MICITT.

Figure 3.9. **Percentage of GERD financed by industry in selected countries**



Note: LAC: Latin America and Caribbean. Data for Uruguay, LAC average, Colombia, Singapore, Ireland, OECD average corresponds to 2014. Data for Costa Rica and Panama corresponds to 2013.

Sources: OECD (2017), "Main science and technology indicators", *OECD Science, Technology and R&D Statistics* (database), http://dx.doi.org/10.1787/data-00182-en; RICYT (2016), *Indicadores de insumo* (database), www.ricyt.org/indicadores and data provided by the MICITT.

Technology transfer from abroad

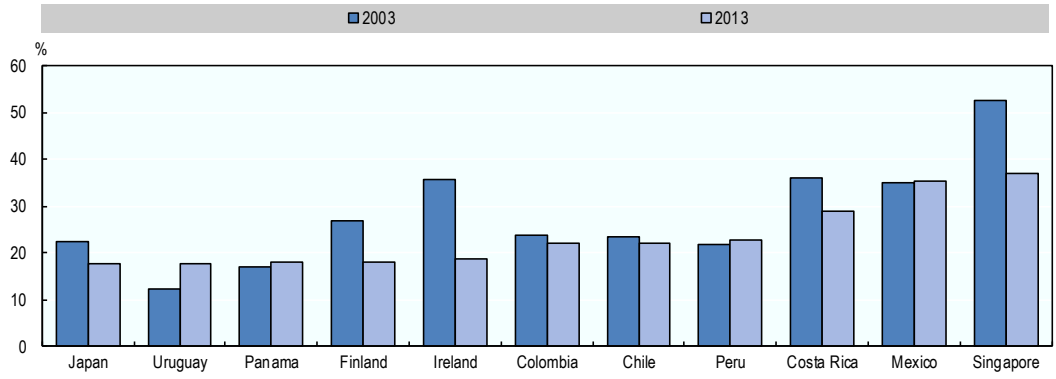
Technology transfer – generally defined as the process of acquiring, absorbing and learning from foreign technology – is a fundamental prerequisite for catching-up and building innovation competences. According to many countries' experiences (Kim, 1993; Fagerberg and Srholec, 2008), firms "learn" from foreign technology by acquiring and using imported machinery and equipment (embodied technology), and through arm's-length contracting and know-how licensing with foreign firms ("disembodied" technology).

Foreign technology licensing can bring important benefits to firms through learning and know-how. Technology purchasing is not neutral with regard to its impact on firm innovation and the type of innovation that firms produce. It facilitates adaptive and incremental innovation, setting the basis for broader innovation activities.[4] Technology purchasing (both of equipment and disembodied technology trough arm's-length contracting), especially of new machinery and equipment, tends to be mostly related to process innovation – the most frequent type of innovation in firms in developing countries –whereas internal R&D is mostly associated with product innovation (Goedhuys and Veugelers, 2012; Arvanitis and Bolli, 2013). These benefits are also larger when firms have an internal R&D capacity.

Costa Rica displays high levels of capital goods imports (as a share of total imports), similar to Mexico or Singapore, and higher than other Latin American countries such as Chile, Colombia, Panama or Peru (Figure 3.10). This means that there is a great potential for technological learning (Box 3.5) from such global interactions, which is mediated by the capacity of local firms to use and absorb such knowledge and interact with multinational companies located in the country. The latter might be the main recipient of such imports –given foreign firms' importance in Costa Rican manufacturing.

Figure 3.10. **Share of capital goods imports in total imports, 2002-13**

As a share of GDP



Source: Monge-González, R. (2016), "Innovation, productivity, and growth in Costa Rica: Challenges and opportunities", https://publications.iadb.org/handle/11319/7376.

Costa Rica displays moderate levels of international technology acquisition as reflected in cross-border payments related to arm's-length contracting and licensing (or sale) of intellectual property. It does have higher intensity of technology payments (relative to GDP) compared to Colombia, Mexico, Panama or Uruguay but lower than OECD countries such as Chile, Finland, Korea or Japan. Care should be taken when reading these figures as much of this activity may concern intra-firm payments; that is, concerning only affiliated firms (abroad) in a multinational network.

Maximising the benefits of external technology depends greatly on internal absorption capacity, i.e. in-house R&D activity and investment (Griffith, Redding and Van Reenen, 2004). Innovation policies in Costa Rica should aim to support both forms of learning (and their financing) and ensure they interact in complementary ways – e.g. by supporting building in-house R&D in parallel to technology acquisition to achieve productivity gains more efficiently. Yet, Costa Rica, as other Latin American countries,

has invested little in technology transfer assistance and supportive institutions, therefore hindering the opportunities from knowledge transfer from foreign direct investment (FDI) and global trade.

Box 3.5. **International transfer and its importance to catching-up**

Innovation in domestic firms can potentially benefit from international knowledge spillovers through global interactions such as international trade and foreign direct investment (FDI). The extent of spillovers and the capacity to learn from trade and multinational activity, however, are determined by domestic absorption capacity and the existence (and quality) of productive linkages with global firms (Cohen and Levinthal, 1990; Griffith, Redding and Van Reenen, 2004).

FDI can potentially benefit domestic firms. The benefits arise from foreign firms demonstrating new technologies, providing technological assistance to their local suppliers and customers, and training workers who may subsequently move to local firms. Local firms can also learn by watching. Moreover, the very presence of foreign-owned firms in an economy increases competition in the domestic market. The competitive pressure may spur local firms to operate more efficiently and introduce new technologies earlier than would otherwise have been the case. Because foreign firms are not able to extract the full value of these gains, this effect is commonly referred to as the spillover effect. The spillover effect has been identified as an important benefit accruing to domestic firms. It is also considered an important mechanism through which FDI promotes growth in a host country (Xiaoqin Fan, 2002).

Successful catch-up has historically been associated with the adoption of existing technologies and techniques in established industries and the diffusion of global technologies, both "hard" technologies –embedded in equipment machinery – and "soft" technologies, such as managerial skills and methods. The experience of Southeast Asian countries has shown that firms can accelerate productivity growth relatively quickly by adopting global production techniques, such as quality management systems and production standards, such as lean manufacturing, original equipment manufacturer (OEM) standards and other firm upgrading activities. This type of technology acquisition played a major role in the integration of Southeast Asian firms into global value chains (Fagerberg, Srholec and Verspagen, 2010).

Sources: Cohen, W.M. and D.A. Levinthal (1990), "Absorptive capacity: A new perspective on learning and innovation"; Griffith, R., S. Redding and J. Van Reenen (2004), "R&D and absorptive capacity: Theory and empirical evidence", http://dx.doi.org/10.1111/1467-9442.00007; Xiaoqin Fan, E. (2002), "Technological spillovers from foreign direct investment: A survey", www.adb.org/sites/default/files/publication/28326/wp033.pdf; Fagerberg, J., M. Srholec and B. Verspagen (2010), "The role of innovation in development", http://dx.doi.org/10.5202/rei.v1i2.15.

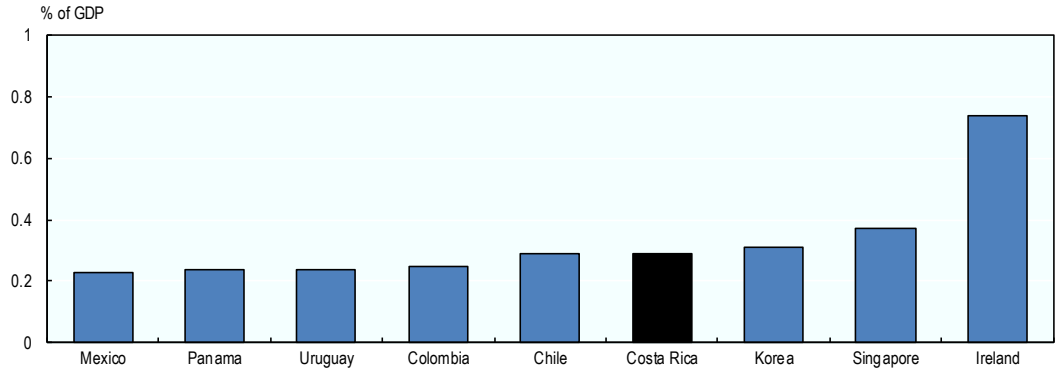
Technology diffusion: The case of ICT

Diffusion of new technologies, such as ICT, is key to the process of catching-up, learning and embracing new innovation opportunities for the economy, such as digitalisation and quality (and impact) in the delivery of public services (e.g. education, health, research, etc.). There is wide evidence on the productivity gains from diffusion of ICT. The acceleration in productivity growth in the United States from the mid-1990s largely reflects the rapid diffusion of ICT.

Investment in ICT is also a form of intangible investment; in other words, these are intellectual assets driving the economic value of firms and countries in today's economies. In terms of national investment in ICT, Costa Rica, as other Latin American

countries, stands below advanced OECD economies. In 2015, its computer software spending was below technology intensive countries such as Ireland and Korea, but above some Latin American countries (Figure 3.11). Costa Rica has been improving in several indicators of access and use of ICT, although several of these figures remain below OECD trends.

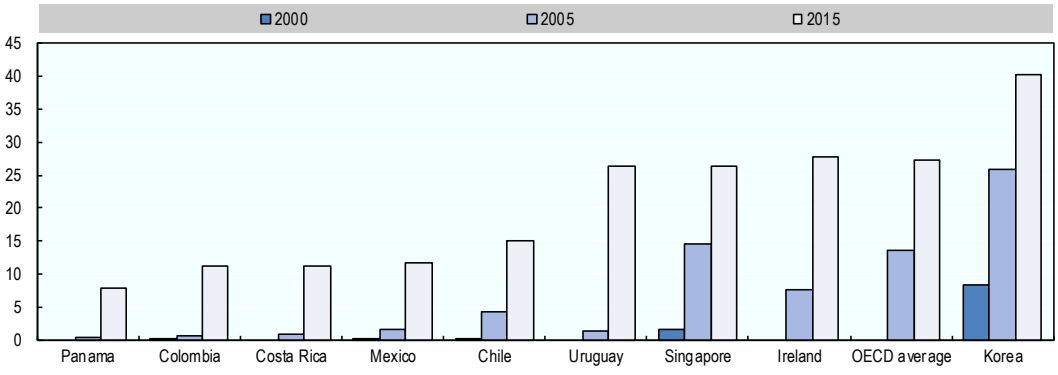
Figure 3.11. **Computer software spending relative to gross domestic product, 2015**



Source: WIPO (2016), "Appendix II: Data tables", www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2016-appendix2.pdf.

Although broadband Internet remains under-developed compared to OECD countries (Figure 3.12), Costa Rica has been improving significantly over the last ten years. It is, however, still behind some of its competitors in terms of broadband Internet subscriptions (per 100 inhabitants). 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 where broadband Internet access is four times greater than in Costa Rica. Costa Rica has significantly increased the use of this type of Internet access since 2010, as a result of the liberalisation of the telecommunication sector (Monge-Gonzalez, 2016).

Figure 3.12. **Fixed broadband subscriptions per 100 inhabitants**



Source: ITU (2016), *Fixed Broadband Subscriptions* (database), www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx.

According to ITU data, Costa Rica clearly has a leading role in Latin America in terms of mobile broadband Internet penetration. For example, in 2013 the LAC average was 20.91 whereas Costa Rica displayed 72.1. In terms of fixed broadband subscriptions per 100 inhabitants, Costa Rica improved from 1.04 in 2005 to 11.17 in 2015. Broadband Internet access is highly important because it can improve the movement of knowledge inside the country, as well as between Costa Rica and other countries, working as a vital facilitator for the flow of talent, ideas and capital in human networks. In regards to speed of connection, Costa Rica ranks at the bottom of the list, with 2.55 megabytes. Penetration of mobile telephony has been increasing, from 69% in 2010 to 156% in 2015.

Science, technology and innovation outputs

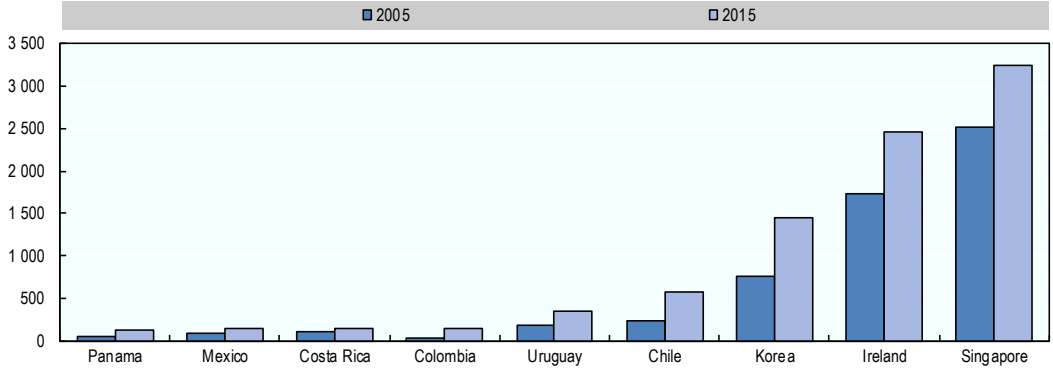
Innovation output is notoriously difficult to measure. Indicators of technological innovation and scientific output are widely used and the available information generally only captures some types of innovation activities, mostly linked to R&D-based technological innovation. The limitations behind these indicators are related to the fact that they only provide a partial view of innovation activity in a given country (Box 3.1). This is particularly relevant in developing countries, where innovation activities are usually linked to technological acquisition and absorption and where R&D-based technological innovation is less frequent. Despite these limitations, the articulated use of the available indicators across countries and over time allows comparisons within and between countries.

Scientific output

Costa Rica's intensity of scientific output slightly increased between 2005 and 2015, from 103 to 150 publications per million population. Still, this number remains significantly below small innovation-intensive OECD countries such as Korea (1 451) and Ireland (2 450) as well as Singapore (3 245) (Figure 3.13). On the other hand, comparing the country's intensity of scientific output within the Latin American context, Costa Rica performs at a medium range within the selected countries. Along with Mexico it presents a slower growth rate of scientific output than other countries in the region, such as Chile, Colombia and Uruguay, which doubled or tripled their scientific publications per million population in the same period.

Figure 3.13. **Intensity of scientific output**

Scientific publications per million population, selected countries

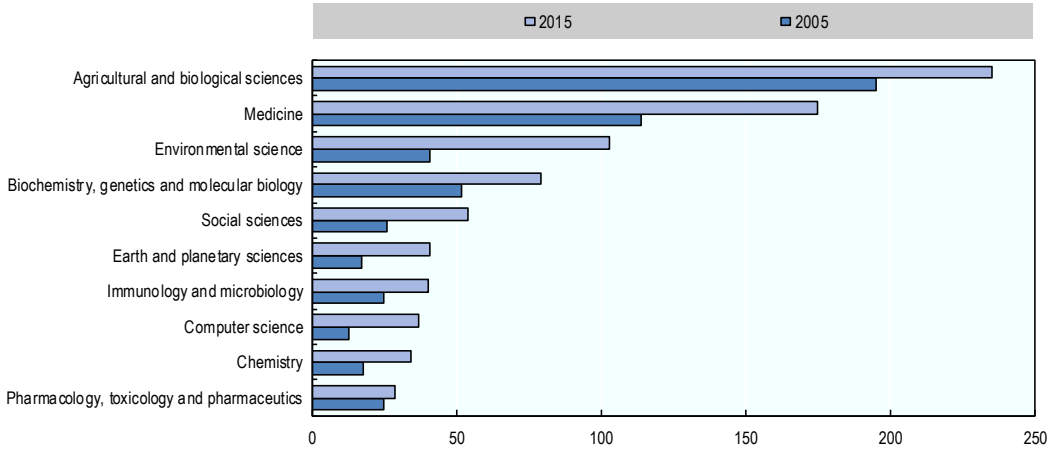


Source: Scimago Research Group (2016), Scimago website, www.scimagojr.com/index.php.

The scientific fields where Costa Rica produces the highest number of research publications are agricultural and biological sciences and medicine, followed by environmental sciences and biochemistry, genetics and molecular biology. Social sciences remain an important scientific field in terms of publication production, but the country's top scientific areas are mainly concentrated in basic and applied sciences (Figure 3.14).

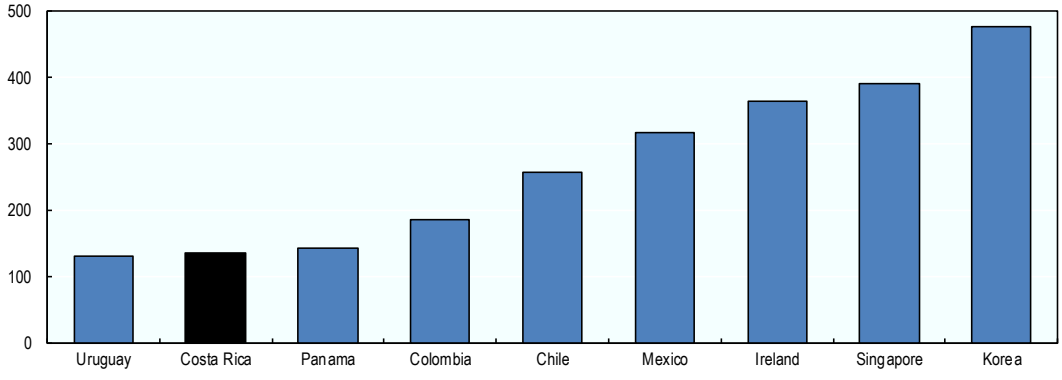
The H index is a common measure that aims to quantify both productivity and citation influence. It provides a measure that takes into consideration the number of published articles and how often they have been cited in order to estimate their impact, in this case in the 1996-2014 period. Costa Rica's H index is 137. Figure 3.15 shows Costa Rica's low H index compared to some Latin American countries as Chile, Colombia, Mexico and Panama and in comparison to innovation-intensive economies like Ireland, Korea and Singapore.

Figure 3.14. **Top scientific field in terms of publication production, Costa Rica**



Source: Scimago Research Group (2016), Scimago website, www.scimagojr.com/index.php.

Figure 3.15. **H index, selected countries, 1996-2014**



Source: Scimago Research Group (2016), Scimago website, www.scimagojr.com/index.php.

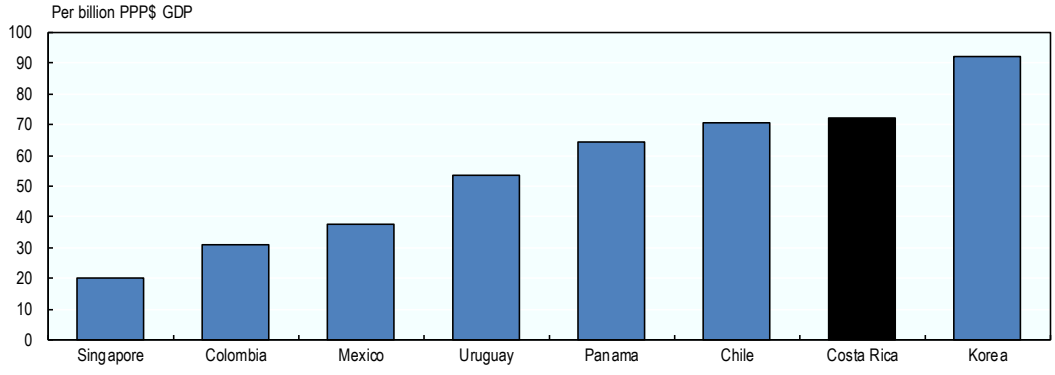
Intellectual property creation

Trademarks are legal instruments that aim to protect unique and distinctive characteristics of a firm, as for instance a brand. Like patents, trademarks are indicators of the generation of economically useful innovations, thus they are considered to be an indicator of innovation output. Trademarks are very important to innovation in the services sector. As well, they are a better indication than patents of the innovation activities carried out by small firms, especially with respect to non-technological innovation. Figure 3.16 presents trademark applications issued to residents at a given national or regional office. In this regard, Costa Rica displays high numbers of trademark applications, above Singapore and many Latin American countries, and only behind one innovation-intensive economy, Korea. This fact is evidence of the importance that Costa Rican firms give to protecting their brands.

However, patenting numbers by domestic residents are weak. Residents from countries with similar populations, such as Panama and Uruguay, produce twice as many patents as do Costa Ricans. The position of Costa Rica in terms of patent generation appears somewhat more positive when considering patent applications by non-residents, but the number of such applications is still low. This situation contrasts with the high share of foreign activity in national value added. At any rate, Costa Rica's resident patent record is rather weak compared to other countries.

Not surprisingly, given the low numbers in intellectual property outputs, Costa Rica does not yet have a prominent position as a global exporter of technology licensing – as reflected in the meagre revenues reported in the technology balance of payments for this type of international transaction.

Figure 3.16. **Trademark application class count by origin, 2014**



Note: Number of trademark applications issued to residents at a given national or regional office.

Source: WIPO (2016), "Appendix II: Data tables", www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2016-appendix2.pdf.

Trade sophistication

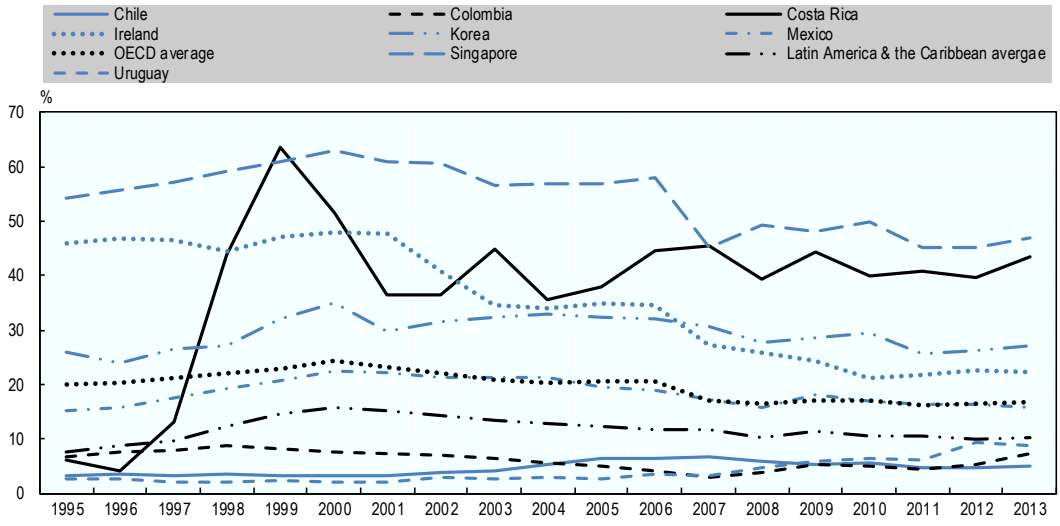
The export-led growth model anchored on fiscal incentives, tax deductions and the creation of free trade zones (FTZ) was highly effective in attracting multinational activity in advanced manufacturing sectors – starting with Intel's greenfield investment in an assembly and test plant in 1997 – and had a great contribution to employment and economic growth.

This strategy progressively led to greater diversification of the export basket, reflected in increased importance of manufactured goods, and especially of high-technology intensive products (electronics). Manufacturing (gross) exports expanded dramatically, from 29.8% of the total value of exported goods in 1980 to 61% in 2012. Exports grew at an annual growth rate of 8.6% between 1980 and 2012 (7.9% in export goods and 11% in services), inducing the structural transformation of the export basket.

Costa Rica has substantially increased its share of high-technology exports as a percentage of its manufactured exports since 1998. This increase was highly fostered by Intel's arrival during this time. During the early 1990s, high-technology exports represented less than 10% of total manufactured exports, while in 2014 they represented 43%. As observed in Figure 3.17, in this regard Costa Rica surpassed innovation-driven economies such as Korea, where high-technology exports were 27% of manufactured exports.

Figure 3.17. **High-technology exports**

As a percentage of manufactured exports, selected countries



Note: The Latin America and Caribbean average includes International Development Association (IDA) and International Bank for Reconstruction and Development (IBRD) countries according to the World Bank.

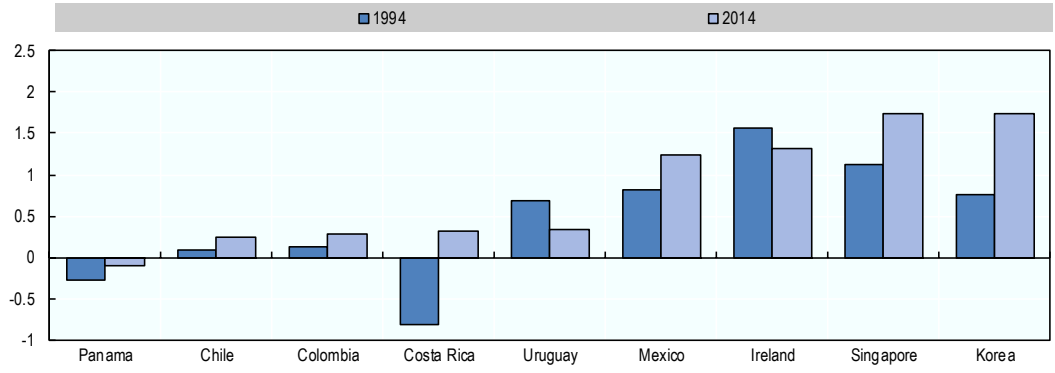
Source: World Bank (2016), *WDI Database*, http://data.worldbank.org/data-catalog/world-development-indicators (retrieved in September 2016).

According to data from PROCOMER (2016), 79.3% of high-tech exports and 66.5% of low-tech ones were carried out through FTZs in 2015. This evidences the great importance that FTZs have in Costa Rica's innovation-driven development model.

Overall, the trend has been towards upgrading in global value chains (GVCs), from textiles to electronics and medical devices. In more recent years, a different and new structural transformation has been taking place, with the relocation of volume-based manufacturing operations to Southeast Asia and the People's Republic of China (hereafter "China") in the wake of Intel's global restructuring and the rise of exports of business services, in particular (knowledge-based) informatics and information services (Padilla Perez and Alvarado Vargas, 2014).

Costa Rica has increased its score in the Economic Complexity Index (ECI) in exported goods significantly over the years (Figure 3.18), especially after the installation of Intel and the launching of electronics exports. According to Hausmann et al. (2011), the ECI indicates the multiplicity of knowledge competencies embedded in it, which can be combined differently to create new products and technologies (Box 3.6). Therefore, generally, competitive countries are those that show high diversification and high levels of economic complexity in their export basket.

Figure 3.18. **Economic Complexity Index**



Source: The Observatory of Economic Complexity (2016), *Economic Index Atlas* (database), http://atlas.media.mit.edu.

Box 3.6. **The Economic Complexity Index**

The complexity of an economy is related to the multiplicity of useful knowledge embedded in it. Because individuals are limited in what they know, the only way societies can expand their knowledge base is by facilitating the interaction of individuals in increasingly complex networks in order to make products. According to Hidalgo and Hausmann (2009), the economic complexity of a country can be measured by the mix of these products that countries are able to make.

Some products, like medical imaging devices or jet engines, embed large amounts of knowledge and are the result of very large networks of people and organisations. These products cannot be made in simpler economies that are missing parts of the network's capability set. Economic complexity, therefore, is expressed in the composition of a country's productive output and reflects the structures that emerge to hold and combine knowledge. To generate a more accurate measure of the number of capabilities available in a country, or required by a product, it is necessary to correct the information that diversity and ubiquity carry by using each one to correct the other. For a country, this requires calculation of the average ubiquity of the products that it exports, the average diversity of the countries that make those products and so forth. For products, this requires calculation of the average diversity of the countries that produce them and the average ubiquity of the other products that the country makes.

Sources: Hidalgo, C.A. and R. Hausmann (2009), "The building blocks of economic complexity", http://dx.doi.org/10.1073/pnas.0900943106, methodology and index calculation, available at: http://atlas.media.mit.edu; Hausmann, R. et al. (2011), *The Atlas of Economic Complexity*.

The ECI for Costa Rica suggests that the overall level of sophistication of traded goods is not that high: at 0.31 in 2014, which is quite similar to Uruguay. This means that when considering the whole basket of goods exported and their interrelations for producing new products, there are few possible combinations to generate new economically complex products. Ireland, Korea, Mexico and Singapore all report scores two or three times higher than Costa Rica. China increased its ECI from 0.65 to 1.02 over this same period.

Notes

1. Science, technology, engineering and mathematics.
2. As for statistics on R&D personnel, similar problems arise with respect to statistics on R&D expenditures (see Box 3.2).
3. *Source:* RICYT.
4. Reverse engineering of imported technologies and imitation (of products and equipment) are also important mechanisms of learning and technology assimilation, and have been critical at earlier stages of industrialisation in Asian countries such as Japan, and more recently the People's Republic of China and Southeast Asian countries.

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Chapter 4.

Innovation actors in Costa Rica

This chapter describes the main actors in the Costa Rican innovation system – business enterprises, higher education institutions and public research organisations – and highlights their respective roles in the development of innovation activities in recent years. It reviews competences for innovation, and related strengths and weaknesses.

The business sector

A changing economic structure and a polarised firm sector

Like the majority of Latin American countries, the structure of the Costa Rican economy has undergone important changes over the past 20 years (Figure 4.1). It has become more "tertiarised" and both business sector services and public services (community, social and personal services) have become more prominent. The most important expansion took place in the business sector services, whose share has increased from 40% in 1995 to 45% in 2011. In contrast, the share of manufacturing in value added decreased, from 21% to 16%. The contribution of agriculture, hunting and forestry along with mining to value added and production have all decreased.

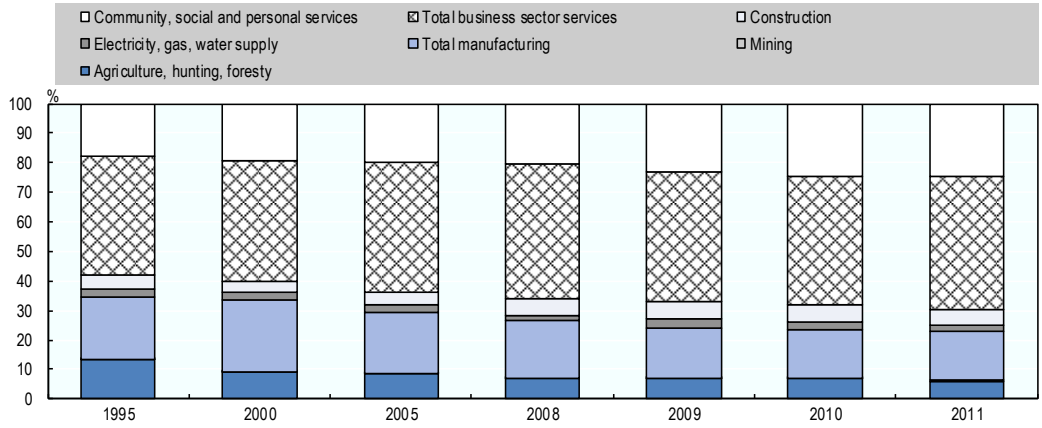
Structural changes can also be observed in the export basket (Figure 4.2). Industry has gained importance over time while the agricultural sector has declined, and this process was in large part explained by the inflow of foreign direct investment (FDI), including the flagship investment of Intel in the late 1990s. As discussed in the previous chapter, the export-led growth model anchored on fiscal incentives, tax deductions and the creation of free trade zones (FTZs) was highly effective in attracting multinational activity in advanced manufacturing sectors and largely contributed to employment, economic growth and macroeconomic stability in the country. Since late 2013, however, the importance of the manufacturing sector in Costa Rica's total exports has started to decline and this is largely due to Intel's restructuring and the closure of its assembly plant.

Another important change concerns the rise of export services, especially tourism and travel services, and information, computer and communication services, which have been growing constantly since the early 2000s (Figure 4.3). The increase in computer and communication services is in part related to the recent expansion of offshore services, as more multinational companies have set up backup offices in Costa Rica, as well as to growth in new domestic ICT companies becoming more active in export markets. In 2014, about half of services exports consisted of computer, information and communication services. This is evidence of new growing technological and knowledge capabilities of the Costa Rican business sector.

As in most countries in Latin America, small and medium-sized enterprises (SMEs) dominate the firm population and the business sector (especially micro-firms), and employ most people in Costa Rica: 93.4% of companies are SMEs (Forth Report on the Situation of SMEs in Costa Rica, MEIC, 2016), employing about 220 483 people, or 31.2% of all jobs in the business sector in Costa Rica. SMEs in services, industry, commerce and information technology represent 25% of employment in the private sector. The remainder corresponds to small and medium-size producers in agriculture. In total, in 2013 SMEs accounted for 33.05% of gross domestic product (GDP).

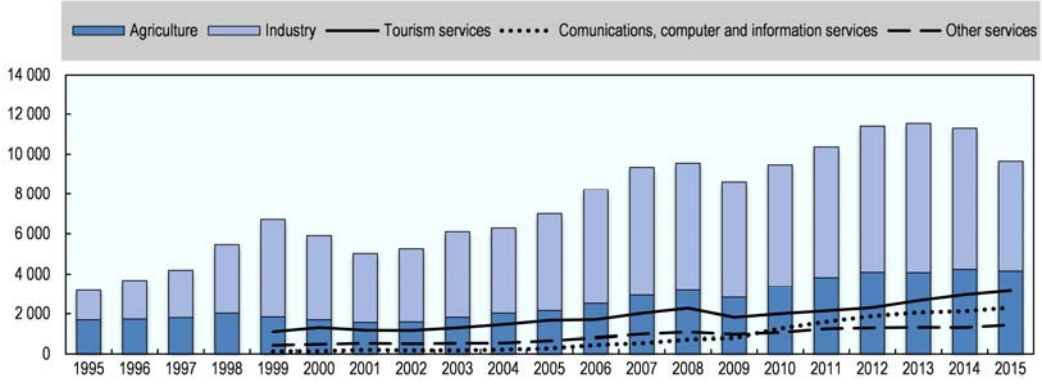
According to a recent study on SMEs in non-agricultural industries (MEIC, 2016), SMEs represent 75.5% of the business sector and are mostly active in services (43%) and commerce (41%). They are also geographically concentrated: 74% are located in the Central region. This is a major challenge in Costa Rica as most of the economic activity and the development of SMEs continues to be localised in the metropolitan area. The greatest economic activity with the highest shares of companies is commerce, which concentrates 43% of SMEs in Costa Rica. The contribution of SMEs to employment in these industries, however, is not that high: they only account for 25% of employment generated in the productive sector. The number of firms registered at the national system of enterprise information (SIEC) continues to grow – by 21% between 2010 and 2013.

Figure 4.1. **Value added by sector in Costa Rica**



Sources: OECD (2016b), *Trade in Value Added* (TiVA database), https://stats.oecd.org/index.aspx?queryid=66237; Monge-González, R. et al. (2011), https://publications.iadb.org/bitstream/handle/11319/5344/TN318%20Innovation%20and%20Employment%20Growth%20in%20Costa%20Rica.pdf?sequence=1.

Figure 4.2. **Exports by economic sector**



Notes: Data for 2015 are preliminary – they may be subject to revision. Total exports include special regimes: definitive, free trade zone and "inward processing regime". Agriculture merchandise is defined following Annex I of the OMC Agreement on Agriculture.

Source: COMEX based on data from PROCOMER.

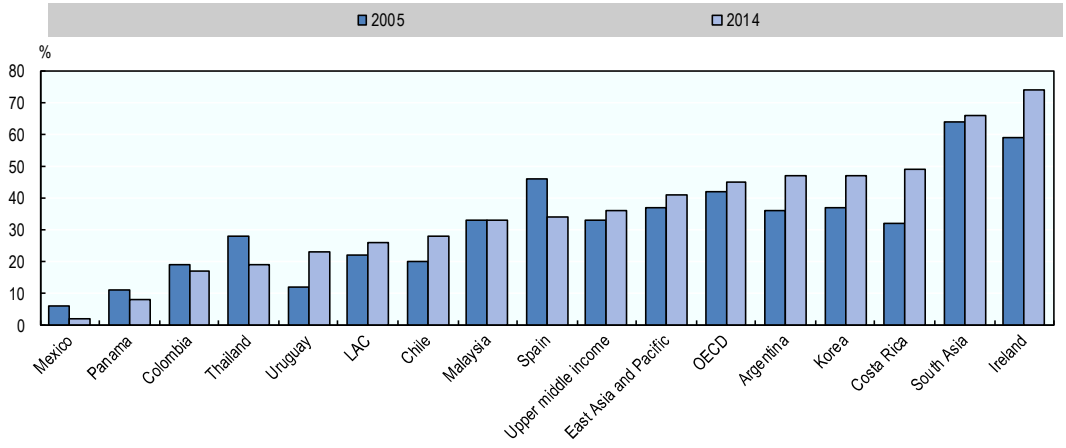
In spite of their important participation in employment, SMEs generate 11% only of the total Free On Board value of exports in industry, trade, services and ICT. The branch with the largest percentage is services and industry. In general, the export capability of SMEs is weak and their share in exports remains quite small. Moreover, 40% of companies that export tend to exit at the end of the first year (Monge-González et al., 2011).

A very important challenge for Costa Rica is therefore to increase the participation of domestic businesses, primarily SMEs, in export activity, notably in medium- and high-technology industries, and more generally in innovation activities. In principle, exports in medium- and high-technology industries indicate a more knowledge-based economy and more innovation, although this inference is weakened when exports have low domestic value added, as is the case in Costa Rica. New steps need to be taken to allow domestic firms to upgrade their capabilities and enhance their value added, and

develop innovative competitive advantages, which would allow Costa Rica to better integrate global markets.

In contrast, SMEs are quite active in public markets, in particular in services. Medium-sized enterprises represented 28% of the SMEs registered in the SIEC as contractors that sold services (or goods) to the state in 2015. On average, 94% of state's suppliers over the period 2013-15 were SMEs and in 2015, 94% of public purchases were allocated to SMEs. Most of this activity concerned one sector: in 2013, 46.8% of the state's suppliers were in services.

Figure 4.3. **Computer, information and communication commercial services exports as a share of total services exports**



Note: LAC: Latin America and Caribbean.

Source: World Bank (2016b), *World Development Indicators Database*, http://data.worldbank.org.

Export composition and the rise of new competitive sectors

According to the Costa Rican Export Promotion Agency (PROCOMER), exports have been growing, albeit at a slower pace since 2012. The ratio of agriculture to industrial exports has been shifting in favour of the latter. In 1995, 53% of total exports consisted of agriculture-related (non-manufactured) exports whereas in 2015 they represented 43% of total exports. Due to Intel's restructuring and the closure of its assembly plant, exports of manufactures contracted by 22% (in gross terms) in 2015 compared to the previous year. It is expected that this downsizing will permanently affect the trade volume in electronics but will eventually be compensated by future growth in other manufacturing sectors with positive export evolution (e.g. instruments and medical devices) and new FDI coming to the country.

By 2015, goods exports accounted for 18% of GDP and comprised a mix of high technology and traditional products. By 2015 the five leading export products were medical devices (16.5%), bananas (8.6%), pineapples (8.4%), food preparations (4.1%) and coffee (3.2%) (COMEX, 2016). Costa Rica is still the first high-tech exporter in Latin America and among the highest in the world (World Bank, 2016). Technology-based services are becoming significant and account for a large and growing share of exports. After tourism, information and technology (IT) services are the second-highest exporting service, valued at USD 1.9 billion, around four-fifths as much as microprocessors. Export

activity remains largely concentrated in the FTZ area and manufacturing firms. FTZs accounted for 47 % of merchandise exports in 2015, compared to 12% in 1995.

Productivity performance: A dual business sector and weak business dynamics

Productivity has not improved much in recent years and growth has mostly been driven by enhanced labour and capital inputs (Monge-González, 2012). Productivity is too low in Costa Rica to successfully compete with more industrialised countries in the production of high skill-intensive goods. At the same time, wages in Costa Rica are too high to allow the country to compete in the production of unskilled labour-intensive commodities.

The productivity lag is particularly acute among micro firms and SMEs. The great majority of domestic SMEs lack the capacity to access and absorb new technologies and knowledge, which restricts the process of endogenous technological change and the possibilities for firm internationalisation and global value chain (GVC) integration. Furthermore, a wide dispersion in productivity prevails among Costa Rican companies, both between sectors and between companies of different sizes within a given sector (Monge-González and Torres-Carballo, 2015). Agriculture and service sector firms show the lowest productivity, and productivity dispersion between large and small companies in these sectors is the highest in the economy. In addition, smaller companies show the lowest productivity.

In spite of the above-mentioned achievements (e.g. export diversification), Costa Rica has not been successful in reversing the structural productivity divergence that persists between the export-oriented sector, which is mostly dominated by foreign firms, and the non-exporting sector, which is largely composed of domestic companies. Furthermore, the productivity gap between exporters and non-exporters has widened remarkably over time (Figure 4.4), particularly in manufacturing industries. Figure 4.6 reports differences in labour productivity (expressed as value added per worker) between firms inside and outside FTZs. Accordingly, the labour productivity gap between the two types of companies is quite large. The divergence is particularly accentuated in services: retail (284%), professional and consultancies (1 135%), and administrative services (1 294%). On the positive side, it is interesting to note that the productivity gap between old companies and young firms (those less than five years old) is vanishing (Figure 4.5). This means that in contrast to previous years, new firms are become more efficient and capable of reaching the same productivity levels as those reported by established companies.

Productivity growth in the Costa Rican business sector is also penalised by the lack of business dynamics. Business dynamics (rates of new firm creation and exit) are weak and have even further debilitated in recent years (Figures 4.7 and 4.8). Since 2007 birth growth rates have been negative whereas death growth rates have remained positive. Further, the percentage of firms considered to have high growth (Figure 4.8) – reporting positive growth rates in the previous four years – decreased significantly between 2008 and 2011; since then the rate has stabilised around 4%. This lack of business dynamics hinders the potential of industry to renew itself through innovative entrepreneurship, and limits employment growth. The process of business entry and exit as well as post-entry firm growth allows industry performance adjustment through a process of creative destruction.

Figure 4.4. **Productivity gap between exporters and non-exporters**

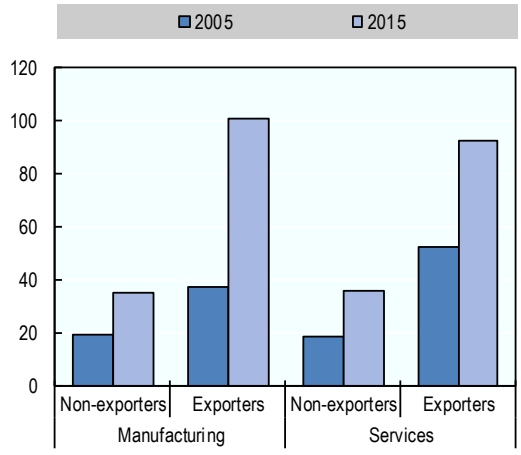
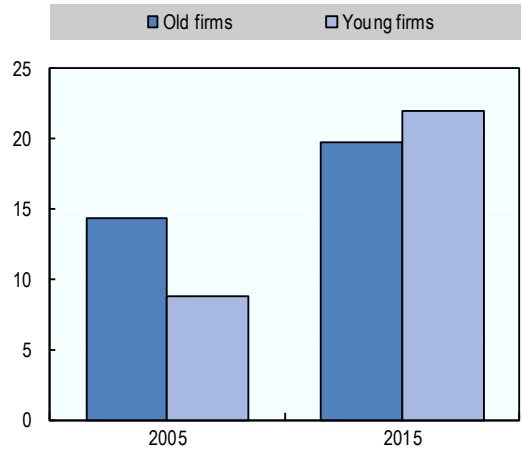


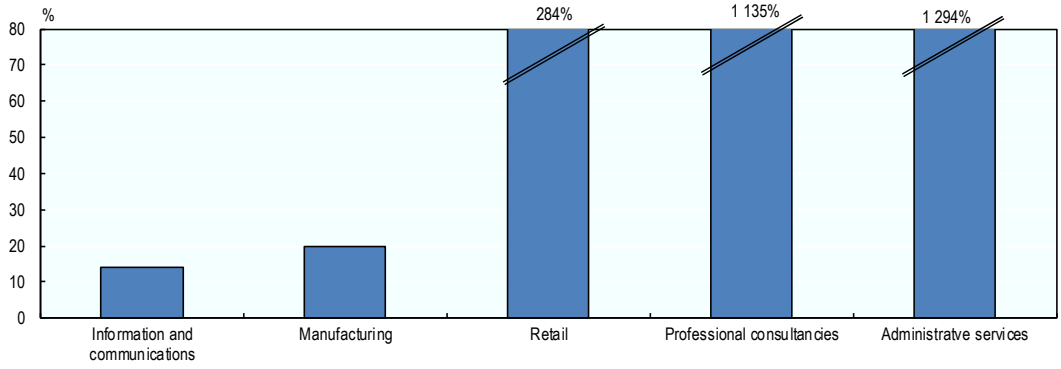
Figure 4.5. **Productivity gap between old and young firms, all sectors**



Source: OECD (2016c), *Economic Surveys: Costa Rica: Economic Assessment*, http://dx.doi.org/10.1787/eco_surveys-cri-2016-en with the aid of the Central Bank of Costa Rica. Data provided by the Ministry of Economy, Industry and Commerce.

Figure 4.6. **Labour productivity differences between firms inside and outside free trade zones are large**

2011-12 average



Notes: The bars show the percentage difference in average labour productivity (expressed as value added per worker) of firms inside and outside free trade zones; values refer to the average of 2011 and 2012 (the latest available years); some sectors are not reported because of lack of or too low number of firms operating in free trade zones.

Source: OECD (2016d), "Costa Rica", in *OECD Economic Outlook, Volume 2016 Issue 1*, http://dx.doi.org/10.1787/eco_outlook-v2016-1-en, with data from the Central Bank of Costa Rica.

Figure 4.7. **Business dynamics, birth and growth rates, Cost Rica**

As a percentage of total firms

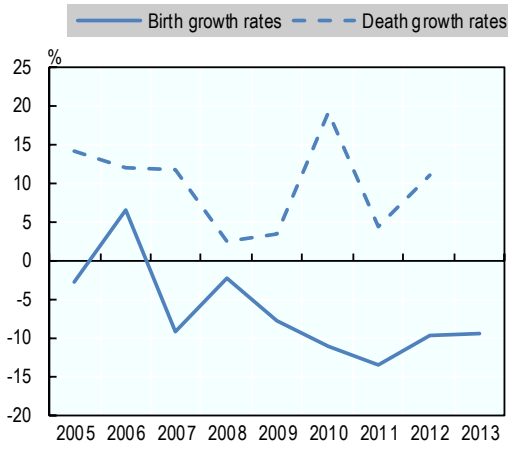
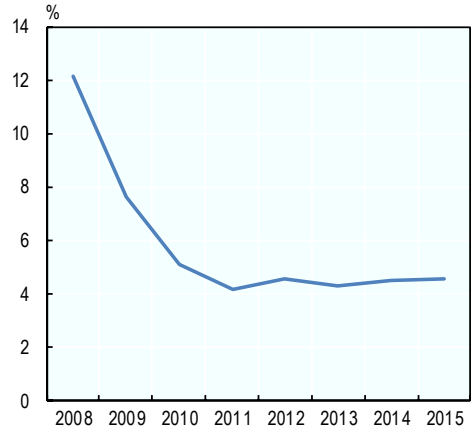


Figure 4.8. **Growth of firms in Costa Rica**

As a percentage of total firms



Source: OECD (2016c), *Economic Surveys: Costa Rica: Economic Assessment*, http://dx.doi.org/10.1787/eco_surveys-cri-2016-en with aid from the Central Bank of Costa Rica.

Costa Rica's business dynamics are also relatively low compared to OECD countries. In spite of the decline in start-up rates in most OECD countries in recent years, they are still far higher than those reported for Costa Rica. While start-up rates in OECD countries such as Belgium and Sweden are about 7% and reach 10% in countries such as Germany and the United States (over the period 2010-13), Costa Rica's start-up rate is less than 1%. These trends are in line with other studies. According to the Global Entrepreneurship Monitor (2014), the rate of new business established decreased from 4.8% to 2.5% and more than 46 000 entrepreneurs discontinued their business between 2012 and 2014. This is a major handicap for the recovery of productivity growth and employment. In OECD countries, young firms are the main contributors to employment growth (Criscuolo, Gal and Menon, 2014). New OECD evidence indicates that most net job creation originates in young and fast-growing firms, which are often equipped with new knowledge or innovation competencies. Not only are start-up rates weak, firms in Costa Rica also face important difficulties to grow. A recent study (Monge-González and Torres Caballo, 2015) found that during the period 2001-12, most of micro and medium-sized companies either did not grow at all or died. Only 6% of micro-enterprises succeeded in moving to the category "small" firms, and 8% of small companies grew to become "medium-" sized companies.

As discussed in the previous chapters, many bottlenecks constrain productivity growth and competitiveness in Costa Rica. Important binding constraints to firm productivity growth – affecting particularly SMEs and their competitiveness include, *inter alia*: 1) a shortage of skills, especially in terms of engineers and technicians; 2) weak innovation capacity by domestic firms and limited (public) support for technology upgrading; 3) financial constraints (limited access to finance) for firms to upgrade projects and innovation; and 4) onerous labour and tax regulations. This situation, combined with a deficient infrastructure for transport and logistics and high costs of energy (higher than regional competitors) compromises future competitiveness. It

also signals an important gap between the FDI strategy (high-tech oriented) and the other public policies for productive development, particularly with respect to skills and innovation.

In addition, labour costs are growing and the costs of shipping and energy are much higher than in other countries in the region. Real estate prices have also increased, due in part to the growth of tourism and foreign investment. Transport infrastructure – roads, railroads and ports – has deteriorated, which compromises trade and future direct investment, and economy-wide productivity performance. The appreciation of the real exchange rate over the past eight years is eroding the country's external competitiveness. Combined with high wage costs, these have made the country less competitive in low value-added sectors. For example, textile exports have dropped dramatically over the last decade, falling from 13.3% of exports in 2000 to 1.6% in 2014. This trend has mainly been attributed to high production costs in Costa Rica compared to neighbouring countries (World Bank, 2015).

There is a large potential to boost the productivity performance of the domestic business sector and democratise the benefits from global economic integration through innovation. This will entail enabling the creation of new competitive advantages in domestic industries to increase value added and their successful integration to export markets and value chains. It also implies developing new sources of growth through innovative entrepreneurship and new industry development with a global impact. Given the limited size of the economy it is imperative to empower domestic firms and new firms with knowledge competences and competitive technological capabilities in order to take advantage of such frameworks to integrate and compete in global and regional markets.

Global value chain integration: Weak business linkages

In spite of the recent restructuring of two large multinational enterprises (MNEs), Costa Rica remains one of the world's most FDI-intensive economies, with an FDI-to-GDP ratio exceeding international levels from 1985 through 2010. With Intel's restructuring process and the exit of Bank of America, FDI decreased by about 1.2 percentage points of GDP, reaching 4.2% of GDP in 2014. Nevertheless, the country continues to attract FDI and raise its share in GDP: in 1997, Costa Rica received USD 407 million (3% of GDP) in FDI inflows, which had grown to USD 2.8 billion by 2015 (5.1% of GDP). The Ministry of Foreign Trade (COMEX) is responsible for trade and FDI policy, while two main agencies are the executing branches behind Costa Rica's success in exporting and attracting FDI: the Export Promotion agency (PROCOMER) and the Investment Promotion Agency (CINDE).

As in the case of the national economy, the composition of FDI has also shifted towards services, which accounted for only 8.3% of total FDI inflows in 2002-05, but increased to 35% in 2012-14, partly attributed to the liberalisation of the telecom and insurance sectors. In contrast, FDI inflows in manufacturing accounted for 18% of total FDI. This contrasts to the previous trend in the early 2000s when FDI inflows in manufacturing represented 64% of all FDI inflows. In 2014, Costa Rica attracted USD 474.4 million of new investments across 39 projects that created 10 281 jobs, offsetting the 4 343 jobs lost due to the exit or downsizing of some foreign firms.

Although economic activity in the FTZs remains strong and new investments are being made, FDI is still weakly connected to local firms and manufacturing exports continue to be concentrated within foreign-owned firms. Despite moving towards a more complex productive structure, productive linkages between MNEs and domestic firms

still remain underdeveloped, reflecting a mismatch between the demands of MNEs and competencies in the local business sector. On average, local suppliers provide only 24% of inputs to MNEs in Costa Rica (World Bank, 2013; Zuniga, 2014). Other studies cite this percentage even lower, at 1% of MNEs' inputs. Locally sourced products are largely low value-added products and services such as packaging, printing materials and services (for instance, cleaning and security). The low absorption capacity of domestic firms, resulting from the aforementioned constraints, and incentives to continue importing (FTZ) are amongst the main factors hindering such connection and spillovers from FDI. This situation reflects a weak connection between FDI policy and the other productive policies (e.g. skills or innovation) prevailing in the past decades.

There are several impediments to developing linkages. On the supply side, the most important constraints are: 1) the inability of SMEs to comply with MNEs' quality standards, delivery times and other requirements; 2) limited access to finance and technical support for upgrading, innovation and integration with MNE operations; and 3) a shortage of skills in areas such as science, engineering and design. On the demand side, Costa Rica could benefit from strengthening MNEs' commitment to develop linkages with local suppliers especially as regards inputs with a high degree of sophistication and specificity. Some MNEs may not be very "linkable" either because the degree of sophistication (or specificity of inputs as was the case of Intel's wafers, and other electronics components and materials) is high or because sourcing is decided by headquarters. In addition, SMEs take the full risk of investing in upgrading as MNEs do not guarantee contract signing. Bank lending is not accessible for this type of investment project due to uncertainty of purchasing (by MNEs).[1]

A recent study by the World Bank (Zuniga, 2014) showed that there is a tangible demand for local sourcing. Of those companies interviewed, 93% declared an interest in local procurement and 40% claimed to have a supplier development programme already in place.[2] This indicates a significant opportunity for the development of business linkages with local SMEs. The highest level of interest was among manufacturing companies, in particular chemical industries, agro-industries and instruments (including medical devices). Other relevant findings on the types of sourcing demands were:

- The chief motivations for local sourcing were lower costs (cited by 85% of companies), shorter response times (82%), and higher quality or more innovative inputs (80%). The least important motivations were regional market expansion (since most MNEs in Costa Rica export to Europe and the United States) and corporate decision making.
- Inputs demanded are both basic components and technology and engineering services. The most sought after inputs were leather and textiles, mechanical components and chemicals. The most sought after services were laboratory testing and data analysis, engineering services and calibration, metrology and software services.

Over the past 15 years, a series of domestic stakeholders – in particular the Ministry of Science, Technology and Telecommunications (MICITT) and PROCOMER – have been working to increase the proportion of suppliers that are able to establish linkages with large exporters. These efforts remain, however, small and fragmented. The government's programmes to support business linkages currently support fewer than 40 firms each year and have insufficient scale and scope to significantly influence the development of productive linkages between domestic SMEs and MNEs.

The shortage of skills is an important obstacle to firm productivity and integration with FDI, especially in high-tech industries. According to the national innovation survey, in key exporting sectors like advanced manufacturing, medical devices or ICT services, the main restriction to innovate is the lack of advanced human capital (43% of companies declare this factor as the main obstacle).

Overall, absorption conditions for embedding FDI into the local economy are weak. Moreover, innovation, particularly technological innovation and technological competences, including in research and development (R&D), are key for developing high-tech industries. The lack of this capacity in Costa Rican firms is a handicap to innovation and linking with MNEs in these sectors.[3] Technological innovation (product and process) requires investment in a wide array of innovation competences, particularly in R&D, which itself requires advanced human capital and adequate infrastructure for research, testing, calibration and product development.

In Costa Rica, policies for long-term embedding of FDI – which must accompany FDI attraction – have been lacking. In addition, both the attraction and local insertion of FDI in knowledge-intensive industries requires innovation-based competitive advantages, and this requires enhanced innovation policy support. Furthermore, innovation efforts (which have increased in recent years) and FDI are insufficiently aligned to attract knowledge-based FDI.

Costa Rica will continue attracting advanced and light manufacturing with an emphasis on knowledge-based FDI. While FDI promotion did not initially involve targeting specific sectors, Costa Rica has increasingly targeted knowledge-intensive activities and is currently focused on three main clusters: advanced manufacturing, life sciences and services. PROCOMER is now adopting a more selective approach, focusing – within high-tech industries – on the attraction of more knowledge-intensive sectors. These trends have contributed to creating emerging industrial clusters in business services, medical devices and advanced manufacturing (OECD, 2012). The number of high-tech projects that it has attracted has increased at an average annual rate of 14% since 2010[4] and in 2013 the sector received its biggest FDI inflow, reaching 72% of total FDI reported for that year. The investment in these sectors accounted for 24% of all FDI projected for the country and more than 50% of Costa Rica's productive FDI. CINDE is now proactively pursuing FDI in aerospace and automotive industries, with better prospects for linking with local businesses.

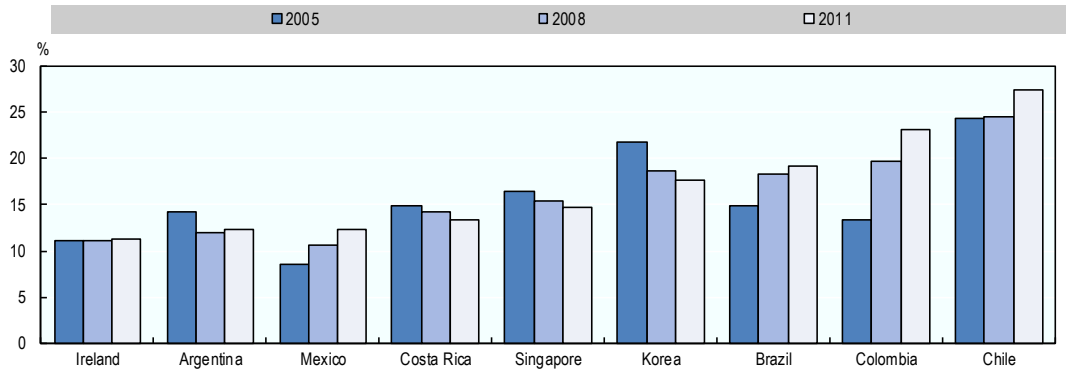
In general terms, Costa Rica is well integrated into global value chains, especially in medium- and high-technology products (Monge González, 2014), but indicators of domestic contribution to exports are lower than global trends. The government is seeking to deepen Costa Rica's participation in the global value added chains of four sectors – medical devices, electronics, aerospace and offshore services – by attracting foreign companies operating in these fields (Gereffi et al., 2012). The GVC participation index is similar to the average in both developed and developing economies: 44.6% compared to 48% and 48.6%, respectively. Backward participation is slightly higher than the world average, but forward participation – domestic value added in gross exports – is below the average in both developed and developing countries. Domestic value added only represents 17% in gross exports whereas the average in developing countries is 23% and 24%, respectively.

There are visible differences in terms of GVC development between manufacturing and services sectors (Figures 4.9 and 4.10), with the latter only showing a positive evolution in terms of domestic value added embodied in exports. Over time, Costa Rica

has slightly decreased its forward participation in manufacturing exports, reaching slightly less than 15%. In contrast, countries such as Brazil, Chile, Colombia and even Mexico, have all increased their ratios, that is, their domestic value added share in exported products. In the services exporting sector, forward participation in GVCs has steadily been increasing, reaching 2.5% of exports in 2011. These figures are still lower than the ones reported for Chile, Ireland, Brazil or even Colombia, and similar to those for Argentina.

Figure 4.9. **Forward participation in global value chains, manufacturing**

As a percentage of gross exports, manufacturing

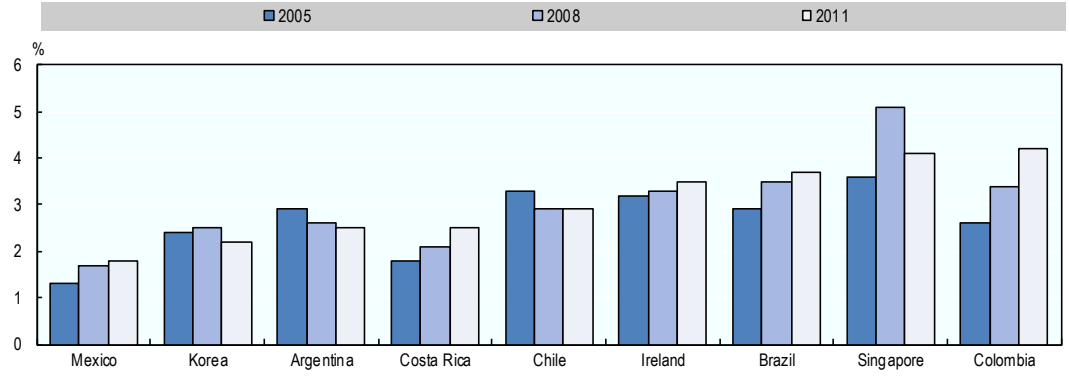


Note: Domestic value added embodied in foreign exports as a percentage of total gross exports. Data retrieved 28 September 2016.

Source: OECD (2016b), *Trade in Value Added* (TiVA database), https://stats.oecd.org/index.aspx?queryid=66237.

Figure 4.10. **Forward participation in global value chains, services**

As a percentage of gross exports, services



Note: Domestic value added embodied in foreign exports as a percentage of total gross exports. Data retrieved 28 September 2016.

Source: OECD (2016b), *Trade in Value Added* (TiVA database), https://stats.oecd.org/index.aspx?queryid=66237.

Innovation efforts by firms

Innovation activities performed by the business sector remain underdeveloped and mainly limited to few, albeit dynamic, industries, including in the expanding services sector, e.g. information and informatics services. A very small share of companies invest in R&D, and Costa Rica's domestic firms show lower propensities than advanced countries in the region towards international technology acquisition, such as for instance through international technology licensing from foreign firms. The country has been granted fewer than ten patents per year on a constant basis since the late 1970s by the US Patent and Trademark Office (OECD, 2011).[5] Malaysia was also registering fewer than ten patents per year up to the 1990s before increasing its activity by more than tenfold.

In terms of R&D intensity (R&D expenditures relative to sales), Costa Rican companies display very low levels of investments compared to companies in OECD countries, as do enterprises in other Latin American countries. For instance, Costa Rican manufacturing firms invest 0.2% of their sales in R&D whereas Spanish firms invest 1.3% and Norwegian firms almost 1% – and these levels are among the lowest reported in the OECD. These figures should be taken with caution as a large part of the manufacturing sector is dominated by MNEs – and the national survey is not stratified by industry and size class of firms.

Several indicators suggest that international technology acquisition by firms in the form of technology licensing is also less important in Costa Rican firms compared to peers from emerging countries in the region and in Southeast Asia. Costa Rican firms show lesser propensity to engage in technology licensing from foreign firms than firms from Chile, Mexico and Panama. A similar technological gap is noted in terms of firm adoption of internationally recognised quality certifications: 13% of manufacturing firms in Costa Rica report having an internationally recognised quality certification whereas the average in developed countries is 39%. Mexico and Panama report higher shares: 24% and 23%, respectively.

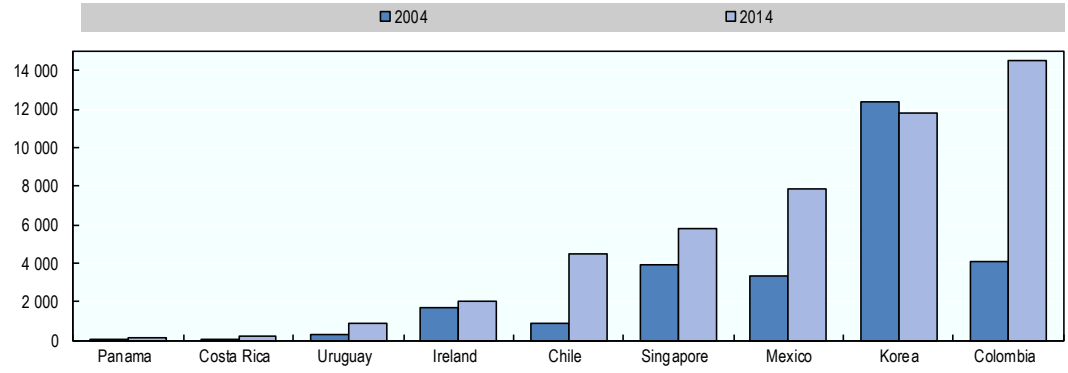
In addition, an analysis of the evolution of ISO 9001 certificates per billion dollars GDP shows that, even adjusting by the size of the economy, the diffusion of such quality standards or adoption of environmentally friendly managerial practices (e.g. ISO 14000s) is less intense than in other Latin American countries and innovation-intensive emerging economies. Furthermore, the evolution of ISO 9000 certificates decreased in Costa Rica during the period 2004-14 (Figure 4.11). The same trend is observed when considering ISO 14001 certificates which concern the adoption of environmental standards. The disparity in technological investments between domestic and multinational companies is striking (Figure 4.12). For instance, whereas 37% of MNEs (in the manufacturing sector) report having an internationally recognised quality certification, only 10% of domestic firms are engaged in such activities. A similar divergence is noted in terms of technology licensing: 15% of MNEs report such activity, while only 8% of domestic enterprises declared being engaged in such technology transactions. Certainly, the intensity of international technology transfer is natural to multinational activity and, therefore, the reported statistics on technology licensing could be largely under-estimated and mostly concern intra-firm transactions.

Innovation activities are also weakly developed in MNEs. Investment in R&D specifically accounts for less than 1% of total national FDI-created jobs (OECD, 2012). The OECD (2012) reports that the number of business functions carried out in Costa Rica increased between 2003-05 and 2009-11. The 2009-11 data on greenfield investment projects in Costa Rica show interesting new types of activities being carried out,

including design, development and testing, R&D, and education and training. However, design, development and testing still account for a small share of the economic activity of foreign firms: a scant 4% of total national jobs created by greenfield FDI correspond to these functions, a third less than that for Malaysia (about 6%).

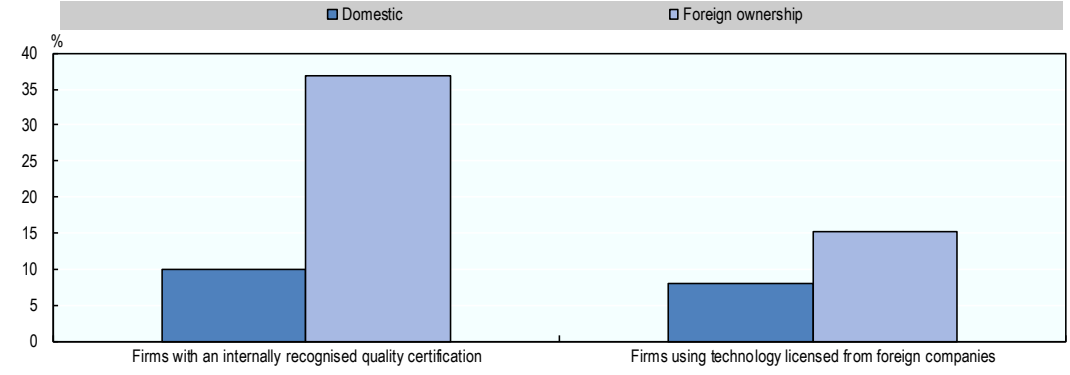
Figure 4.11. **Evolution of ISO 9001 certificates**

Per GDP in billions USD



Source: ISO (2016), *ISO Survey* (database), www.iso.org/iso/iso-survey.

Figure 4.12. **Disparity between domestic and foreign firms in quality certification and technology acquisition**



Note: Foreign ownership corresponds to 10% or more foreign ownership.

Source: World Bank (2016a), *Enterprise Surveys* (database), www.enterprisesurveys.org.

Obstacles to business innovation activities

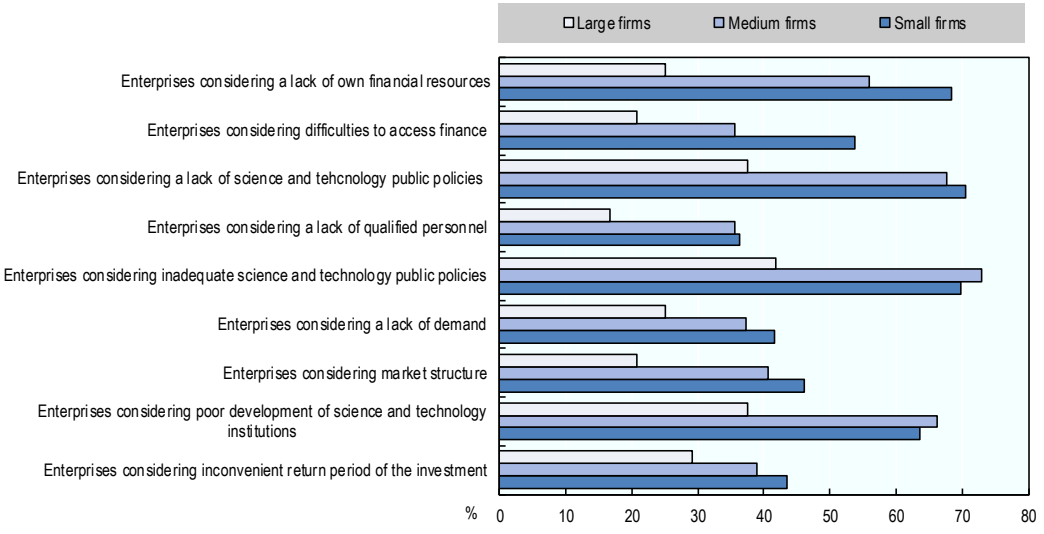
According to the MICITT (2016), the main obstacles to firm innovation are related to market structure, difficulties of access to finance and a lack of qualified personnel. Furthermore, the lack of public policies to promote science, technology and innovation (STI) as well as poor development of science and technology institutions are also considered very important factors hindering innovation activities. Obstacles to innovation generally appear more accentuated for SMEs than for large companies (Figure 4.13).

In the case of innovative firms, some of 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 some

of the most significant obstacles cited are high costs of training and lack of public policies to promote science and technology. Other adverse factors were problems with the intellectual property system and poor access to funding sources.

As previously discussed, addressing the shortage of skills is a national imperative and requires new governance policies for skills acquisition and improved policy co-ordination. The creation of competitive skills and addressing industry demands, however, is hampered by a lack of co-ordination between universities, technical schools and other providers of human resources, on the one hand, and the private sector, on the other (Monge-González et al., 2011). This situation is due in part to a mismatch between the supply of graduates (and training) and the demands of the private sector. The number of researchers with a PhD in science and technology is also weak and the overall number of PhD diplomas delivered every year is also extremely low by international standards. The IT services industry, which has a strong potential of linking with MNEs, requires an increased supply of IT specialists, engineers and technicians.

Figure 4.13. **Obstacles to innovation by firm size, 2013-14**



Source: MICITT (2016), "Indicadores nacionales de ciencia, tecnología e innovación Costa Rica 2014", www.conicit.go.cr/biblioteca/publicaciones/publicacionescyt/otros_documentosCyT/indicadoresCyT-2014.pdf.

Indicators suggest a low use of public funding for firm innovation. This is a critical challenge considering that subsidies are effective in pursuing innovation investment (Monge-González and Rodríguez-Alvarez et al., 2013). Only 17% 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% presented projects to PROPYME and only 0.4% accessed funds. The companies that were not granted funding indicated that their project proposals were either rejected for not complying with all of the 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.

Public research institutions

Main public higher education institutions

A set of public institutions make up Costa Rica's higher education system. In addition to the five public universities (see below for a detailed description) and some emerging private universities, different public bodies, mainly created in the 1970s, regulate and control the system, such is the case of the National Council of Rectors (Consejo Nacional de Rectores, CONARE) and the National Council of Private Higher Education (Consejo Nacional de Enseñanza Superior Universitaria Privada, CONESUP). These institutions, however, often lack a unified approach, presenting institutional rigidities that preserve the fragmentation both of national policies and of resources. As detailed in Chapter 5, this situation results in a weak influence and margin of manoeuvre of national policies for research and innovation.

CONARE and public universities

CONARE, created in 1974, is one of the most important public stakeholders in the higher education (HE) system. It is comprised of the deans of Costa Rica's public universities and has several duties, including developing the guidelines of the National Plan of Public Higher Education (PLANES). The PLANES is then further elaborated by the Planning Office for Higher Education (OPES) and approved. CONARE is also in charge of distributing funds to public universities so that they may achieve the objectives laid out in the PLANES. It has the prerogative to approve the creation of inter-university working groups which aim to analyse specific issues concerning the public research landscape. For example, in 2006 CONARE's Commission of Vice-Rectors for Research approved the creation of the Sub-commission of Indicators of Research of the State's Universities, whose aim is to monitor research trends in public universities (CONARE, 2014). However, in reality, rather than performing rigorous evaluation of the universities' overall activities[6], the sub-commission monitors and benchmarks research activities in the five public universities. CONARE is also involved in other overview exercises of the Costa Rican STI system (i.e. the State of Science, Technology and Innovation report [ECTI, 2014]).

CONESUP

In 1979, CONARE presented a bill to create CONESUP, which was finally established in 1981 through Law N. 6693. CONESUP is an entity under the Ministry of Education in charge of the regulation and supervision of private universities. It is governed by a council of six members: two representatives of private universities, one from CONARE, one from the Ministry of Planning and Economic Policy (MIDEPLAN), an Executive Director as well as the Minister of Education, who serves as chair. The Executive Director is appointed by the Ministry of Education for a five-year period, which can be renewed once. Two executive decrees that regulate CONESUP: Executive Decree N. 29631 provides the general regulations while Executive Decree N. 35941 provides the administrative organisation for the technical secretariat. CONESUP's budget comes from the Ministry of Education. Private universities pay fees to CONARE in order to authorise new universities, new degrees, the creation of new campuses or the modification of universities' curricula.

According to the Law N. 6693, some of CONESUP's main duties are to define the criteria needed for private universities to establish new degrees, such as study programmes, curricular credits, and length of degrees, syllabus and university

infrastructure. In addition, CONESUP promotes the academic evaluation of private universities. However, many of these evaluations are auto-evaluations instead of independent assessments following international good practices. Also, CONESUP is obliged to periodically provide information and oversee and monitor the adequate functioning of the universities, in compliance with the law. It has to be noted that the involvement of CONARE in CONESUP's activities (as described above) may potentially lead to conflicts of interests between the two institutions, as both public and private universities compete in attracting students in higher education programmes.[7] In addition, it has been reported that CONESUP's approval process of private study programmes is generally significantly longer than one month, contrary to what is stated in its regulations.

The university funding system

Costa Rica's HE system is made up of public and private universities. In 2016, there were 5 public and 54 private universities, a large number for a country of Costa Rica's size and population. In particular, the number of private universities is higher than in almost all small OECD countries or small Latin American countries.

Costa Rica's public universities are primarily funded by public resources. All five public universities receive public funds, which are guaranteed by Article 85 of the Constitution. This article establishes that the government will provide a public budget through the Fondo Especial para la Educación Superior (Special Funding for Higher Education, FEES) to the five CONARE public universities in the country: the Universidad de Costa Rica, the Instituto Tecnológico de Costa Rica, the Universidad Nacional, the Universidad Estatal a Distancia and since 2015 to the Universidad Técnica Nacional (see Box 4.3 for an overview of public universities). The budget is managed by the central bank,[8] which transfers funding to each university. The FEES budget distribution is discussed and agreed by a commission formed by CONARE – represented by the deans of the five public universities – and by four ministries: the Ministry of Education; the Ministry of Science, Technology and Telecommunications; the Ministry of Planning and Economic Policy; and the Treasury. Once these parties agree on the total and individual budget allocations it is incorporated into the country's budget, which is approved by the National Assembly. Universities' budgets are generally negotiated every five years;[9] however, more recently they have been negotiated on an annual basis.

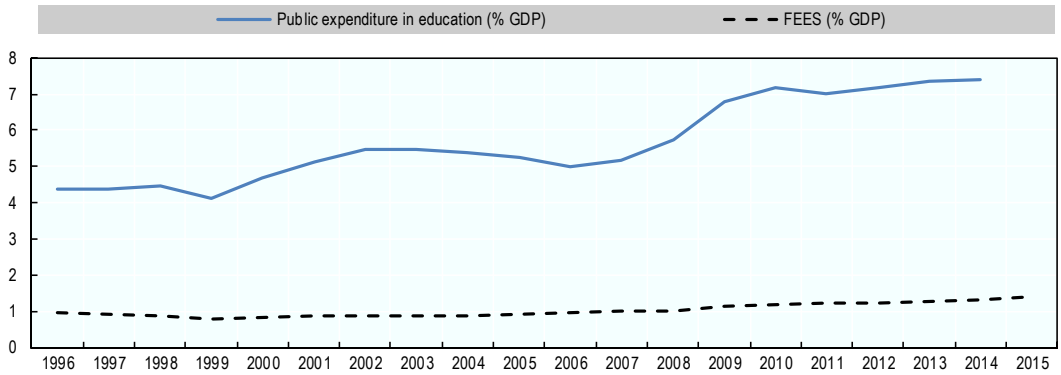
As mentioned above, Costa Rica's education budget continuously increased between 1996 and 2014, from 4.38% of GDP to around 8% in 2014. The FEES budget also increased considerably, from 0.97% of GDP in 1996 to 1.38% in 2015. However, two periods can be distinguished (Figure 4.14). Between 1996 and 2005, the FEES budget decreased from 0.97% to 0.90% of GDP, with a minimum of 0.79% in 1999. Since 2006, however, it has increased, reaching 1.38% of GDP in 2015. The FEES is expected to approach 1.5% of GDP in the coming years, and thus hit the upper limit set by the law (Programa Estado de la Nación, 2016).

FEES funding represents a very important part of public universities' budgets (Table 4.1). The remainder of their funding originates mainly from enrolment fees and services provided by the universities. An exception to this arrangement was the Universidad Técnica Nacional, as it joined CONARE only in 2015. From its establishment until 2015, it received direct monetary transfers from the central government. Notwithstanding the additional new member to CONARE since 2015, the historical distribution of public funding between universities has remained unchanged. The budget for this university will emerge from the increased funds of FEES. In fact, the

way FEES is distributed across different public universities has largely remained unchanged since the 1970s. The Universidad de Costa Rica – the largest and oldest university in the country – receives the highest proportion of funds (Programa Estado de la Nación, 2016). As a general principle, FEES funds are allocated largely following an approach of equality-based participation rather than a performance-based allocation. Competitive funds come from CONARE's special fund, and from CONICIT's programmes (see Chapter 5), which are very small compared to the FEES budget.

Figure 4.14. **Evolution of public expenditure in education and FEES budget**

As a percentage of GDP



Source: Programa Estado de la Nación (2016).

Table 4.1. **FEES funding as a percentage of the total university budget**

	2000	2005	2010	2014
Instituto Tecnológico de Costa Rica	..	..	86%	82%
Universidad de Costa Rica[1]	91%	89%	87%	94%
Universidad Nacional	..	..	..	..
Universidad Estatal a Distancia	55%	63%	..	57%2
Universidad Técnica Nacional[3]	x	x	x	x

Notes: .. no data reported; x: not applicable.

1. University reported expenditures, not the budget. 2. Data for 2015. 3. Joined CONARE in 2015.

Source: Based on data reported by the universities.

The current system has several limitations. The low share of competitive funding based on performance criteria and the lack of external independent do not provide sufficient incentives to increase the overall quality of research at universities. Many OECD countries, especially those with advanced innovation systems, increasingly use performance-based and competitive funding of public research (Boxes 4.1 and 4.2). This rewards well-performing institutions and researchers. While institutional funding provides stability and a basis for strategic planning of long-term research activities, performance-based and competitive funding provides incentives for HE institutions to raise the quality and economic relevance of their research and innovation activities. Private universities, instead, are mostly self-funded, their main source of income is university fees. The Comisión Nacional de Préstamos para la Educación (National Commission of Loans for Education, CONAPE) provides student loans.

Box 4.1. **University research funding mechanisms**

Historically in many OECD countries, universities were funded through a single grant, normally provided by a (higher) education ministry, intended to cover both teaching and research. The OECD has referred to this stream as general university funds. The principle of university autonomy, which became increasingly predominant, meant that the internal allocation of this money was decided by the individual university rather than the state – though the state's often important role in deciding on the number and type of academic jobs meant that universities were not entirely free from the state's influence. Over time, university reforms have reduced or eliminated the role of the central state in university appointments. At the same time, education ministries have increasingly specified the allocation of institutional money towards teaching or research, more recently connecting them to various indicator systems related to inputs, outputs or performance.

In recent decades, the growth of research councils, innovation agencies, and other government and non-government funding bodies offering university research grants has meant that the old institutional funding system is now but one element in university research funding, although it is almost universally the largest individual income stream for any university.

Education ministries tend to provide institutional funding for three reasons:

1. to provide continuity and a stable basis for planning
2. to provide strategic resources enabling universities to invest in new fields, themes and research methods ahead of the point where they can credibly persuade third-party funders to support their work
3. to enable all academics to pursue a minimum level of research without depending on the vagaries of third-party funding.

Recent performance-based research funding systems aim to make part of institutional funding contestable, providing an additional incentive for quality.

Education ministries often provide a second funding stream through research councils or national science foundations. This funding is allocated at the project level, by assessing competing proposals based on quality or "excellence" criteria. The academic community generally plays a strong role in this decision, which provides incentives for producing excellent research. Project-level funding is also believed to provide implicit quality assurance of the institutionally funded research effort in order to produce sufficiently high-quality applications to external funders.

A third funding stream comes from other ministries, which provide incentives to carry out mission-oriented research. This category includes both innovation-related research (often funded by an industry ministry through an innovation agency) and work related to other ministry missions, such as transport, health, energy and the environment.

Source: OECD (2016a), *OECD Reviews of Innovation Policy: Sweden 2016*, http://dx.doi.org/10.1787/9789264250000-en.

Overview of public universities and private universities

Public universities (Box 4.3) and some emerging private universities (Box 4.4) actively contribute to the Costa Rican research landscape. According to the ECTI (2014), the strongest areas in academic research in Costa Rica are bio-chemistry, genetics and medicine. However, scientific production and quality remains significantly lower than the OECD average.

Box 4.2. **The introduction of steering mechanisms in the public research system: The case of Luxembourg**

In the past, Luxembourg's relatively young public research system was mostly based on a bottom-up approach, lacking a long-term vision. Public funding lacked explicit and effective steering mechanisms, and there was a general lack of clarity regarding the mandate and role of actors in the public research system.

Based on the recommendations of the *OECD Review of Innovation Policy: Luxembourg 2007*, the government of Luxembourg launched a major reform of the governance of public research, with the aim to:

- set the goals of the policies supporting research and innovation and clarify the role of the different actors
- increase co-ordination among the different political actors, notably the ministries and agencies
- supervise and evaluate the organisations involved in the science, technology and innovation system.

A key instrument that contributed to strengthening governance was the performance contracts concluded between the government and public research institutions (including the new National Research Funds). The objective of performance contracts is to link the public funding of research and innovation public institutions to their output in research and innovation as measured through key performance indicators (in the case of Luxembourg these include the number of scientific publications, PhDs delivered, third-party competitive research funding, third-party contractual research funding).

This new steering mechanism of public research actors had a number of advantages for Luxembourg. It provided a framework for strategic negotiations, and was well adapted to the country's innovation system. It helped to introduce elements of cross-organisational collaboration and better define the roles of different actors. In addition, it links performance to monitoring and evaluation.

At the same time, performance contracts have clearly contributed to consolidate the autonomy of institutions, by defining the roles and objectives of the actors in the system. This strengthened autonomy, however, also needed a clearer accountability. Therefore, regular external evaluations were introduced as an element of the performance contract system. Given the small size of the country, it was (and is) extremely important that evaluations involve foreign experts to avoid any conflict of interest. The results of these evaluations are public and affect the performance contracts.

The creation of the National Research Funds, a public research funding agency, helped to steer the system towards quality and excellence in research. The National Research Funds has conducted *ex ante* scientific evaluations of competitive research grants able to make the system visible and attractive at the international level. This also helped to attract international talents to Luxembourg.

Finally, the strategic intelligence that the National Research Funds developed in the different evaluation rounds it managed are a key knowledge resource for the government for the definition of innovation strategies and policy instruments.

Sources: OECD (2007), *OECD Reviews of Innovation Policy: Luxembourg 2007*, http://dx.doi.org/10.1787/9789264010284-en; TIP peer review discussion.

Box 4.3. **Costa Rica's public universities**

The Universidad de Costa Rica, a public university established in 1940, is the oldest university in the country. It has 13 campuses located throughout the country, with its main campus located in the country's capital, San José. The university has 1 026 research laboratories, 33 research centres and 13 research institutes.[1] The Universidad de Costa Rica is also the biggest public university in the country, with 40 269 students in 2015. In addition, the number of students enrolled has seen a sustained increase, from 26 870 in 2000 to 40 269 in 2015 (Programa Estado de la Nación, 2016). The university offers 141 undergraduate degrees, 172 *bachilleratos*, 167 masters' programmes and 11 doctoral ones.[2]

In 1990 the university created the Office for Technological Transfer, which was reorganised in March 2005 to become the Unit for Innovation Management and Knowledge Transfer (PROINNOVA). This unit seeks to foster innovation through the transfer of technology and knowledge developed within the university, through the licence of its intellectual property. For this purpose, it offers different services such as guidance in pursuing intellectual property rights and training. PROINNOVA had eight full-time workers in 2015 and a total budget of almost CRC 96 million, 94% of which relies on the university budget. As of February 2015 this office had 3 spin-offs and 12 licensing agreements.

The Instituto Tecnológico de Costa Rica was created in 1971 and in 2015 counted 10 594 enrolled students (Programa Estado de la Nación, 2016) and 1 585 graduate students, 149 of which were PhD students. The university has 5 campuses across the country, and offered 22 bachelor's degrees, 15 master's and 3 PhD programmes (natural sciences, engineering and business administration). This public university has a strong scientific and technological emphasis in its education offer, with a high proportion of its enrolled students in science, technology, engineering and mathematics (STEM). In 1987 the university created the Fundación Tecnológica de Costa Rica (FUNDATEC), to foster linkages between the university and the business sector. The university has ten research centres focused on different areas, such as construction (CIVCO), innovation in the forestry sector (CIF), agroindustry (CIGA), biotechnology (CIB), computer sciences (CIC), chemistry and the environment (CIPA and CEQIATEC), material sciences and engineering (CIEMTEC), sustainable agriculture (CIDASTH) and business administration (CIADEG). The university also has a Liason Centre for the management of intellectual property, negotiation of technology transfer, and fostering linkages between the university and the business sector. The Instituto Tecnológico de Costa Rica was the first university to create a business incubator and an entrepreneurship fostering programme.

The Universidad Nacional de Costa Rica (UNA) is a public university and was created in 1973. In 2015 it had 18 150 students enrolled (Programa Estado de la Nación, 2016). The university has eight campuses across the country, with an academic offer of 136 bachelor's degrees, 54 master's and 5 PhD programmes.[3] In addition, the university created a technology transfer office to strengthen linkages between stakeholders such as the business sector and entrepreneurs with academia. This office offers a range of services that links and enhances the articulation between different actors. Some of the services offered are the laboratory of technical services; support for entrepreneurs in areas such as innovation management and in the development of business models; business incubators and continuous education.[4]

The Universidad Estatal a Distancia (UNED) was created in 1977. It had an enrolment of 21 332 students in 2015, of which 4 452 were in STEM discipines (first quarter 2015). UNED offers postgraduate study programmes, with 110 students enrolled in 2015 at postgraduate level in STEM areas. UNED has not established a technological transfer office (TTO). It is the only Costa Rican university offering the possibility for students to enrol in distance learning courses.

The Universidad Técnica Nacional (UTN) was created in 2008 and joined CONARE in 2015. That same year, it had an enrolment of 9 804, with 4 890 of them in STEM disciplines. The UTN does not deliver master's or PhD degrees. Its research personnel is made up of 23 researchers (none with a PhD) and around 75% of its research budget is allocated to disciplines in science and engineering. The UTN is currently developing a TTO.

Notes: 1. https://www.ucr.ac.cr/acerca-u/ucr-en-cifras.html. 2. https://www.ucr.ac.cr/acerca-u/ucr-en-cifras.html. 3. www.una.ac.cr/index.php/acerda-de/informacion-general/acerca-de-la-una. 4. www.una.ac.cr.

Source: Information provided to the OECD by public universities and Programa Estado de la Nación (2016).

According to CONARE (2015), R&D expenditures by public universities more than tripled between 2006 and 2013 (from USD 23 million to approximately USD 82 million in 2013). More than 60% of these R&D expenditures were concentrated in the country's largest university, the Universidad de Costa Rica (see Table 4.2 for an overview of public universities). Most R&D funding over the years 2011-13 was concentrated in the natural and social sciences, followed by agricultural sciences and medical sciences. The number of active researchers increased from 1 663 in 2006 to 2 258 in 2013, 43% of which were female in 2013. Contrary to innovation-intensive countries, only 20% of active researchers in public universities had a PhD in 2013. This is not surprising given the very low number of PhD graduates enrolled in Costa Rican higher education programmes (see below). The area with the highest proportion of PhD researchers is the natural sciences.

Since 2006, the scientific production in public universities (as measured by scientific publications) has increased, although to a much lesser extent than investments in R&D: they increased by 40% when taking into account the journals in the Thompson Reuters database and they almost doubled when considering journals in the Scopus database (CONARE, 2015). Scientific output (as measured by indexed publications) of universities in Costa Rica remains quite moderate.

Interactions between public universities and the business sector are weak and have not progressed considerably over the last decades. For example, in 2012 the largest university in the country, the Universidad de Costa Rica, established only 9% of its contractual research collaborations with Costa Ricans firms (ECTI, 2014). This share has not progressed since the 1970s. There are, however, a few notable exceptions: some of the research labs and research centres within public universities appear to have developed linkages with the business sector (especially in the agro-food and biotech sector), both domestically and internationally.

Table 4.2. **Costa Rica's public universities: Key figures for research and innovation, 2015**

	Universidad de Costa Rica	Universidad Nacional de Costa Rica	Universidad Estatal a Distancia	Instituto Tecnológico de Costa Rica	Universidad Técnica Nacional
Budget for research	CRC 39 billion (USD 70 million)	CRC 8.6 billion (2014) (USD 15 million)	CRC 1.2 billion* (USD 2 million)	CRC 4.3 billion* (USD 8 million)	CRC 861 million (USD 1.5 million)
Number of researchers	1 496	138*	123*	266**	23
Research papers	328 (0.2 per researcher)	93 (0.7 per researcher)	68* (0.5 per researcher)	158* (0.6 per researcher)	2 (0.08 per researcher)
Technological transfer office budget	CRC 95 million (USD 170 000)	n.a.	No technological transfer office established	CRC 4.3 million (USD 10 000)	Technological transfer office under development
Technological transfer office personnel	9	12	No technological transfer office established	8	Technological transfer office under development

Notes: CRC: Costa Rican colone (currency). * Data for 2014, ** Data for 2016.

Source: Data provided by public universities.

Private universities in Costa Rica are relatively new, with most of them established during the 1980s and 1990s. The state, through CONESUP, supervises and regulates private universities. CONESUP authorises the creation of private universities, approves their tuition fees and syllabus, and monitors and inspects them (Programa Estado de la Nación, 2016). The important number of private universities has increased the dynamics

of tertiary education in the country, increasing the number of enrolled students. One of the key elements that explain this increase is the availability of student loans from CONAPE (Programa Estado de la Nación, 2016). Most private universities are, however, not very engaged in research and innovation activities. Box 4.4 gives an overview of some of the emerging Costa Rican private universities.

University graduates

Costa Rica has continuously increased the number of students enrolled in higher education (Figure 4.15), along with the number of awarded diplomas, both in private and in public universities. In 2014, there were 102 077 students enrolled in public universities. During the same year, 49 775 diplomas were awarded by higher education institutions: 14 996 (30.1%) by public universities and 34 779 (69.9%) by private ones. However, only a small share of the diplomas awarded in 2014 correspond to postgraduate degrees. Only 8.1% of diplomas awarded in public universities corresponded to master degrees while a meagre 0.1% corresponded to PhDs. The same performance is observed in private universities, where 8.4% of diplomas in 2014 corresponded to master programmes and only 0.2% to PhDs (Programa Estado de la Nación, 2016). Along with the country's sustained increase in public expenditure in education, the number of enrolled students in public and private universities has increased.

Box 4.4. **Emerging private universities in Costa Rica**

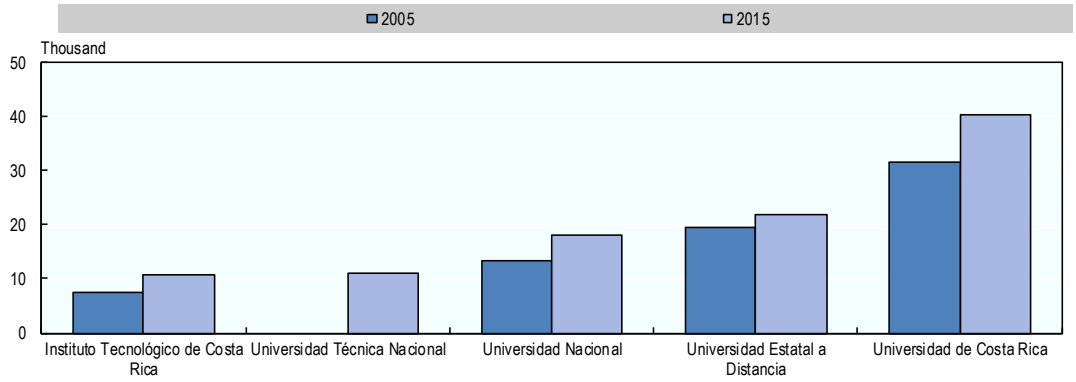
The Universidad Latino Americana de Ciencia y Tecnología (ULACIT) is a private university formally created in 1987. It was established with the aim of increasing and promoting science and technology among the country's human resources. It was also created to aid the country's development process through science and technology. The university has a technology transfer office (Centro de Innovación y Transferencia Tecnológica, CIT), which is its main body that articulates, fosters co-operation and linkages between the university and the private sector. The CIT offers training, certifications, project management and in-house programmes. Nowadays, the university has five academic degrees that have official accreditation by the National System of Accreditation of Higher Education (SINAES).[1]

Another emerging private university in Costa Rica is the Universidad Latina de Costa Rica (ULatina). This university was recognised by CONESUP in 1989 and offers over 70 different degrees in several fields of knowledge. It has 12 academic degrees with official accreditation by SINAES.[2] In 2010 the Universidad Latina and the Universidad Inter-americana de Costa Rica merged, creating the Universidad Latina de Costa Rica, which had 16 480 students in 2015.[3]

In addition, the Centro de Formación en Tecnologías de Información y Comunicación (Cenfotec) is a private university created in 2000. It aims to foster and increase human capital in Costa Rica's growing software industry. The university's academic offer and applied research focuses on ICTs, and also presents very strong linkages with the private sector. The university has created academic degrees for the country's fast-growing software sector, such as software engineering. In addition, it offers training in cybersecurity and database management, among others.[4]

Notes: 1. www.sinaes.ac.cr/index.php?option=com_content&view=article&id=13&Itemid=115.
2. www.sinaes.ac.cr/index.php?option=com_content&view=article&id=13&Itemid=115.
3. www.universia.cr/universidades/universidad-latina-costa-rica/in/37148.
4. https://www.ucenfotec.ac.cr/acerca-de-u-cenfotec.

Figure 4.15. **Students enrolled in public universities**

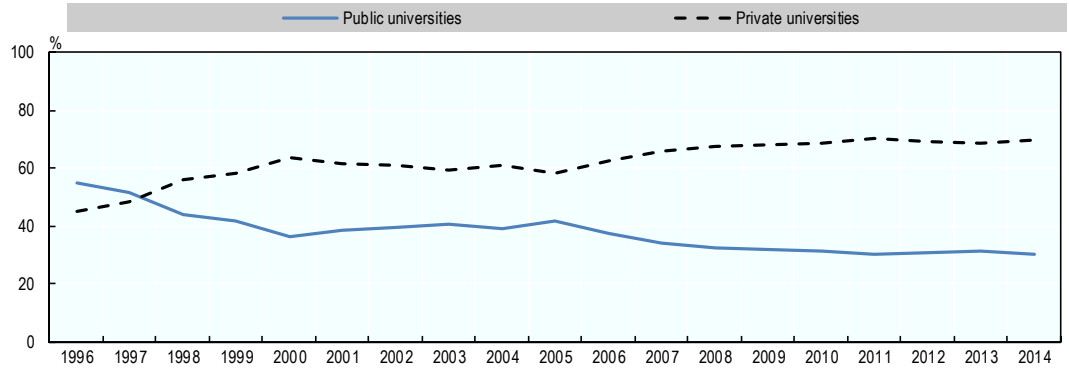


Note: The Universidad Técnica Nacional was created in 2008.

Source: Programa Estado de la Nación (2016).

Overall, the number of degrees granted by Costa Rica's university system increased from 14 753 to 49 775 over the 1996-2014 period. At the same time, the shares of degrees granted by public and private universities changed significantly. While in 1996, 54.8% of degrees were granted by public universities, in 2014 only 30.1% were from these universities. On the other hand, private universities drastically increased their share, from 45.2% in 1996 to 69.9% in 2014 (Figure 4.16).

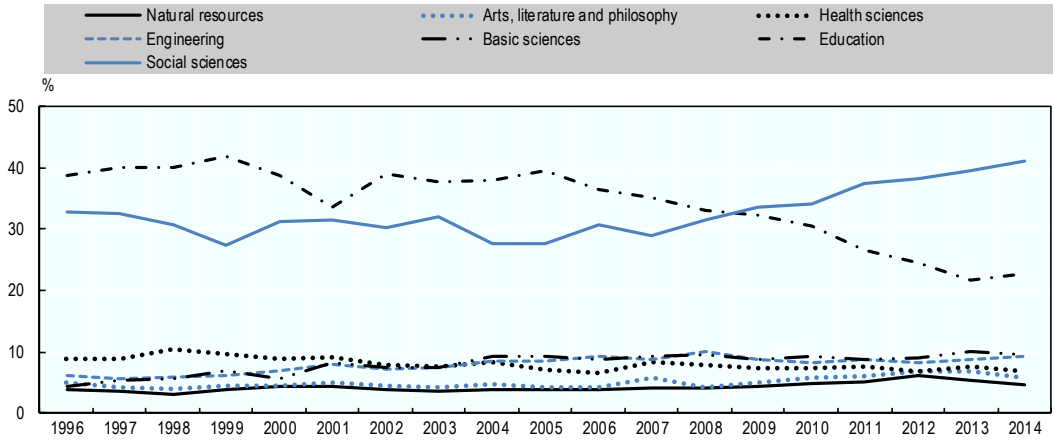
Figure 4.16. **Total degrees granted by public and private universities, Costa Rica**



Source: Programa Estado de la Nación (2016).

As regards the field of knowledge of granted degrees, social sciences and education traditionally have a dominant position, while basic and applied sciences remain weak (Figure 4.17). Data for 2014 show that most students enrolled in public universities are graduating in social sciences (41%) and education (23%), with a very weak graduation performance in fields such as engineering (9%) and health sciences (7%), which are significantly more in line with private sector demands, as well as to competitive sectors of the economy (such as health devices for instance). This issue reinforces some of the country's main challenges: the misalignment between the supply of tertiary education graduates by field of knowledge and the industry's demand of skills and capacities (Compendio Estado de la Educación, 20114; Monge-González, 2016).

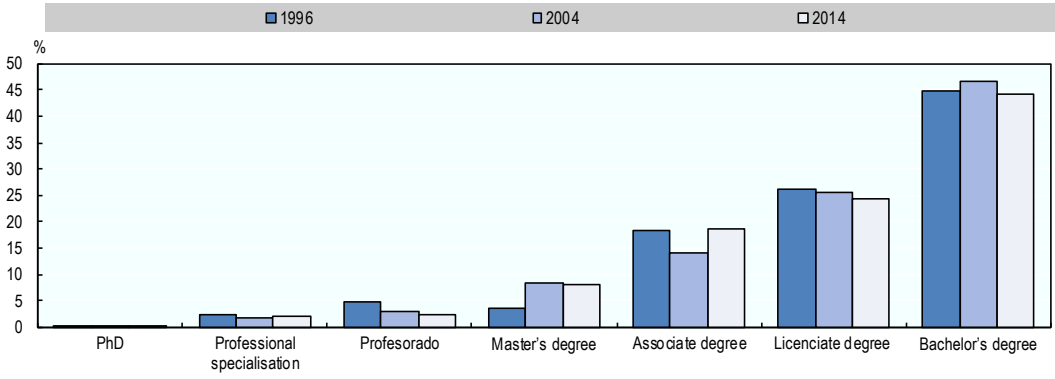
Figure 4.17. **Degrees granted by public universities, by field of knowledge, Costa Rica**



Source: Programa Estado de la Nación (2016).

This challenge is also reinforced by the low levels of postgraduate degrees granted by Costa Rica's universities. Only 8.2% of the diplomas awarded by public universities and 8.6% of those awarded by private universities corresponded to postgraduate (master's and PhD) degrees in 2014 (Figures 4.18 and 4.19). According to Hipatia (2016), out of 33 381 professionals trained between 2000 and 2015 in the medical sciences, only 0.26% were PhDs; for engineering and technology fields, of 40 235 professionals trained in that area over the same period, only 0.19% obtained a PhD degree.

Figure 4.18. **Degrees awarded by public universities, by level of degree, Costa Rica**



Note: Professorado corresponds to the degree delivered for teaching in secondary schools; associate degree to the undergraduate academic degree; *licenciate* degree to the graduate academic degree corresponding to five to six years of study.

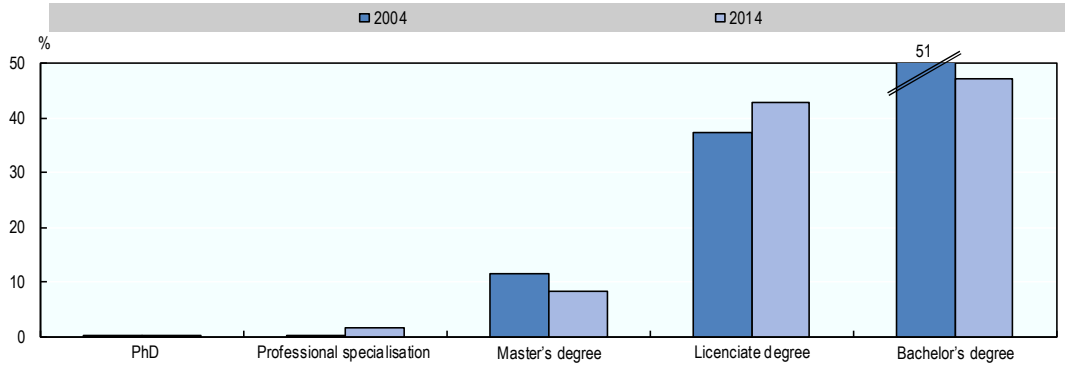
Source: Programa Estado de la Nación (2016).

Public research institutes

In many OECD countries, applied public research institutes play an important role in promoting linkages between value chains and innovation ecosystems. They also have the objective of articulating the industry demands, and provide a significant source of income (OECD, 2016a). While universities are powerful actors in the Costa Rican innovation system, the role of public research institutes is underdeveloped. There are some

exceptions, however. Private, or in some cases semi-private, organisations associated with leading traditional sectors of the economy (including coffee, bananas, pineapple, sugarcane, livestock) have developed research units or centres responsible for research, technology transfer and technical assistance to upgrade and make these sectors more productive. Some centres are equipped with labs for analysis and testing and often assist firms in the relevant sectors in fields related to genetics, biotechnology, weather and climate change-related applied research.

Figure 4.19. **Degrees awarded by private universities, by level of degree, Costa Rica**



Note: Licenciate degree corresponds to the graduate academic degree corresponding to five to six years of study.

Source: Programa Estado de la Nación (2016).

In the case of Costa Rica, the majority of research centres are concentrated in public universities, where the preponderance of the country's research activities is performed. According to on the Plan Nacional de Ciencia, Tecnología e Innovación (National Science, Technology and Innovation Plan, MICITT, 2011) and its seven priority areas, R&D units linked to these areas are mainly concentrated in public universities (Table 4.3).

Table 4.3. **R&D units, by science and technology sector and field, 2013**

	Natural and exact sciences	Engineering and technologies	Medical science	Agricultural science	Total
Academic	35	21	7	9	72
Government	5	5	9	5	24
Private	2	19	1	1	23
Private non-profit	4	2	0	0	6
Others	0	1	0	4	5
Total	46	48	17	19	130
Percentage	35.4	36.9	13.1	14.6	100.0

Source: Programa Estado de la Nación (2016).

Despite the well-functioning research centres that undertake research activities and provide services to the business sector, notably in the agro-bio field (see Boxes 4.5 and 4.6), these still remains more the exception than the rule in Costa Rica's innovation system. Interactions between public universities and the business sector are still weak and have not progressed considerably over the last decades.

Box 4.5. Examples of research labs in Costa Rica

The National Centre for Biotechnology Innovation

The National Centre for Biotechnology Innovation (CENIBiot) is a biotechnology centre in Costa Rica originally funded by national and international co-operation funds. This centre was created in January 2007 through a joint venture between the European Union and the Costa Rican government. Since 2012 the centre is entirely managed by a board of governors, with representatives from the government, academia and the business sector.

CENIBbiot was created to enhance the incorporation of R&D and biotechnology in the business sector, and to boost the use of technologies to increase competitiveness in the agro-industry sector of the country. The centre operates in the fields of treatment of the agroindustry waste; biocontrollers, biofertilisers and biopesticides; biofuels; microorganism production for depollution of residual water; and biotechnology of plants. In addition, the centre has specialised equipment and offers different training services in areas such as molecular biology, biochemical analysis, bioproceses and plant cells.

The National Centre for Science and Food Technology

The National Centre for Science and Food Technology (CITA) was created in 1974 in joint co-operation between the Ministry of Agriculture and Livestock and the University of Costa Rica. In 1996, the Ministry of Science, Technology and Telecommunications started to collaborate with this centre, enhancing the institution's leadership. CITA is one of the main scientific research institutes for science and food technology in Costa Rica. It is focused on research, analytical services, training and consulting services, with a strong commitment to bridge linkages and provide scientific and technological co-operation in order to respond to the needs of business sector, as well as those of society, through food engineering and well-being.

The centre has developed partnerships with business sector organisations such as the Chamber of Food Industry of Costa Rica, in order to foster the linkages with this sector. Through CITA's training programmes the centre seeks to promote professional development as well as technological and knowledge transfer within the country's business sector. In addition to training, the centre also offers consulting services in the interest of fostering the incorporation of new technologies and new knowledge in national and regional enterprises. Moreover, CITA offers analytical services through its accredited laboratories in chemistry, microbiology and sensorial analysis. The microbiology laboratory focuses on applied research while the others provide services to the business sector.

The Biotechnology Research Center

The Biotechnology Research Center (CIB) is a key player in educating highly competent human resources destined to strengthen biotech research and industry in Costa Rica. The CIB started in 1994 and is part of the Biology School at the Costa Rica Institute of Technology (TEC).

The CIB combines different areas of biotechnology, contributing with integral solutions to the fields of agriculture, food industry, forestry, environment and biomedicine. It has three main research areas: plant biotechnology, environmental biotechnology and biomedical applications, which encompass the following transversal areas: molecular biology, bioinformatics, biochemistry, ecology and bioprocess. The CIB also works in collaboration with other programmes and research groups from TEC in areas such as nanotechnology, electronic microscopy and radiation technologies.

Sources: www.cenibiot.ac.cr; www.cita.ucr.ac.cr; www.tec.ac.cr/centros-investigacion/centro-investigacion-biotecnologia-cib.

As a way to strengthen public-private collaboration in research and innovation, Costa Rica could consider further developing public research institutes with the mandate to address specific challenges in industry or technology sectors by establishing partnerships with relevant business partners. In recent years, these types of strategic and challenge-oriented public-private collaborations in STI have emerged in many OECD countries (such as innovation alliances in Germany or the Top Sector approach in the Netherlands). They are generally aligned to national innovation strategies and priorities.

Box 4.6. **The Cloromido Picado Institute**

The Cloromido Picado Institute is a national research and scientific institute created in 1970. In 1972 it became part of the Universidad de Costa Rica. Since its creation it has developed significant research, mainly focused on the study of snakes and the poisons and toxins produced by this group of animals, as well as by arthropods and some microorganisms. This research facility has several laboratories in biochemistry, histology, molecular biology and biosecurity, among others.

The Cloromido Picado Institute is also engaged in active research regarding anti-poisons, and has developed essential research in the biomedical field. The Cloromido Picado Institute has helped advance the knowledge frontier in Costa Rica regarding the history of the country's snakes and other poisonous animals, biochemistry and microorganisms. In addition, this organisation has improved the technology production of anti-poisons and other important immunological products.

This research institute also has an influential industrial division in charge of the development of anti-poisons and anti-toxins which are used in Costa Rica as well as in other countries in Central America. In addition, it collaborates with different research groups – national and from abroad, government and the private sector –to provide health solutions. In this regard, the institute has developed important co-operation linkages abroad with countries in Central America, Africa and Oceania. Cloromido Picado commercialises several of its products in countries such as Ecuador, Nigeria and Panama and is currently part of a research group developing an anti-poison serum for the snake found in Papua New Guinea (*oxyuranus scutellatus canni*). The centre's researchers are also developing a veterinarian anti-tetanic serum in Costa Rica.

Source: www.icp.ucr.ac.cr.

Vocational education and training in Costa Rica

There are two main technical vocational education paths in Costa Rica: one offered by the Ministry of Public Education (MEP) through technical and vocational schools and the second provided by the National Training Agency (INA, see Box 4.7) (Álvarez-Galván, 2015). The MEP offers technical study programmes in agriculture, industry and trade, and services both during the daytime and in the evening. Technical schools also provide a two-year mid-level technician degree.

About 20% of the secondary education age group attends technical vocational schools. Enrolment has increased tremendously since 2003 thanks primarily to the increase of female enrolment and the addition of evening classes. Over recent years, most vocational education and training students were in trade and services (74% in 2013) followed by industry (19%) and agriculture (8%) (Álvarez-Galván, 2015).

Box 4.7. **The National Training Agency**

The National Training Agency (INA) is an autonomous institution created in 1965 to contribute to the development of human capital and productivity growth through the provision of training services to individuals and enterprises. INA also provides skill certification services. INA is financed through contributions from enterprises (1.5% of the wage bill). The 2002 SME Law has broadened Its mission and portfolio of activities to include technical assistance to small and medium-sized enterprises (SMEs) in support of skills upgrading, entrepreneurship, innovation promotion and productivity development. While INA's activities are usually praised among SMEs, there seems to be growing concerns about some rigidities that hinder its performance, notably as regards the delivery of training and technical assistance programmes and the difficulties for INA to hire highly qualified, part-time, non-civil servant professionals.

Research infrastructure and technological transfer offices

There are concerns about the status of science and technology infrastructure in Costa Rica's public universities and research labs. According to a survey carried out by Hipatia (2016), more than half of the research unit respondents reported a lack of adequate equipment for research. The most affected units appear to be in natural sciences, and the least affected in agricultural sciences. There is also a considerable lag regarding investments in the acquisition of new research infrastructure and in the maintenance of existing research infrastructure. The practice of use-sharing of research infrastructure is not well developed or incentivised among research organisations.

Furthermore, as is the case in many Latin American countries, Costa Rica faces challenges regarding the commercialisation of knowledge. Despite the recent creation of technological transfer offices (TTOs) in public and in some private universities, the linkages with the business sector – apart from the agricultural one – still remain weak. TTOs are generally small and underfunded (see Table 4.2). They are still in an emerging experimental stage regarding the management of patents and licensing agreements.[10]

Conclusion

The autonomy of Costa Rica's public research system confers it legitimate advantages that are rarely enjoyed in most OECD countries. These advantages should be accompanied by more accountability regarding the performance and orientation of research and technological activities. A new balance in the funding of public research activities should not come at the expense of the overall amount the resources devoted to research. It should lead to an increase in the public provision of competitive R&D grants and the support of technological diffusion activities, as well as incentives to collaborate with the business sector.

The question therefore remains open on the nature of institutional reforms that can conciliate the constitutional autonomy of the public university system and its funding arrangement with the need to increase the performance of its research activities and ensure that they better contribute to economic development and address social needs.

Institutional reforms should address the following shortcomings of the present system:

- the imbalance between core and competitive funding of research activities
- the lack of systematic and external evaluation of researchers and research activities according to various criteria such as quality, relevance, knowledge linkages, transfers and commercialisation, etc.
- the underdevelopment of TTOs.

CONARE has had a positive role in the development of Costa Rica's public university system. It should have a pivotal role in its evolution towards improved performance in a manner that complies with the spirit of the Constitution. While preserving the pegging of FEES to GDP (moving to a 1.5% target), this evolution could progressively reduce the share of FEES allocated to research activities for public universities as a whole in the form of core or institutional funding (currently around 15% of FEES), and simultaneously increase the share allocated through competitive funding. Emulating the procedure that is in place in most OECD countries, the competitive allocation process would be managed by a professionalised research funding agency.

Notes

1. Steps are being taken to allow SMEs to use purchasing orders as guarantee schemes (new Law of Guarantees approved by the National Assembly in May 2014).
2. The survey also showed that most of the inputs used by MNEs were supplied by headquarters or by global suppliers: on average, about 58% of the inputs of interviewed companies originated from these two sources. On average, local suppliers provide 24% of inputs. More information is provided in Zuniga (2014).
3. The World Economic Forum (2013) classified Costa Rica as a country in transition that is moving from an efficiency-driven to an innovation-driven economy. The jump to an innovation-driven economy is yet to be made.
4. Likewise, the investment generated by the companies attracted by CINDE has grown at an average annual rate of 10.3% since 2010 (CINDE, 2013).
5. Chile registered fewer than 10 patents per year up to the mid-1990s; since 2005 it has been granted, on average, 20 patents per year.
6. Each university has its own mechanisms to monitor and evaluate research projects.
7. Concerns in this regard were indicated during the OECD's fact-finding mission to Costa Rica.
8. Although Article 85 of the Constitution states that FEES is administered by the Central Bank, over recent years, the FEES budget has been administered and transferred by the Ministry of Finance.
9. www.ucr.ac.cr/presupuesto-universitario.html.
10. As per interviews with the OECD team during the fact-finding mission to Costa Rica.

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Chapter 5.

Innovation policy and governance in Costa Rica

This chapter examines public innovation policy and governance in Costa Rica. It begins with an overview of the historical evolution of science, technology and innovation policy in Costa Rica. It then examines the main policy actors and governance arrangements under the light of observations made in earlier chapters and outlines areas in need of dedicated policy attention.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

The evolution of science, technology and innovation policy and institutions in Costa Rica

The pioneering role of eminent scientists and rise of the academic sector

As in several other tropical Latin American countries, Costa Rica's first scientific and technological institutions were established between the end of the 19th and the beginning of the 20th century in such fields as botany, biology, tropical medicine, zoology and agriculture. They were founded mostly by Costa Rican scholars who had studied abroad, in Europe or North America, or by foreign scientists who had moved to the country attracted by its rich biodiversity.[1]

One of the most notable early achievements during this period was accomplished in the field of tropical pathologies and immunology by one of the most famous Costa Rican researchers, the biologist Clodomiro Picado (see Box 4.6 in Chapter 4). At the institutional level, the development of this field of scientific study was supported and consolidated by the creation of the Ministry of Public Health in 1928. Since then, this field has become an area of research excellence in Costa Rica. The creation of the University of Costa Rica (UCR) in 1940, the country's first public university, created new momentum for S&T-related capacity building promoted by the government through both increased public investment and institution building. Following the 1948 Civil War and the abolition of the army in 1949, the government increased budgetary resources for science, technology and innovation (STI) infrastructure; education; and the formation of human capital.

New institutions were created to accompany these investment priorities, mostly in the form of autonomous public agencies such as the National Training Agency (INA), created in 1965 to support the technical upgrading of the labour force, or the Costa Rica Electricity Institute established in 1949, which had to develop some endogenous technical capacities to fulfil its mission of energy provider. These agencies were often funded through extra-budgetary sources such as trust funds or excise taxes. As in other Latin American countries, this momentum mainly benefited from the impulse given by international organisations such as UNESCO (Finnemore, 1993) and support from multilateral financial institutions.

In 1972, the National Council for Scientific and Technological Research (Consejo Nacional para Investigaciones Científicas y Tecnológicas, CONICIT) was established by Law 5048 as an autonomous institution enjoying its own juridical personality and endowed with a trust fund to be replenished annually with at least CRC 1.5 million.[2] The main missions of this new institution were to:

- promote the development of scientific and technological activities for pacific ends[3]
- advise the government on scientific and technological matters
- develop and maintain an inventory of human, physical and institutional resources which constitute the scientific and technological potential of the country.

CONICIT thus contributed to an expansion of public research that was mainly focused on the higher education system, which grew rapidly with the creation of new universities: the Technological Institute of Costa Rica (Instituto Tecnológico de Costa Rica, TEC) in 1971, and the National University (Universidad Nacional, UNA) in 1973.[4] In effect, the development of public S&T capacities was mainly confined to the academic sector. It did not give rise to the creation of public research centres dedicated to the development and dissemination of knowledge in specific scientific disciplines or selected

technological areas outside the university system. The very limited number of non-academic public research institutes, or for that matter public technology centres (with the exception of the health and agricultural sectors)[5] highlighted in Chapter 4, is a Costa Rican peculiarity which will prove to have a negative effect on technology diffusion activities that universities were less prepared to assume.

Renowned academics were appointed to CONICIT's board of directors, and an overwhelming share of its resources was allocated to public university research centres based on a rationale derived from the dominant STI paradigm of the time: a linear supply-push model according to which innovation would emerge naturally from investment in research and the advancement of knowledge by scientific institutions. Research was deemed rooted in the search for solutions to socio-economic problems which at that time in Costa Rica were mainly related to biology and agriculture.[6]

In 1973, public universities created vice-chancellor for research offices in order to accompany the development and broadening in scope of their research activities, underpinned by increased budgetary resources and complemented by CONICIT's transfers, which are managed in an independent and autonomous fashion as guaranteed by the Costa Rican Constitution. In 1974, the four public universities increased their co-ordination in budgetary and planning tasks, thus opening the way to extending their academic autonomy to a progressive control over budget appropriations guaranteed by the Constitution and to be formally managed by the National Council of Rectors (Consejo Nacional de Rectores, CONARE) established in 1977. Since then, CONARE has played a dominant role in all decisions concerning public funding of research characterised by the overwhelming prevalence of institutional funding (as discussed in Chapter 4).

Achievements in capacity building and the lack of applied research institutions

Initial government initiatives in the area of science and technology mainly took the form of institution building and increased resource allocation that responded to capacity-building objectives supported by multilateral organisations. These trends were particularly clear during the times of the import substitution industrialisation strategy (ISIS) (Rodríguez-Clare, 2001). During the first phase of ISIS (1963-73), the availability of skilled labour offered comparative advantages to Costa Rica which enabled the country to derive greater benefits from market opportunities and global integration than others (e.g. adhesion to the Central American Common Market). The agricultural sector also improved, as increased yields and diversification fostered by research and technological diffusion activities were developed by government and academic research centres (Rodríguez-Clare, Trejos and Sáenz, 2003).

There are many reasons behind the failure of ISIS, which had to be phased out in 1980 after almost two decades of existence.[7] A major handicap of this model was the decision not to accompany the industrialisation efforts with policies and institutions in support of technological upgrading and diffusion, and their inter-play with exporting and global integration. The system lacked the public technological institutes (except in the area of agriculture) which, as providers of public goods, can play a fundamental role in the dissemination of knowledge, provision of technical services, and technology transfer to enterprises, and more specifically to small and medium-sized enterprises (SMEs).

The 1980s: A new development strategy with weak linkages to STI policy

After the macroeconomic stabilisation policy put in place in the aftermath of the crisis due to the budgetary deficit and increased debt generated by a failed industrial import substitution strategy, Costa Rica liberalised its economy in 1982 and subsequently opted

for a development path based on export promotion and policies to attract of foreign direct investment (FDI) whose main instruments were fiscal incentives (Rodríguez-Clare, Trejos and Sáenz 2003). Regardless of some changes in funding and the approach to STI, the effective contribution of S&T policy to the new development strategy based on FDI attraction and the promotion of greater value-added exports was very limited, and to some extent policies were disconnected from each other.

The Ministry of Science and Technology and Telecommunications (MICITT) was created by decree in 1986,[8] precisely when this development strategy was gaining momentum. It is therefore legitimate to wonder whether the policy orientations of that ministry were aligned or co-ordinated with those of the new development strategy. The S&T Programme 1986-1990 developed by the new ministry aimed at adopting a more comprehensive approach to S&T policy as it explicitly included objectives related to the technological upgrading of industry. However, this reference was hardly implemented in practice in the new development strategy (Box 5.1). First, the ministry lacked the resources and the competencies to effectively design and implement policies in support of business innovation. Second, the logic of S&T capacity building of CONICIT and the academic community represented by CONARE continued to prevail in the first years after the creation of the ministry.

Two events partially saved this ambitious programme and balanced it out a little by integrating pull-incentives and giving a more prominent role to the business sector. The first occurred in 1988: the minister[9] secured a USD 34 million loan from the Inter-American Development Bank (IADB) for S&T development, the so-called joint BID/CONICIT/CONARE loan.[10] This loan effectively allowed a more balanced allocation of resources between measures aimed at fostering business innovative capacity (FODETEC loans), support to competitive public research projects (FORINVES grants), the formation of skilled human capital and S&T infrastructure, which still received the lion's share of the loan. This loan became effective in 1990, only after the promulgation of Law 7169 (the second event), which establishes a new S&T ministry equipped with a broader mandate and more substantive responsibilities in steering the S&T system as well as commitments for budgetary resources.

In spite of new funding incentives, the governance of the S&T system did not improve significantly enough to foster systemic interactions or incentivise a "co-evolution" between the dynamics (and needs) of innovation by firms and the development of the knowledge infrastructure and research capacity of higher education institutions (HEIs) and public research institutes (PRIs).[11] By this time, it was rather clear that a weak absorptive capacity of a large majority of SMEs was negatively affecting integration in global value chains and linkages with foreign firms, problems that still plague the country today.

Government and public actors in the science, technology and innovation system: The present context

The current configuration and constituency of public actors and policy agencies in the STI context is crucial to understanding the overall governance of STI activities in Costa Rica. The fragmentation of the public administration, the autonomous status of many public agencies and state universities, as well as the evolving and overlapping competencies given to public institutions through the legislative process have inhibited the co-ordination among public actors of Costa Rica's STI system.

Presidential and ministerial bodies

The **Presidential Council on Competitiveness and Innovation** (PCCI) is chaired by the President of Costa Rica and composed of the Minister of the Presidency, the two Vice-Presidents and three representatives of the business sector. In 2014, two new councils, each chaired by a vice-president, were created under the aegis of the PCCI: one on competitiveness and the other on human talent and innovation. This renders it more difficult to elaborate coherent strategic orientations to promote innovation and competitiveness as mutually reinforcing facets of economic growth. Neither the PCCI nor its two subsidiary councils have a budgetary co-ordination function. The historical evolution of the council's functions is discussed below.

In contrast to some other Latin American countries like Chile, Colombia, Mexico or Peru as well as a number of advanced OECD countries, Costa Rica has a ministry in charge of science and technology. Formally, the role of the **Ministry of Science, Technology and Telecommunications**[12] (MICITT) is defined by the provisions of Law 7169 on the Promotion of Scientific and Technological Development (Box 5.1). Several assessments (ECLAC, 2014a; Maggi, Rivas and Sierra, 2012; Crespi, 2010) argue that the very existence of such a ministry is a positive factor, as cabinet status is considered as evidence of political commitment and legitimacy to steer and co-ordinate policy making and budgetary appropriation processes. However, the MICITT has very little margin of manoeuvre to take policy initiatives or orient the allocation of funds in support of research or innovation activities.

The MICITT's budget is one of the lowest of all ministerial departments (0.12% of the total government budget in 2015). Budget appropriations devoted to funding S&T-related institutions and or channelled to CONICIT for the implementation of the Incentives Fund and PROPYME programmes are mostly determined by past pieces of legislation that bind the ministry. These appropriations amount to less than half of the ministry's budget and in recent years around 0.01% of GDP (Table 5.1).[13] It should be noted that despite the financing of CONARE and public universities' R&D activities through the the Special Funding for Higher Education (Fondo Especial para la Educación Superior, FEES) and the "Fondo de Sistema", the MICITT continues to provide institutional funding to public universities' research centres, such as CONARE/CeNAT and UCR/CITA.

The MICITT's three directorates involved in support programmes (innovation, human capital and research) have very limited influence on programme design and implementation previously determined by law. Their main function lies in the preparation of the competitive calls for these programmes and the responsibility to make a "reasoned judgment" on the appropriateness and relevance of application they receive prior to their transmission to CONICIT. They are not involved in the selection process and do not have authority or even acknowledged legitimacy on policy monitoring or assessment activities.

In Costa Rica, the **Ministry of Finance** plays a more limited role than in most other countries in the process of budget allocation to the public sector, as many autonomous or "deconcentrated" public agencies' resources are not decided through budgetary procedures. Such an arrangement leaves only 5% of the central government's budget for discretionary spending. Revenue earmarking is extensive as autonomous public agencies' annual budgets are approved by the Comptroller General in accordance with specific legislation, thus reflecting a legal rather than a policy standpoint (OECD, 2016a). This is notably the case of public institutions that have relatively important research activities.

Moreover, the annual resource allocation to institutions like CONICIT feed into a trust fund that can accumulate assets over time.

Box 5.1. The creation of the Ministry Science, Technology and Telecommunications and the Law for the Promotion of Scientific and Technological Development

The "Law for the Promotion of Scientific and Technological Development" (Law 7169) promulgated in 1990 represented a major institutional initiative deemed to have important consequences on the science and technology (S&T) policy-making process as well as on the definition, scope and implementation of the instruments in support of it. With minor amendments, this law is still in force today.

This law created the so-called "National S&T System" (NSTS), composed of all public and private institutions, including higher education institutions (HEIs), whose main activities are related to S&T or which dedicate a share of their financial and human resources to S&T activities. The main purpose of creating the NSTS was to define a national S&T community with a voice in the policy-making process and to formally entrust the Ministry Science, Technology and Telecommunications with the responsibility to "steer"[1] the NSTS. Indeed, Article 13 of Law 7169 states the minister defines "the mechanisms and the levels of co-ordination to ensure the required concertation among the NSTS stakeholders". Given the high autonomy and control over their resources enjoyed by important stakeholders of the system, this steering function was likely to be problematic. In effect, the minister may not have been entrusted with sufficient authority and leverage to ensure consensual commitments among interests that are often misaligned, if not conflicting. This state of affairs was bound to affect the governance of the system.[2]

For the first time, this law formally acknowledged that budgetary resources must be appropriated for the implementation of S&T policy. Provisions are made in the law for the creation of a (multipurpose) Incentives Fund managed by the National Council for Scientific and Technological Research to be replenished on an annual basis, and for the creation of an Incentive Commission in charge selecting the beneficiaries of the financial support scheme to be recommended for approval.[3]

The main attributions of the ministry were: 1) define the orientations of the S&T policy in concertation with the NSTS according to mechanisms to be defined by the ministry, and contribute to articulating this policy with the country's global socio-economic policy; 2) prepare, implement and monitor a National S&T Plan in co-ordination with the NSTS; 3) allocate funding incentives defined by law to S&T-related activities or projects, according to decisions taken by the Incentive Commission; 4) in liaison with sectoral ministries, propose ratios of budgetary funds to be allocated to research-performing public institutions attached to these ministries; 5) improve the legal, regulatory and administrative framework conditions that impinge upon the effective development of S&T activities; 6) promote international co-operation in S&T in co-ordination with other relevant ministries.

Notes: 1. In Spanish the MICITT was named the "rector" of the NSTS, a function that goes beyond that of mere leadership and can encompass control over orientations and resources 2. For a sound analysis of the governance issues raised by Law 7169 see Crespi (2010). Most of the arguments developed in that analysis are still valid to this day. 3. This commission, chaired by the minister, includes two representatives from the Treasury, one from the Ministry of Agriculture, one from the Ministry of Economy and Industry, one from CONICIT, three from public universities (nominated by CONARE), and three members of chambers of (agriculture, industry and the Association of Private Enterprises).

Table 5.1. **MICITT budget: Share in total government budget and transfers[1] in support of science, technology and innovation**

Thousand USD

	2006	2010	2012	2013	2014	2015
MICITT total budget outlays (disbursements)	3 500	11 725	10 418	19 985	14 104	12 200
MICITT budget as a share total government budget	0.07%	0.14%	0.10%	0.22%[1]	0.14%	0.12%
MICITT transfers for science, technology and innovation	2 661	7 818	5 907	6 724	4 993	5 246
University of Costa Rica/National Center of Food Science and Technology	220	292	312	327	303	223
National Council of Rectors/National Center for High Technology	41	1 195	895	400	372	281
University of Costa Rica/CIIGB[2]	8	x	x	x	x	x
Atomic Energy Commission	87	222	206	216	200	185
Accreditation Agency	49	590	651	600	511	472
CONICIT operating costs	745	1 677	1 881	2 001	1 899	2 050
CONICIT Incentives Fund	647	3 158	1 770	1 753	1 193	1 517
CONICIT PROPYME	352	512	3	800	372	374
National Science Academy	85	163	177	178	114	112
CEFOF Training Centre[3]	432	-	-	-	-	-
Share of STI disbursements support in total MICITT budget	76.0%	67%	57%	31%	35%	43%
MICITT disbursements for STI support as a percentage of GDP	0.012%	0.024%	0.013%	0.014%	0.010%	0.010%

Notes: x: not applicable.

1. This increase corresponds to the transfer of responsibility of the telecommunications sector to the MICITT in 2013. 2. Costa Rica's contribution fee for its participation in the International Centre for Genetic Engineering and Biotechnology. 3. Central American Industrial Development Training Centre (fee).

Source: Ministry of Science, Technology, Innovation and Telecommunications and Ministry of Finance.

The Ministry of Finance is one of the signatories of the government agreement with CONARE regarding the definition of the amount of FEES that finances the system of public universities, including its research activities. It has been agreed that this amount should eventually reach 1.5% of gross domestic product (GDP). The only commitment requested from the universities in matters of research is that "they promote the strengthening of S&T activities and take actions to increase every year the enrolment in these activities during the time of the agreement". The Minister of Finance is a member of the Presidential Council on Competitiveness, and as such has some influence on the allocation of resources to competitiveness promotion programmes. However, she/he is not a member of the Council on Innovation and Human Talent, which tends to point out that resources issues are not under the purview of the council.

The **Ministry of Economy, Industry and Commerce (MEIC)** has a steering role in improving framework conditions and implementing policies that sustain the development and enhance the competitiveness of SMEs. It does not have direct responsibility in funding innovation support programmes. However, it was under the aegis of the MEIC that the SME Law 8262 was promulgated. This law established the PROPYME and FODEPYME[14] programmes in 2002.[15]

The **Ministry of Foreign Trade (COMEX)** indirectly contributes to fostering innovation in a number of ways, the most significant probably being through its autonomous Export Promotion Agency's (PROCOMER) Export Linkages programme

which supports the development of commercial and technological linkages between multinational enterprises (MNEs) and local enterprises.[16] This programme was launched in 2002 with the support of an IADB loan. An agreement concluded in 2011 between the MICITT, PROCOMER and the Investment Promotion Agency (Coalición Costarricense de Iniciativas de Desarrollo, CINDE) facilitated the use of PROPYME in fostering linkages through support to accreditation and certification services, thus opening the way to increased linkages and the possibility of technological spillovers of MNEs' activities (Monge-Gonzàlez et al., 2013; ECLAC, 2014a). However, this agreement does not seem to have resulted in a steady increase in the flow of applications to PROPYME: as noted above, after a surge in 2012 there has since been a regular decline in the number of applications (Table 5.2).

The dual objective of fostering the innovative capacities and competitiveness of SMEs and their linkages with MNEs calls for closer co-operation between the MICITT and PROCOMER, which has already materialised in the implementation of the programme on Innovation and Human Capital for Competitiveness financed by the IADB "PINN" loan in 2014.

Given the constitutional provisions that grant broad autonomy to the state universities and guarantee their endowment with public resources through FEES, the **Ministry of Education** does not have any institutional oversight or funding responsibility over HEIs. The only role it plays is an arm's-length regulatory one through its minister's chairmanship of the executive board of the National Council of Private Higher Education (Consejo Nacional de Enseñanza Superior Universitaria Privada, CONESUP). This council is the only entity that can authorise the creation of new private universities and the opening of new curricula. Such a regulatory power is legitimate but the ministry should ensure that, given the importance of skilled human capital development, it be exerted efficiently, avoiding conflict of interests and without undue delays suffered by private universities.

Other ministries. In Costa Rica, contrary to other Latin American and a number of advanced OECD countries, sectoral ministries do not directly fund research programmes or projects either in institutes they oversee or in academic research centres. However, there are institutions which are administratively "attached" to sectoral ministries but have an autonomous status and which conduct research and technological transfer activities. The most notable ones are:

- The National Institute for Innovation and Technological Transfer in Agriculture (INTA), is an autonomous institution established by law in 2002 to substitute the Ministry of Agriculture's research department. INTA has a staff of around 190, of which 60% are researchers. Its R&D expenditures amounted to USD 7.4 million in 2015.[17] INTA's research agenda is demand driven through producers associations and its "extension services" or technological diffusion activities are conducted in co-operation with the ministry's technical staff. INTA does not benefit from research programmes or projects supported by the MICITT.
- INCIENSA, the Costa Rican Institute for Research and Teaching in Nutrition and Health, is an autonomous institution attached to the Ministry of Health mainly involved in health monitoring, epidemiology and disease prevention activities aiming at informing public decision making. Its basic research activities are limited and its R&D expenditures amounted to USD 0.8 million in 2015.

CONICIT

CONICIT's two main functions are to manage competitive funding programmes and the S&T registry created by Law 7169 in order to "measure the resources allocated to S&T activities be they domestic or foreign, public or private, budgetary or extra-budgetary". The statute of CONICIT as an autonomous institution endowed with its own resources has played a key role in the development of S&T infrastructure in the decades following its creation and, later, in the management of the two main funds for research: the Incentives Fund and the PROPYME programme. Major features in the operation of these funds are:

- In relation to the volume of competitive projects CONICIT reviews and the amount of funds it allocates through the Incentives Fund and PROPYME, CONICIT's administrative and operative costs are very high by international standards.
- Its review process could be improved: given the topical diversity of the projects it has to review, it probably lacks the competencies to pass informed judgment on all the projects before transmitting its results to the Incentive Commission for final approval.[18] This is notably the case for business innovation projects. Apparently, as already noted in previous IADB assessments (Crespi, 2010; Maggi, Rivas and Sierra, 2012) review panels often lack external qualified accredited experts, a characteristic often crucial for small countries like Costa Rica.
- As mentioned above, the fact that CONICIT resources come in the form of a trust fund may affect its *modus operandi* as patrimonial management behaviour may have adverse effects on the portfolio of its activities and disbursement schedules. In fact, this *modus operandi* accounts for broad differences between the annual budgetary transfers CONICIT receives from the MICITT for the Incentives Fund and PROPYME (Table 5.2) and the actual disbursement schedules of these programmes.[19] Other reasons that might account for the lack of consistency between the annual budget transferred by the MICITT to CONICIT and the actual disbursement schedules are a deficient scheduling of calls, which causes a late placement of resources, and the tardiness of the ministry to generate and sign the contracts that grant the benefit.[20]
- While CONICIT did develop a registry of public and private institutions carrying out S&T activities, this registry falls rather short of the requirements mentioned in Law 7269 and notably as regards the information that would be necessary for monitoring and evaluation purposes.

Public financial institutions

The Development Bank System (SBD), which regroups all public financial intermediaries, is a second-tier bank endowed by public institutions' contributions established in 2008 by Law 8634 "to promote and finance economically and technically feasible productive projects consistent with the country's development model".[21] In 2014, a new law[22] broadened the portfolio of the SBD's activities, making it not only the main public financial institution providing financial and non-financial services aimed at fostering SMEs' entrepreneurship and competitiveness, but also a major actor of the public system of support of innovation and research activities in its own right through the FINADE trust fund.[23] In the areas of S&T and innovation, the SBD's main interventions focus on:

Table 5.2. **Incentives Fund and PROPYME: CONICIT-disbursed funds**

Thousand USD

	Incentives Fund				PROPYME		TOTAL
	R&D projects		Human capital				
2009	235.6	6.3%	3 205.4	86.1%	279.9	7.5%	3 720.8
2010	341.9	14.6%	1 922.4	82.1%	76.5	3.3%	2 340.7
2011	384.1	10.9%	2 816.0	80.0%	318.1	9.0%	3 518.1
2012	391.8	9.0%	2 183.7	50.2%	1 771.4	40.8%	4 346.9
2013	434.1	9.9%	2 770.7	62.9%	1 196.7	27.2%	4 401.5
2014	293.3	12.1%	1 475.0	61.0%	648.2	26.8%	2 416.4
2015	-	-	1 449.5	84.0%	276.0	16.0%	1 725.5
2009-15	1 845.1	9.8%	12 617.2	67.3%	4 286.9	22.9%	18 749.1

Source: MICITT.

- grants for R&D expenditures for innovative projects; support to technological transfers and human capital development
- training and technical assistance programmes for SMEs
- support to entrepreneurship and the development of start-ups through the provision of seed and venture capital in association with incubators and private venture capital funds.

In the case of R&D grants and technical assistance projects, the selection process is not competitive: the SBD board has discretionary power to approve projects presented by firms or research institutions that would benefit from its support, sometimes for very large amounts.[24]

In the case of seed capital, the SBD has created a competitive fund, which has already had two calls. This fund finances the costs of 6-12 months of incubation in a private or public university incubator. Funding can be extended for an additional 12 months if an enterprise is actually created after the incubation stage. The total amount of resources allocated following the first two calls was USD 2.3 million, or around USD 48 000 per project (Monge-González, 2016). In the course of interviews conducted during the OECD fact-finding mission for this review in January 2016, members of private venture capital funds asserted that because of the regulatory norms under which the SBD operated it was bound to apply prudential rules on the use of its trust fund and therefore had to interrupt the programme. There were not any calls for projects in 2015.[25]

Agencies in charge of attracting foreign direct investment and export promotion

Two agencies – with different but complementary aims and objectives – have played a central role in the Costa Rica's export-oriented strategy: CINDE, the national institution responsible for promoting the country as an investment destination, and PROCOMER, whose main purpose is to promote the country's exports. CINDE is a private, non-profit institution created in 1982 and declared of public interest in 1984. PROCOMER was created in 1996 through Law 7638, which created the Ministry of Foreign Trade. PROCOMER facilitates and promotes Costa Rica's commerce abroad. According to the

law, its main duties rely on designing and co-ordinating programmes related to export promotion and investment.

The Inter-American Development Bank

The IADB is not a national actor but, by extension, is included in this section given its role in supporting public policy in the area of STI in Costa Rica since 1988[26] through technical co-operation projects and loans. In 2013, a USD 35 million loan agreement was approved[27] to implement a "Programme of Innovation and Human Capital for Competitiveness" (PINN programme) over the five year period 2014-18.

Steering and strategic co-ordination for science, technology and innovation

Agenda setting and developments in co-ordination mechanisms in the mid-2000s

By the first half of the last decade there was increased recognition from public and private stakeholders that, to be mutually reinforcing, the complementary requirements of FDI attraction (and local embedding) and promotion of endogenous technological capabilities of local firms called for increased co-ordination at the strategic and policy design levels.

The first manifestation of this recognition was the organisation of the so-called "Siglo XXI Strategy" initiative launched in 2004. This initiative consisted of a broad consultation process involving more than 200 representatives from the government, entrepreneurial and academic sectors, aiming at reaching a consensus over long-term development objectives and sectoral priorities, with a view to recommend an action plan based on investment in knowledge to achieve them.[28] The main outcomes of this consultation were: 1) a shared diagnostic of the weaknesses of the country's S&T and innovation system; and 2) a set of recommendations, not only in terms of quantitative objectives related to inputs to and outputs of the STI system to be reached over the medium and long term, but also in terms of institutional changes.

Like in many consensual exercises of this nature, no budgetary resource requirements were defined or associated to objectives, and these were more often the reflections of good wishes than achievable targets. On the other hand, the declaration gave great importance to R&D expenditure, and defined a target of 3% of GDP to be reached by 2050. In addition to the great challenge of making that happen, it is questionable that the strategy gave less importance to more technology transfer goals critical to productivity catch-up, such as technology diffusion and firm upgrading.

In the decade that followed the Siglo XXI exercise, several institutional initiatives inspired by its diagnostic and recommendations were taken, but they did not fundamentally alter the prevailing state of play and institutional inertia. In 2007, a National Innovation Commission was established29 (for a six-month period) to translate the Siglo XXI diagnosis of the STI system into new institutional arrangements and come up with strategic programmes to be steered and implemented under the aegis of the MICITT.

This commission confirmed and deepened the preceding diagnosis with an emphasis on the systemic and framework conditions that impede innovation as well as weaknesses in the policy instruments. The main recommendation of the commission was another institutional change aimed at securing high political commitment to the promotion of innovation and the definition of policy orientations reflecting this commitment. In 2009, the National Innovation Council (Consejo Nacional de Innovación, CNI) was created. It

is chaired by the President and includes members of the government in charge of areas more closely related to STI matters.[30] This institutional design coupling a government level STI cabinet and a high-level body made up of stakeholders was entrusted with consensus building around long-term STI policy orientations and policy recommendations and was inspired by best practice models of governance implemented in a number of OECD countries (Box 5.2).

Less than a year later (and 20 years after the STI Law), in the framework of a more general governance reform instituting presidential councils to better inform the policy-making process in priority areas involving several ministries, the incoming Chinchilla administration abolished the CNI, replacing it with a new PCCI[31] chaired by the President.[32] To achieve a greater impact in the Costa Rican institutional setting, the PCCI could improve its actions by:

- developing an information base that allows consensus to be built on the diagnosis on competitiveness and STI issues in order to produce evidence-based recommendations
- playing a role to align the volume and allocation of resources with policy recommendations[33]
- fostering inter-ministerial co-ordination in STI policy and helping to reduce the overlapping responsibilities between policy design institutions and policy implementation agencies.

In 2014, Presidential Decree 38662, while formally maintaining the PCCI (albeit with reduced membership)[34] added two new councils, each chaired by a vice-minister: the Competitiveness Council and the Innovation and Human Talent Council. Each of these two second-tier councils has a membership that includes ministers with responsibilities touching upon the concerned areas and representatives of the academic sector and/or the business sector.[35] It should be noted that the MICITT is not a member of the Competitiveness Council: this is a missed opportunity to raise the political commitment to support science and technology as drivers of innovation and competitiveness.

Planning and agenda setting today: The National Science Technology and Innovation Plan

Advanced OECD countries generally engage in formal planning exercises in the STI area involving detailed objectives and action plans.[36] Since 2010, in Costa Rica, the elaboration of a National Science Technology and Innovation Plan (PNCTI) is a legal obligation to be carried out at the beginning of each new administration. The PNTCI is prepared under the aegis of the MICITT in the framework of a process that involves the collaboration of a large number of stakeholders from the government, public agencies, research centres, higher education and business sectors as well academic experts.

The 2011-14 PNTCI

The plan presents a diagnostic of the main challenges facing the development and diffusion of STI activities in the economy and society and, taking into account the priorities laid out in the National Development Plan, defines a number of strategic orientations as well as thematic and sectoral priorities deemed to frame STI policies during the government of the day's mandate. It goes as far as detailing its strategic orientations in specific lines of action, and the associated resources, main implementing institutions or actors, and performance indicators.

Box 5.2. **Functions and types of high-level science, technology and innovation policy councils**

Science, technology and innovation councils are used as a mechanism in many countries to respond to the growing need for more effective innovation governance by fulfilling the functions not only of priority setting and advising, but also policy co-ordination and strategic planning. The majority of the councils examined in a recent benchmarking serve primarily an advisory function (Austria, Canada, Denmark, Germany, Singapore, Switzerland, the United Kingdom and the United States). Some councils also have a co-ordination function (the People's Republic of China [hereafter "China"], Finland, Germany's Innovationsdialog and Wissenschaftsrat, Japan and Korea) and/or priority setting (China, Finland, Japan and Korea) or even policy planning function (Finland). Their role in evaluation tends to be limited, but this is mostly due to a lack of institutionalisation of evaluation rather than for reasons of "good design". International experience also shows that the co-ordination function is the most difficult to achieve.

Against the backdrop of these different mandates, four main types of councils can be distinguished:

1. joint planning model: the government uses the council as a virtual "horizontal ministry of innovation", much as engineering companies build project teams by bringing together people across different disciplines
2. co-ordination model: the council communicates horizontally across ministries' responsibilities so as to align policies in support of innovation, without this alignment always being binding
3. advice model: the council provides non-binding advice to the government
4. platform model: the council functions as a "sounding board", providing the government with a forum for interacting with a selection of representative high-level stakeholders, usually from industry and academia, but also at times including labour unions, research institutes or other actors.

Identifying best practices and generating transferable lessons is a risky task given that so many aspects of these councils' performance are conditioned by the contexts of their respective national innovation systems. However, some broad lessons can be drawn from two international comparisons of STI councils:

- The chairing by the prime minister and the presence of ministers is generally positively associated with a council's ability to ensure co-ordination and communication between the different sectors; but statutory participation should be underpinned by genuine commitment.
- The policy elaboration, co-ordination and advising roles of councils must not get entangled in resource allocation or budgeting; this might undermine their neutrality and independence, and also generate strong opposition from ministries who might see the council as a threat.
- STI councils should consult and co-operate with the other actors of the system to access the strategic intelligence distributed across the system. Councils must create an evidence base on which consensus can be built. Their decisions should therefore be based on wide and transparent consultations, as well as thorough analysis. If possible, these analyses should not be carried out by only one ministry. Most councils have analytical resources (a secretariat, budget for analyses).
- Councils' form and processes should be robust against changes of government by being sufficiently flexible to accommodate some changing priorities while maintaining continuity of strategic intelligence and advice.
- Councils should make their mark quickly, both as a "thought leader" in policy making and through successful intervention. This also implies good communication and dissemination of reports.
- Realistic expectations should drive the design of STI councils' mandates. Councils cannot be tasked to address all national needs for innovation policy, i.e. evaluation and oversight should be carried out separately, implementation corresponding to operating/funding agencies, etc.

Sources: Schwaag Serger, S., E. Wise and E. Arnold (2015), *National Research & Innovation Councils as an Instrument of Innovation Governance: Characteristics & Challenges*, www.vinnova.se/upload/EPiStorePDF/va_15_07T.pdf; OECD (2009a), "Chile's National Innovation Council for Competitiveness".

The plan's diagnosis of the Costa Rican STI system, to a large extent inspired by an IADB technical co-operation document (Crespi, 2010), unambiguously points out some of its major weaknesses, such as those related to the design, financing and implementation of support policies. It is, however, more evasive regarding governance and institutional issues. The plan also fulfilled a useful function as regards the definition of strategic priority areas for research funding based on the three criteria: 1) national S&T potential and/or natural resources; 2) expected long-term economic and social benefits; and 3) pervasiveness.[37] Given the limited budgetary appropriations available to the MICITT to finance research projects through the Incentives Fund, these priorities were deemed to be mandatory in competitive calls but only had an indicative character in HEI research funded by FEES.

The plan's ambitions were probably unrealistic with respect to what could actually be accomplished over its duration, given the mismatch between estimates of resources to finance the lines of actions detailed in the plan and the actual availability of such resources.

The 2015-20 PNCTI

In 2013, in the framework of its "State of the Nation Programme" (PEN)[38] and with the support of the IADB, CONARE launched an in-depth analysis of the Costa Rican STI system. This initiative gave rise to the State of Science, Technology and Innovation (Estado de la Ciencia, Tecnología y Innovación) (ECTI, 2014) report released in 2014 which provided very useful input to the new plan.

As the preceding plan, the 2015-20 PNTCI (MICITT, 2015) was also elaborated through broad consultation with the STI system's stakeholders and taking into account the socio-economic priorities of the current administration. However, apart from the identification of sectoral and transversal priorities that could benefit from special programmes,[39] this document remains largely analytical in its approach and generic in its calls for action. In fact, while it retains the relevant diagnostic elaborated by the ECTI, highlighting the complex and ineffective institutional framework, the shortage of public resources, and the dispersion of poorly endowed support programmes, it falls short of presenting clear guidelines that can frame an effective policy design and implementation process by the current administration. The document also does not address the key issues of resources and improvements to the institutional setting.

Governance of science, technology and innovation in Costa Rica

Specificities and challenges

The recent OECD Public Governance Review of Costa Rica (OECD, 2015a) highlighted a number of institutional specificities and practices that affect governance mechanisms and entail adverse consequences on policy design and implementation in many areas in which the central government and/or sectoral ministries have a major steering, co-ordination and funding role (Box 5.3). Good practices around STI governance mechanisms are described in Box 5.4.

Fragmentation

STI governance suffers from fragmentation syndromes at several levels that weaken the MICITT's capacity to exert the steering responsibility over the STI system conferred by Law 7169. These include:

Box 5.3. **Institutional settings and practices in Costa Rica: Effects on governance mechanisms**

Costa Rica's institutional setting affects the implementation of efficient governance mechanisms. The OECD Public Governance Review of Costa Rica highlighted a number of areas for improvement:

- The country has a fragmented public administration, which is characterised by an important number of subsidiary bodies of central government ministries and a large institutionally decentralised sector (e.g. semi-autonomous and autonomous agencies, state-owned enterprises) subject to weak accountability mechanisms. Steering and co-ordination capacities of the centre of government or ministries in charge policy design and implementation involving autonomous agencies are limited.
- To counteract the negative effects of this high fragmentation, Costa Rica also experiences a high propensity to establish by law inter-institutional bodies with a co-ordination mission across ministries and agencies; however, more often than not these co-ordination bodies have been used to preserve vested institutional interests without dismantling silo approaches to policy making.
- A large share of the budget, about 50% of total consolidated general government spending, is managed by the institutionally decentralised sector and falls outside the budget preparatory process. Autonomous agencies' appropriations do not have to be approved by the Legislative Assembly but by the Comptroller General, and approval is from a legal rather than a policy standpoint. In addition, there is no effective mechanism to ensure that these agencies' objectives are aligned with those of the central government.
- The share of earmarked expenditures in budget outlays is very high, as more than half of central government spending is constrained by constitutional and legal mandates or agreements such as the ones allocating 8% of GDP to education and mandating that financing of public universities reaches 1.5% of GDP.
- Despite the establishment of a national monitoring and evaluation system about two decades ago, Costa Rica has still not made the shift from a process-oriented towards a result-oriented monitoring, accountability and evaluation culture.

Source: Adapted from OECD (2015a), *Costa Rica: Good Governance, from Process to Results*, http://dx.doi.org/10.1787/9789264246997-en.

- The fact that CONICIT was established as an autonomous institution with some policy attributes before the creation of the MICITT gives rise to overlaps in policy design and implementation[40] and deprives the MICITT of the authority to demand more accountability from CONICIT not only on the evaluation of support programmes,[41] but also on the management of its trust funds.
- The creation of the Development Bank System, since 2014, and independently from the MICITT which does not participate in its board, gives it a prominent role in the promotion of STI activities[42] without oversight of, or consultation with, the MICITT.
- The autonomous status of public universities and CONARE which extends to the provision of budgetary appropriations pegged to GDP directly from the Treasury. The scope of this autonomous status, which is quite unique compared to OECD countries, means that the overwhelming share of public research is financed

through institutional or core funding.[43] This state of affairs deprives the MICITT from any significant steering capacity over Costa Rica's largely university-based public research system through more competitive funding instruments.

Box 5.4. **Moving towards more effective governance of science, technology and innovation policy: Lessons from OECD countries**

Governance of science, technology and innovation (STI) systems can be defined as the set of – largely public – institutional arrangements that shape policy design, implementation, delivery and evaluation, and determine how the various public and private actors interact in allocating and managing resources devoted to STI (OECD, 2005). OECD experience provides ample evidence that, beyond the magnitude of the volume and allocation of resources allocated to STI infrastructure and activities, countries' innovation performance depends on the effectiveness of governance mechanisms.

The governance of STI systems has changed profoundly over the last three decades in most OECD countries. The main factors behind these changes have been:

- The broader scope of policies that impinge upon innovation performance have increased the importance of a "whole-of-government" approach to STI policy design; hence the need for efficient co-ordination mechanisms among concerned ministries or agencies as regards policy orientations and their translation in terms of policy mix and budgetary allocations in STI matters.
- Greater stakeholder involvement from the public knowledge (research and education) community and the business sector in the definition of strategic orientations, which has often led to the creation of S&T policy councils that include non-government stakeholders. Some countries have specialised working groups or "innovation networks" – involving industry, institutions, government, academia and experts – in thematic areas such as skills, education, sectors (e.g. manufacturing; agriculture), etc. These groups facilitate the creation of policy roadmaps and innovation agendas, which will nourish the design of strategies and policy programmes at a higher level.
- Greater accountability of both agencies in charge of policy implementation and delivery and public institutions that receive support for their STI-related activities. A corollary of this increased accountability is the importance attached to policy monitoring and evaluation in good governance practices. This, in turn, requires a sound and reliable system of STI indicators and innovation statistics.
- Greater attention to institutional functionality by clearly distinguishing the functions of policy design from those of policy implementation, leading to the creation or transformation of government implementing agencies with a larger management autonomy balanced by greater accountability.
- The increased importance of public-private partnerships and of reliance on intermediary institutions to foster knowledge interactions, better respond to social and collective needs, and increase the leverage of public investment in S&T on private spending.

Legislative stalking, out-of-budget earmarked expenditures

Costa Rica has a high propensity to launch new institutional initiatives through the legislative process or presidential decrees that include earmarked appropriations with a long lifetime. Law 5048, which created CONICIT in 1972, states that CONICIT was to receive a fixed annual endowment of CRC 1.5 million[44] to implement and finance its activities. When Law 7169, which created the MICITT in 1990, was established, the

Incentives Fund created in the framework of that law replaced CONICIT's previous annual endowment. The provisions of Law 5048 were not fundamentally altered except from the fact that earmarked appropriations would simply "transit" through the MICITT's budget without any question about their continuing rationale.

On the other hand, the creation of the FINADE as an SBD trust fund in the framework of the 2014 Law 9274 with earmarked endowments certainly provides new funding opportunities for innovative projects and SMEs' capacity building but may also give rise to duplication with existing programmes as well as increased overall overhead costs for the public support system as a whole.[45]

Financing of support programmes: The importance of trust funds

Contrary to the general practice in OECD countries, most support programmes implemented by CONICIT (and the SBD), are not funded by budgetary appropriations that have to be disbursed or committed in the course of the fiscal year but through trust funds. CONICIT trust funds are replenished every year by transfers from the MICITT budget.

In the case of the SBD, replenishment is done through mandatory contributions by other financial and non-financial institutions. Financing through a trust fund may have some advantages, as the schedule of transfers of resources to beneficiaries is not constrained by the fiscal year commitments requirements. But this lack of constraint may have the disadvantage of inducing the fund managers to adopt patrimonial asset management behaviour with adverse effects on the portfolio of its activities and disbursement schedules. Also, notwithstanding supervision safeguards, automatic replenishments not subject to performance criteria are far from encouraging management efficiency, with possible adverse consequences on the portfolio of supported activities and the level of operating overhead costs.

The creation of a new innovation agency

Given the conspicuous lack of absorptive capacities of a large majority of SMEs and the weakness of technology diffusion institutions and activities, innovation policy must be embedded into a broader entrepreneurship policy with a diversity of customised programmes, from the provision of technological managerial services to that of seed capital and new technology-based firms and the promotion of knowledge linkages with MNEs.

In this area the Costa Rican government has put forth an institutional initiative in line with some sound policy implementation practices. The proposed creation of a new innovation agency[46] that would be responsible for the implementation of measures in support of SME entrepreneurship, capacity building and innovation is indeed a reasonable step towards improving policy effectiveness and impact. Policy co-ordination and synergies among support programmes would be enhanced and policy fragmentation reduced as the agency would implement SME support programmes in enterprises that are presently carried out by different actors in the system. According to the proposed scheme, the SBD would retain responsibility over financial instruments for SME support measures such as subsidised loans and guarantees.

Like PROCOMER, the agency would enjoy autonomy with a private law status, which presumably would allow for sounder and more efficient management as well as accountability practices. In principle, the creation of this new agency would not call for

additional budgetary commitment as its resources would come from transfers (mainly trust funds) from those institutions whose responsibilities it would take over. The executive board of this new agency would be constituted of a minister or vice ministers from relevant ministries.[47] The agency's autonomy would facilitate the flexible management of resources and personnel. It would be committed to carry out regular evaluations of policy programmes. Comparable Latin American countries such as Chile and Uruguay offer alternative models that could be relevant for Costa Rica (Box 5.5). OECD countries also offer alternative models: in some cases they established a single agency in charge of the allocation of competitive funding for science and innovation programmes (as in the well-known case of the Research Council of Norway, see Box 5.6). In other cases countries established separate agencies, typically one in change of innovation support (generally referred to as innovation agencies, such as Vinnova in Sweden or Tekes in Finland) and one (or more than one) in charge of the allocation of competitive scientific research grants (generally referred to as research councils) as in the case of the Swedish and British research councils or the Academy of Finland. These professionalised research agencies are typically responsible for rigorous and independent monitoring and evaluation of the public research system.

The innovation policy mix

The scope, nature and focus of government and other public actors' STI-related support policies can be highly country specific. They depend on a number of factors which have to do with the level of development, the structure and openness of the economy, the specificity of institutional contexts, the endowment in natural resources, the initial conditions regarding the strength and organisation of the S&T capacities, the articulation between components of the STI system, and the framework conditions that impinge upon innovation performance. They also depend on the relative importance of the rationale for public support, be they market or systemic failures,[48] and the risks of possible government failures.[49]

Beyond country differences, government interventions should relate to the rationales mentioned above and give rise to explicit or implicit "policy mixes" that address the challenges faced by the performance of the innovation system and involve a combination of: 1) measures aiming at enhancing S&T capacity (infrastructure, generation of knowledge and human resources development); 2) support measures and incentives to enhance private sector investment in R&D and innovation activities and to foster the diffusion of knowledge and interaction among institutions and agents; and 3) institutional and regulatory reforms aiming at reducing the obstacles to innovative activities, including those related to framework conditions.

A review of Costa Rica's policy portfolio and policy mix must take due account of two factors that may offset the importance of policy shifts: 1) the low level of public resources devoted to the promotion of STI activities in general, and *a fortiori* for each individual programme; and 2) the institutional inertia discussed above that gives rise to legislative stacking and path dependency effects on policy design. In Costa Rica, policy instruments are often defined in detail in pieces of legislation or decrees that remain in force for a long time, rendering it difficult to adapt the prevailing institutional framework to policy changes or to the evolution of the drivers of innovation endogenous or exogenous to the STI system.

Box 5.5. **Innovation agencies in Latin America: The case of Uruguay and Chile**

In 2005, and after a new government took office, Uruguay engaged in a reform of its science, technology and innovation (STI) governance bodies. After discussing different options of institutional arrangements such as a new STI ministry, a centralised unit or an inter-ministerial cabinet, the government decided to modify governance mechanisms and create a new innovation agency (Rubianes, 2014). In 2005, the Inter-ministerial Cabinet for Innovation (GMI) was created by presidential decree (136/005), offering a transversal and multidisciplinary approach to STI as well as a new and important hierarchy within the executive power. The GMI is formed by several ministries including the Ministry of Economy and Finance; the Ministry of Livestock, Agriculture and Fisheries; the Ministry of Industry, Energy and Mining; the Office of Planning and Budget; the Ministry of Public Health (since 2010); and the Ministry of Education and Culture (which holds its presidency). The new GMI is responsible for establishing the political and strategic guidelines regarding STI in the country.

As part of the reform, new financial resources were granted to STI and for the first time in the country an STI National Strategic Plan (PENCTI) was created. As well, in 2006 (by Law 18084) the National Research and Innovation Agency (ANII) was created as the sole agency in charge of executing the country's STI strategy, previously defined by the GMI. The ANII has a board of governors which is formed by representatives from all of the ministries that are part of the GMI in addition to two members of the National Council of Innovation, Science and Technology (CONICYT). This agency has several instruments and programmes that aim to boost research, innovation, human capital and entrepreneurship in the country. The ANII's approximate budget for 2016 was USD 35 million.[1]

CONICYT, which was created in 1961, was reformed as well. More stakeholders were represented in the new CONICYT, such as workers' unions and public enterprises. The private sector and private universities also enlarged their representation. This improved its hierarchy as an advisor to the executive power and to parliament.

InnovaChile, Chile

In Chile, InnovaChile is a public agency under the umbrella of the Chilean Economic Development Agency in charge of administrating innovation policies to increase the competitiveness of Chilean firms. The agency provides grants and matching grants to companies and technological centres that apply for projects. Financing is thus purely demand driven. The lines of support are (through co-funding or direct services): corporate innovation, technology transfer, innovative entrepreneurship, strengthening the innovation ecosystem, and advisory and technical services.

Since 2007, Chile has a national council for innovation. The National Council of Innovation for Development, formerly named National Innovation Council for Competitiveness, is a public-private organisation whose mission is to advise the presidency in the identification, formulation and execution of policies and actions to strengthen innovation and competitiveness in Chile. In January 2013, the government created an S&T Advisory Committee to improve the governance of the innovation system. The committee identified several obstacles that are hard to address under the current governance framework. A key objective is to optimise the use of the public budget for innovation. Public R&D expenditure is managed by different agencies; they respond to different ministries and do not necessarily adhere to an integrated, common, long-term vision for STI policy. The S&T Advisory Committee suggested creating an institutional body to co-ordinate the agencies involved.

Note: 1. www.anii.org.uy/institucional/documentos-de-interes/6/planes-operativos-anuales.

Sources: www.anii.org.uy; www.corfo.cl; www.conicyt.cl; www.cnid.cl; Angelelli, P. et al. (2009), "Ciencia, tecnología e innovación en Uruguay: Avances, desafíos y posibles áreas de cooperación con el BID", www.iadb.org/wmsfiles/products/publications/documents/35166756.pdf; ECLAC (2014b), "Nuevas instituciones para la innovación: Prácticas y experiencias en América Latina", http://repositorio.cepal.org/bitstream/handle/11362/36797/1/S1420026_es.pdf; OECD (2011a), *Business Innovation Policies: Selected Country Comparisons*, http://dx.doi.org/10.1787/9789264115668-en; OECD (2009a), "Chile's National Innovation Council for Competitiveness: Interim assessment and outlook", www.cincel.cl/documentos/Recursos/CHILE_COUNCIL_FINAL.pdf; Rubianes, E. (2014), "Políticas públicas y reformas institucionales en el sistema de innovación de Uruguay", http://repositorio.cepal.org/bitstream/handle/11362/36797/1/S1420026_es.pdf.

Box 5.6. **The Research Council of Norway**

The Research Council of Norway was created in 1993 as the dominant, multipurpose agency to serve the 15 sector ministries as a funding body and main intelligence unit for the system. Its main formal tasks are: 1) to fund scientific, applied and collaborative R&D of all kinds of private and public actors; 2) to supervise the internationalisation of Norwegian R&D; 3) to help to keep the extensive institute sector (public research institutes) afloat, with a number of instruments, including some block funding; 4) to act as the main sponsor of evaluations; and 5) to advise the government on science, technology and innovation (STI) policy questions. Its responsibilities cover a combination of tasks unique among OECD countries.

Thanks to its unique role and generous appropriations, the Research Council of Norway is a large agency, with an annual budget of approximately EUR 950 million and nearly 500 employees, a remarkable size for a country of 5 million inhabitants. It handles around 25% of all government expenditures for R&D, mainly in the form of about 100 instruments, including approximately 60 funding programmes. In 2015, it awarded grants to roughly 5 000 projects, from funding large-scale scientific centres to awarding small individual grants to companies. The remaining 75% of public R&D appropriations consists of direct appropriations to higher education institutions in the form of general university funds, some innovation policy measures and significant health-related R&D funding.

The council is governed by an executive board, the majority of whose members are appointed by the government. At the next level, four division research boards run the different sub-structures within the council, including a science funding council, a second council for funding innovation policy and two mission-oriented divisions – one dealing with public sector innovation, health and the welfare society, the other with energy, resources and environmental issues. A third level of internal governance includes numerous thematic programme boards and committees, mainly to oversee funding programmes and make individual funding decisions. At all three levels, the boards include representatives from different spheres, including science and industry.

The Research Council of Norway offers thematic and large-scale programmes, centre funding, individual and collaborative grants, infrastructure funding and networking measures.

Sources: OECD (2017), *OECD Reviews of Innovation Policy: Norway 2017*, forthcoming.

According to several studies (Maggi, Rivas and Sierra, 2012; Programa Estado de la Nación, 2014), at the end of the last decade Costa Rica's portfolio of STI-related policies or financing instruments was relatively reduced compared with that of most Latin American countries. As shown in Table 5.3, in 2016, Costa Rica's portfolio was not as reduced as it has been claimed. But this apparent diversity reflects in fact a policy fragmentation and hides imbalances and shortcomings which, to a large extent, result from governance weaknesses, paucity of resources, institutional constraints, and rigidities or strategic orientations ambiguities.

Following the main policy areas headings identified in Table 5.3, the main issues raised by the current policy portfolio are:

- R&D/S&T capacity building. In this area, only the scholarship item has a real critical mass. The volume of public competitive funding resources allocated to research projects (the Incentives Fund and FORINVES) remains extremely low. In 2013 it amounted to less than USD 500 000, compared with the USD 81.7 million of state universities' discretionary R&D expenditures and even with the USD 3.9 million allocated to co-operative research by CONARE's "Fondo del Sistema". Given the fact that the National Center for High Technology (CeNAT) and the National Center of Food Science and Technology (CITA) are funded respectively by CONARE and the University of Costa Rica (i.e. core funding), the complement given by the MICITT is minimal and finances mainly operating

costs, which means that this flow of resources cannot realistically be considered as a public programme. Research infrastructure is mainly financed by a percentage of FEES and not according to a public programme.

Table 5.3. **STI support programmes in Costa Rica and selected Latin American countries, 2016**

	Chile	Colombia	Costa Rica	Mexico	Uruguay
R&D/S&T capacity building					
Support to R&D projects (competitive)	XX	XX	– Fondo incentivos – FORINVES – Fondo del Sistema de CONARE	XX	XX
Excellence research centres	XX	XX	– National Center for High Technology and its labs – National Center of Food Science and Technology	XX	X
S&T infrastructure	XX	X	Included in FEES	XX	X
S&T scholarships	XX	X	– Fondo incentivos – PINN 2.1	XX	X
Links with diaspora researchers	XX	X	– PINN 2.2 – TICOTAL network	XX	XX
Technology diffusion and transfer					
Public research and technology institutes	XX	XX	– National Institute for Innovation and Technological Transfer in Agriculture[1]	XX	X
Technology transfer offices	XX	XX	-	XX	X
Postgraduate internships in firms	X	-	-	X	X
Certification and accreditation	XX	XX	– ECA[2] – PINN 1.1 – PINN 2.3	XX	XX
Promotion of business innovation					
Innovation funds	XX	XX	– PROPYME – PINN 1.2 – SBD[3] (FINADE)	XX	XX
Fiscal incentives	X	X	-	-	-
Promotion of new technology-based firms					
Seed and venture capital funds	XX	X	SBD	XX	-
Support to incubation and acceleration	-	-	PINN 1.3	X	-
Promotion of S&T collaboration					
Public-private S&T partnerships	XX	X	-	XX	X
Support to cluster formation	XX	-	-	X	-
Strategic or sectoral priorities					
Sectoral funds	X	X	-	X	X
Priority area support programmes	X	X		X	X

Notes: X: means that the type of programme exists in the country. XX means there is a greater emphasis on that type of programme.

1. The National Institute for Innovation and Technological Transfer in Agriculture is the only public research institute that has a technological transfer mission. 2. Costa Rica's accreditation agency. 3. Development Bank System.

Sources: Authors elaboration based on OECD/World Bank Innovation Policy Platform, www.innovationpolicyplatform.org; RICyT policy database; IADB (2014), "Programa de Innovación y Capital Humano para la Competitividad".

- Technology diffusion and transfer. This is a weak point in Costa Rica's STI policy portfolio. There are no incentives for HEIs to develop this type of activity, which is undertaken on a low scale compared with other countries.[50] Also, as already highlighted several times, with the exception of the INTA, Costa Rica has

never really developed a system of public technological institutes (Bitrán and González Urrutia, 2012). The low outreach of PROPYME probably reflects a compounded weakness of both the supply of and the demand for technological services. The system of accreditation of innovation managers, which has never been developed to the necessary scale, may, however, gain some momentum in the framework of the PINN programme.[51]

- Promotion of business innovation. This policy also remains a weak point in Costa Rica's portfolio. In fact, as highlighted in Chapter 4, the industrial and agricultural sectors, in which Costa Rica's firms have experienced a rather good innovation performance (e.g. computing services, electronic design, aerospace and export agricultural products), have done so without much government support. Here again, evidence shows that the acquisition of managerial and technological capacities as well as the generalisation of certification and metrological services are a precondition to the development of innovation projects. Here again also, the impact of the PROPYME programme, for which the number of applications has decreased since 2012, seems to be rather dubious[52] for reasons of limited scale, poor design and critical mass, apart from those related to the management of the programme.
- Promotion of new technology-based firms. The SBD initiatives aiming at identifying promising start-ups, financing their participation in incubation programmes with possibilities to receive seed capital are a path in the right direction, albeit very small. Not only has the next stage, which would have been the creation of and participation in venture capital funds (leveraging private financing), not been undertaken, but the first seed capital stage has been interrupted.[53] Here again, a policy initiative in the right direction has been thwarted by the low scale of the operation and the institutional context in which it was launched, as well as by the failure to accompany promising start-ups past the incubation and seed capital stage.
- Promotion of S&T collaboration. Apart from a flawed attempt to condition support to a PROPYME project to a complicated scheme of collaboration with a research and/or a technology institution (abandoned in 2012), there are not any STI support programmes that are explicitly designed to promote co-operation or collaboration between private firms and public or private research institutions, or even that give premium support for projects to be carried out in co-operation. The lack of policy attention to the benefits of collaboration is also clear as concerns the absence of any cluster policy, contrary to its increasing importance in many OECD countries or regions.[54]
- Strategic or sectoral priorities. National science, technology and innovation plans have defined sectoral, or so-called "transversal", priorities and these priorities are effectively taken into account in the framework of the Incentives Fund and the FORINVES programme's competitive calls for research projects. However, possibly due to limited resources, the MICITT has never designed or funded any significant research programme open to public and private institutions in priority areas identified in the PNCTIs. Given the limited role of sectoral ministries in research, there are not any sectoral funds financed by these ministries and/or co-financed by the MICITT.[55]

The Ministry of Science, Technology and Telecommunication's policy portfolio

The Incentives Fund

The wider scope of the ministry's attributions combined with an increase of resources allowing the design and implementation of a broader policy portfolio (Table 5.4) reflect the more comprehensive and balanced approach fostered by Law 7169 (Box 5.1).[56] Indeed, from a previous focus mainly centred on the development of skilled human resources and research infrastructure, the policy mix shifted to include the promotion of, and financial support to, research and innovation activities, both in the public and the private sectors. This shift was already incipient in the BID/CONICIT/CONARE loan, of which approximately 25% of the resources were to be devoted to such activities.[57]

Table 5.4. **Scope of STI support programmes to be financed by the Incentives Fund**

Focus	Managing institution	Complementary funding
Human capital, research centres, research and technological transfer projects		
Wage premiums to researchers	CONICIT (with CONARE support)	Public universities
Postgraduate scholarships in S&T[1]	CONICIT (with CONARE support)	
Support to the creation and operation of scientific colleges	National Scientific College Council	Ministry of Education
Funding of the creation, development and operation of research centres and programmes in priority areas	CONICIT (with CONARE support)	International co-operation
Matching funds for research and technology transfer projects carried out by public universities and non-profit organisations	CONICIT	-
Co-financing of scientific colleges	Ministry of Education/CONARE	Ministry of Education
Promotion of innovation and technological development		
Subsidised loans for business innovation projects and technological upgrading	CONICIT	Financial system
Matching funds for innovation projects and technological management support	CONICIT	-
Support to venture capital funding of new technology-based firms	n.d.	Financial system
Grants for the development of technological parks	n.d.	Business initiatives
Support to public-private research partnerships in new technology areas	n.d.	n.d.
Popularisation and diffusion of science and technology		
Prizes and fairs	CONICIT	

Notes: n.d.: not determined.

CONICIT: National Council for Scientific and Technological Research; CONARE: National Council of Rectors. 1. Apart from postgraduate scholarships offered by public universities and CONARE.

Source: La Gaceta Diario Oficial (1990), Ley de Promoción del Desarrollo Científico y Técnico.

The fact that the new law created a policy funding instrument with the creation of the Incentives Fund was certainly a welcome improvement over the previous decree but the outcome fell short of expectations for a number of reasons related to the volume and the management of the incentive system:

- The volume of resources actually allocated to this fund was very limited, amounting to the equivalent of approximately USD 1 million for the first year with USD 0.5 million annual increments until the level of appropriations reached

USD 2.5 million.[58] Given the extremely wide scope of activities that the fund could finance (Table 5.5), such a low endowment could lead to a fragmentation of support with low leverage effects, high operating costs and inefficiencies due to below critical mass effects.

- The definition of activities that could be eligible for support and the criteria for application were not widely circulated and, to this day, it remains difficult to access and review them. This leads to a lack of transparency in the support system, to asymmetries of information and possible risks about discretionary processes in the attribution of incentives contributing to disincentives to apply, all the more so as the very application process was too often hampered by red tape.[59]
- The source of financing for the supported activities does not come directly from annual budgetary appropriations as is the case in most countries. It comes from a trust fund managed by CONICIT and replenished by annual transfers from the MICITT, as previously discussed.
- The vetting and selection process for the attribution of support to potential beneficiaries of competitive funding instruments was at the same time administratively cumbersome and ill adapted to the wide variety of activities that could benefit. The Incentive Commission could not possibly have all the necessary competencies to pass an informed judgment on the application of support for such a wide variety of programmes.
- The law did not mandate any regular evaluation of the outcome and efficiency of the implemented policies to be financed by the Incentives Fund, and the accountability requested from the operative agencies, mainly CONICIT, was mostly in terms of administrative ratios.

In conclusion, and compounding the issues related to the management of the Incentives Fund, it should be noted that despite the positive shift towards a more comprehensive and balanced approach to STI policy fostered by the law, the effectiveness of this shift was hindered by institutional inertia and lock-in effects of past policy orientations that proved difficult to overcome.

PROPYME – technological upgrading and innovation in SMEs

The rapid development of FDI in high-tech sectors in the 1990s presented risks as well as opportunities for Costa Rica's development strategy (OECD, 2012b). On the one hand, the risk of increased duality between a performing and innovating FDI sector with little positive spillover effects on the local industry that too often lacked managerial and technological capacities to develop procurement, subcontracting or supplier relationships with FDI. This risk was exacerbated by the crowding out effect on skilled human capital primarily absorbed by MNEs at the expense of local firms. On the other hand, the opportunity to lay the conditions for continuing upgrading of exporting industries and technological content of MNEs was appealing. This would entail increasing investment in human capital and S&T infrastructure in ways that further attract advanced (knowledge-intensive) FDI while contributing to increasing SMEs' competitiveness and their links with MNEs. Complementary measures were therefore in order.

The deficiencies of the Impulso programme led to it being replaced by the PROPYME programme, established by law in 2002.[60] PROPYME was created with the aim to clarify the nature of projects and expenditures that the programme could support as well as its implementation process (Monge-González et al., 2013). In its initial version,

the programme financed projects devoted to R&D and innovation-related investment, development or acquisition of technology, patent registration and human capital development, or a combination of projects involving some of these expenditures. Support was provided as non-reimbursable grants for up to 80% of the total project costs. An important eligibility criterion was also introduced as qualifying projects were to involve collaboration with a public or private research or technology centre.[61]

PROPYME has been subject to several assessments (Conejo Vargas, 2013; Monge-González et al., 2013; Maggi, Rivas and Sierra, 2012), which all point to a rather mixed record from the beginning of the programme in 2003 through 2011. During that period, the MICITT received, on average, less than 20 applications a year, 16 of which were, on average, approved. The average disbursement was extremely low, just above USD 15 000, which is explained by the fact that among the 143 projects approved, 35% did not involve any kind of innovation, but merely either the provision of technological services or human capital training (Table 5.5). The main reasons advanced for this poor performance are "the unawareness of firms about the programme", the "bureaucratic and cumbersome application procedure", an inexplicably long review and selection process, and possibly difficulty to satisfy the conditions of eligibility.

Table 5.5. **Distribution of approved PROPYME projects according to type of innovation, 2003-11**

Type of innovation	Number of projects	Total amount (USD)	Average amount (USD)
Incremental high	4	290 612.7	72 653.2
Incremental moderate	29	674 476.6	23 257.7
Incremental low	60	1 076 889.1	17 947.9
None	50	157 384.3	3 148.4
Total	143	2 041 978.3	15 379.0

Source: Conejo Vargas, L. (2013), "Políticas de apoyo a la Pyme: A diez años de la ley 8262", http://estadonacion.or.cr/files/biblioteca_virtual/019/conejo_2013.pdf.

Among the main weaknesses of the programme design, the following can be highlighted:

- Conditions of eligibility. One of these conditions was that in order to be approved a project should be implemented in the framework of collaboration between the applicant firm and a research centre. However, the partnership was not to be constituted from the start. The firm first has to come up with its own project which, once approved, had to be matched with a certified research centre.[62] This feature proved to be a constraint that firms were not always ready to accept, especially if they had to engage in a partnership that could become unsustainable during the long review process.
- Fragmentation. If a firm's innovation project included several components which were eligible for PROPYME support,[63] it had to apply for a separate grant for each separate individual component.
- Overestimation of innovative potential. Without technical assistance most entrepreneurs were not in a position to present an innovation project. The large majority of firms that did apply were confusing innovation with technological upgrading of their production processes, which led to relaxing the selection criteria. As stressed by Maggi, Rivas and Sierra (2012), "Around 60% of projects supported by PROPYME correspond to activities related to modernisation of

production, training and access to information. As a result the bulk of the fund is not directed towards supporting innovation as such but rather towards activities that could be qualified as 'extensionism' or technical assistance".

- Calls for proposals. The MICITT did not organise schedules of calls with specific deadlines to apply for support, which led to uncertainties about delays, alignment with priorities and partnership opportunities.
- Programme financing and overhead costs. The financial support provided by CONICIT comes from a dedicated trust fund that, by law, is automatically replenished every year practically without regard to any performance consideration. Uncommitted resources remain in the trust fund, increasing its assets. This mode of financing is far from encouraging management efficiency and it has been estimated that during the period 2003-11 CONICIT spent close to half of PROPYME's allocation on overhead and administrative costs (Guimón, 2013).
- Institutional confusion. Last but not least, the independent report to the State of the Nation on the assessment of the "Policies in support of SMEs ten years after Law 8262" (Conejo Vargas, 2013) also mentions another reason that has already been highlighted: the difficult collaboration between the MICITT and CONICIT in policy implementation due to overlapping responsibilities and even different definitions of the programme scope on their respective portals.[64]

This last difficulty may explain why it took so long (nine years) to acknowledge the very limited achievements of the PROPYME programme[65] and to come up with initiatives aiming at improving its performance in terms of design, outreach and outcomes. Major changes were introduced in 2012, namely better alignment of application and selection procedures along best practices, notably as regards the scheduling of competitive calls, the cutting of red tape and the duration of the review process; the possibility to fund certified "innovation managers" to enhance firms' capacity to design innovative projects[66] during the application phase to PROPYME and/or to support project implementation after approval; and closer co-operation with other institutions such as the MEIC, PROCOMER, CINDE, Chambers of Industry, and the SBD[67] to foster demand for the programme and increase synergies, in particular between PROPYME and CR Provee, with complementary objectives and sources of financing.[68]

More progress could still be made in this area: first, as regards the level of competency of selection panels, with members with more experience in business innovation; second, in streamlining the approval process that continues to involve CONICIT, the MICITT and the Incentives Commission. PROPYME's record has significantly improved since 2012, at least in terms of the number of applications, processing delays and grants allocation. In that year alone, 89 projects were financed, or more than 60% of projects supported during the previous nine years. However, these effects were not long-lasting as the number of projects submitted and approved has regularly diminished ever since (Table 5.6).

Table 5.6. **Approved PROPYME projects, 2012-15**

Year	Number of approved projects	Disbursements (thousand USD)	Average disbursement per project (USD)
2012	89	1 771.4	19 904
2013	48	1 196.7	24 931
2014	23	648.2	28 181
2015	12	276.0	23 003

Source: CONICIT.

Moreover, these improvements did not go as far as addressing two governance issues. First, that of the MICITT's and CONICIT's overlapping responsibilities. In fact, and paradoxically, some improvements in selection procedures and criteria were apparently achieved through the increased involvement of the MICITT in what had been a CONICITT prerogative. Second, the cumbersome vetting process involving these two institutions, CONICITT technical panels and the Incentives Commission, has remained unchanged. Apparently, as of the end of 2015, CONICITT had not yet managed to develop an effective monitoring and evaluation toolkit for the PROPYME programme and its operative costs remained rather high, especially in view of the number of projects it has to deal with.

The IADB loan for Innovation and Human Capital for Competitiveness

In 2013, the IADB approved a USD 35 million loan to implement a Programme of Innovation and Human Capital for Competitiveness (PINN) over the period 2014-18. This programme has two components (Table 5.7):

1. Investment for business innovation. Projects or activities that can be financed include: 1) technical assistance for the development of business capacity building; 2) innovation and technological transfer projects; and 3) support to new technology-based firms.
2. Advanced human capital for competitiveness. Programmes that can be financed include: 1) postgraduate scholarships in Costa Rica or abroad, in priority areas as defined in the PNCTI; 2) talent attraction to foster the development of innovation projects in enterprises; and 3) specialised reskilling professional training for innovation projects. Boxes 5.7 and 5.8 provide examples of policy programmes to link technical education to the business sector in Latin America and Germany.

Table 5.7. **IADB loan Programme on Innovation and Human Capital for Competitiveness**

COMPONENTS	Allocated funds (thousand USD)	%	Expected number of projects	Maximum grant per project (thousand USD)	Committed grants March 2016	
					Thousand USD	%
I. Investment for business innovation	**10 400**	**29.7%**			**2 687.10**	**25.8%**
I.1. Development of business capacities for competitiveness	4 000	11.4%	100	50	2 687.10	67.2%
I.2. Innovation and technological transfer projects	5 400	15.4%	85	125	0	0%
I.3. New technology-based enterprises	1 000	2.9%	120	30	0	0%
II. Advanced human capital for competitiveness	**23 500**	**67.1%**			**11 466.45**	**48.8%**
II.1. Advanced human capital training programme	19 600	56.0%	x	x	11 466.45	58.5%
II.2. Talent attraction programme	1 200	3.4%	x	40	0	0.0%
II.3. Professional qualification programme	2 700	7.7%	x	x	0	0%
III. Administration of loan	**1 100**	**3.1%**	**..**	**..**	**x**	**x**
Total	35 000	100%	..	..	14 153.55	40.4%

Notes: ..: not available; x: not applicable.

Source: Based on information provided by the Inter-American Development Bank and the Ministry of Science, Technology and Telecommunications.

Box 5.7. **The German dual training system**

Germany has developed a successful and comprehensive policy approach that supports manufacturing clusters and especially small and medium-sized enterprises. Germany's policy framework has encouraged applied research and public-private co-operation, which has enabled and fostered innovation.

A key strength of the approach has been the country's dual training system that has managed to develop a highly trained workforce. In Germany, there is an important degree of association between government, the private sector and employees. This collaboration has benefited the country's dual training system.

Firms that participate in the dual training system sign private law contracts with young people, and offer an hourly wage similar to the one perceived by an entry-level employee. Training is mainly on the job. However, industrial chambers and state governments also have an active supervisory role. Once German students complete their apprenticeship or their vocational training, they are accredited by the Federal Institute for Vocational Education and Training, based on their performance on the exam.

The German system provides workers with specialised skills, adaptation and learning abilities, and fosters human capital development. It encourages innovation within the manufacturing sector, as it successfully allows firms to employ trained workers, which may improve production processes. Firms have strong incentives to participate in this system, since apprentices become highly trained future workers, providing firms with future competitive advantages. Labour costs are high in Germany; therefore the system provides an opportunity for firms to evaluate young workers before hiring them. In sum, this successful public-private collaboration has provided Germany with a highly trained and skilled labour force contributing to the leading role of the country's manufacturing industry.

Source: Brookings Institution (2015), "Skills and innovation strategies to strengthen US manufacturing: Lessons from Germany", https://www.brookings.edu/wp-content/uploads/2016/06/LessonsFromGermany.pdf.

The programme pays great attention to the enterprise sector either by providing grants to firms' innovation projects (to finance equipment, professional services or subsidise wages in the case of foreign talent) or to start-up managers or, in the case of postgraduate scholarships, to support the acquisition of knowledge necessary to develop innovative activities in enterprises or facilitate the attraction of high-tech enterprises.

The nature of programmes and the distribution of resources implicitly reflect the importance given to the attraction of high-tech FDI in policy priorities regarding innovation and competitiveness issues. The greatest effort is put on human capital development – which is a condition for attracting and embedding FDI locally. The emphasis put on enhancing business upgrading (including quality systems and standards, certification) highlights the willingness to address prerequisite conditions for enhanced linkages between local SMEs and MNEs.

The MICITT is the loan executing body, and the Incentives Commission is responsible for the final approval of projects after their evaluation. PROCOMER is in charge of the technical evaluation of sub-component I.1 (see Table 5.7) and CONICIT in charge of the technical evaluation of all of the other sub-components except I.3. which remains under the responsibility of the MICITT. In a preliminary draft of the loan, the IADB highlighted that the lack of co-ordination between the MICITT and CONICIT as well as issues of transparency of the evaluation processes raised risks to the effective

implementation of the loan programme. This acknowledgement led to a quite unusual prerequisite for an IADB loan: that its first disbursement was conditional to the conclusion of an inter-institutional agreement between the MICITT and CONICIT with a clear definition of their respective responsibilities in project implementation processes.[69]

Box 5.8. **Skills-enhancing programmes in Latin America**

Examples of skills-enhancing youth programmes exist in several countries in Latin America, such as Argentina, Brazil, Colombia and Peru. These programmes have generally had positive results on youth employability, on their earnings and on job quality (ILO, 2016), having a significant social impact on the population.

Several of the training interventions combine classroom teaching, workplace learning and job search services. For instance, the Jóvenes con más y Mejor Trabajo programme from the Ministry of Labour, Employment and Social Security of Argentina provides training for young people to learn about working skills, labour rights and job searching techniques, including the use of ICTs for this purpose. Furthermore, the programme offers the possibility to engage in internships during different education cycles. The programme is open to unemployed people aged 18-24, with permanent residence in the country, who have not completed either primary or secondary cycles.

In 2005, the Programa Nacional de Inclusão de Jovens (Projovem) was launched in Brazil. This programme was modified in 2008 and aims to increase schooling, professional qualifications and socio-economical inclusion. Projovem is part of a comprehensive youth national policy and has four different focuses and modalities: Projovem urbano (focusing on jobs in urban areas), Projovem adolescente (focusing on adolescents), Projovem trabalhador (focusing on providing a first job opportunity to young people) and Projovem campo saberes da terra (focusing on people working in agriculture).

The Jóvenes en Acción programme in Colombia was developed by the Department for Social Prosperity and the National Learning Service, and aims to provide training to young people from the less favoured regions of Colombia. The objective is to provide social and economic inclusion. In order to access Jóvenes en Acción, young people must be 16-24 years old, have completed high school and be registered in the Familias en Acción plan or be an internally displaced person.

The Ministry of Labour and Employment Promotion of Peru has developed the ProJóven programme, which was active until 2013. It aimed to contribute to the quality of employment of young people 16-24 years old, through their insertion in the formal labour market. It also provided technical training and work experience articulated with information and labour intermediation services in order to fulfil the requirements of the business sector and the labour market.

Active comprehensive labour market policies and skills-enhancing youth programmes are important domains where regional countries should focus. These policies may contribute to positive socio-economical outcomes and become important mechanisms for vulnerable populations (UNDP, 2016).

Sources: ILO (2016), *Soluciones eficaces: Políticas activas del mercado de trabajo en América Latina y el Caribe*, www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms_492374.pdf; UNDP (2016), *Regional Human Development Report for Latin America and the Caribbean: Multidimensional Progress: Well-being Beyond Income*, www.latinamerica.undp.org/content/rblac/es/home/library/human_development/informe-regional-sobre-desarrollo-humano-para-america-latina-y-e.html; www.trabajo.gob.ar/jovenes; www.brasil.gov.br/educacao/2012/04/programa-capacita-jovens-para-o-mercado-de-trabalho; http://comoinscribirse.com/jovenes-en-accion-2015; www.oitcinterfor.org/experiencia/projoven-ministerio-trabajo-promoci%C3%B3n-del-empleo-per%C3%BA.

Balance of instruments in the current policy mix

The descriptive vision offered by the policy portfolio needs to be complemented by the pattern of resource allocation among support programmes to reflect the explicit or implicit policy mix as arbitraged by the budgetary process. The policy mix that prevailed during the 2009-15 period can be inferred from the distribution of resources among programmes funded by the Incentives Fund and PROPYME and by the PINN loan since the beginning of its disbursements.

Resource allocation balance

For the programmes funded by MICITT transfers over the last six years, the actual allocations[70] to programmes devoted to the development of high-skilled human capital received the lion's share of resources (67.7%), while technological upgrading and innovation projects (PROPYME) on the one hand, and R&D projects on the other, received respectively 22.9% and 9.8%.

The expected allocation of resources of the PINN programme for 2014-18 (Table 5.7) shows that the development of high-skilled human capital retains practically the same relative position, at 67.1%, whereas innovation projects are allocated 15.4%, proportionally less than in the preceding period by PROPYME. Capacity building activities are allocated 11.4%. PINN does not allocate any resources to R&D projects. The same priorities are emphasised even more during the first year of PINN operation: until March 2016 the only funded programmes were those devoted to advanced human capital training (which already absorbed close to 60% of its available resources) and the capacity-building programme.

Supply- vs. demand-side policy instruments

According to OECD criteria, Costa Rica's STI policies are mostly supply-side oriented,[71] as their main focus is to foster knowledge creation and acquisition, human capital development, and capacity building through grants and other financing instruments. However, given institutional specificities and the low level of resource transfers in support of STI, this appreciation has to be nuanced.

In recent years most OECD country governments have paid increasing attention to demand-side innovation policies, such as innovation-based public procurement in areas such as health, energy or the environment; tax incentives aiming at lowering the costs of innovative products or services for consumers; or regulatory measures that drive the replacement of obsolete devices by new safer innovative ones. Apart from singular exceptions concerning procurement in the energy sector, such policies are practically non-existent in Costa Rica.

Tax incentives for innovative SMEs

Unlike most OECD countries, Costa Rica only provides support to enterprises' investment in R&D through innovation funds and loan guarantees. There is no indirect R&D support scheme through fiscal incentives, irrespective of the nature of the industry or the R&D project.[72] In Costa Rica, the Treasury's reluctance towards such incentives is based on the importance given to the neutrality of the tax system and the desire to avoid emulation by various pressure groups. Typically, R&D tax incentives mostly benefit enterprises with experience in developing research activities and are mainly used by these firms to complement their own resources for incremental innovation projects.

It is therefore not a very appropriate support instrument to induce enterprises that innovate little or not at all to engage in an innovation path requiring R&D investment. Tax incentives could then benefit only innovative firms that are reluctant to apply for innovation funds for reasons related to the cumbersome and bureaucratic management of applications and selection. In consequence, there could be a rationale for implementing a tax credit scheme strictly devoted to R&D and patent registration expenditures and restricted to SMEs. In the event that the Treasury becomes more open to the possibility of R&D tax incentives, consideration could be given to extend such incentives to MNEs, but under the condition that their R&D expenditures are incurred in collaborative projects with Costa Rican research institutions.[73]

Conclusion on the current policy mix

The main conclusions that can be drawn from the policy mix balance are the following:

- Costa Rica's main explicit policy priority is towards the development of human capital, which effectively addresses a weakness of the STI system suffered both by both MNEs and SMEs.
- The eventual success of innovation promotion policies is seen as largely predicated upon concomitant or prior support to SMEs' capacity building; in the short term and in the context of limited resources, programmes in support of actual innovation projects – incorporating new embodied or disembodied knowledge – are given a lesser priority.
- Given the autonomy of state universities and the quasi absence of public research and/or technological institutes, the minimal resources allocated to research activities reflect an implicit acknowledgement that, in practice, the government has no significant means to steer the academic research sector towards mission-oriented programmes and improved performance in terms of knowledge creation and diffusion.

The concentration of resources on human capital development and SME capacity building is well done as it reflects the priority to address the most pressing obstacles to innovation-led development. However, it also reflects major imbalances of a policy mix that fails to address two important issues that impinge upon the performance of innovation systems, and in particular the future of Costa Rica's innovation system: 1) the articulation between the creation, diffusion and commercialisation of knowledge; and 2) the leverage of public investment in S&T on private innovation expenditures. Without rebalancing the current policy mix to address these issues during, or closely after, the current cycle dominated by the PINN programme, there is the danger that the co-evolution of a performing research sector and the progressive increase of the private innovation expenditures that signals the kick start of a virtuous dynamics of the STI system might be delayed or missed (Teubal, 2008).

In this sense, the current policy mix is not a true and comprehensive STI policy mix but a bet on the future. Foregoing the linkages with the country's research capacities, it aims at creating the conditions in which more focused innovation promotion policies will effectively meet their demand from SMEs better endowed with skilled human resources and managerial capacities to fruitfully invest innovative activities and develop linkages with MNEs that would allow them to benefit from technological spillovers.

Broadening the scope of the policy

The policy portfolio appears to be more diversified than usually assumed but this diversity may be only apparent and reflect more a fragmented set of poorly endowed instruments than a coherent articulation of complementary policies. This diversity cannot hide a number of blind spots or bundled programmes that may need more customisation. Highlighting the diversity of OECD countries' experience may shed light on Costa Rica's S&T policy blind spots.

Mission-oriented programmes

Mission-oriented programmes seek to muster research capabilities to respond to social needs, in particular in the areas of health, energy and the environment. They are generally open to collaboration between public research centres and the private sector. Such programmes require co-ordination by ministries and/or public institutions for their design and funding. In many countries they have benefited from multiannual funding schedules and been implemented through public-private partnerships (Box 5.9) and/or through dedicated research funding allocated through competitive calls. In Costa Rica, the autonomy of HEIs and its funding consequences may hinder the development of such programmes unless new mechanisms can be considered for funding HEIs' research activities.[74]

Box 5.9. **Strategic public-private partnerships in OECD countries**

Public-private partnerships (PPPs) in research and innovation are conceived as legal relationships or agreements over a fixed-term/indefinite period of time, linking public and private actors – e.g. industry, universities, public research/technology institutions, entrepreneurs, etc. – where both sides interact in the decision-making process and co-invest scarce resources such as money, personnel, facilities and information in order to achieve specific joint objectives in research and innovation. In other words, PPPs provide a legal structure to pool resources and gather critical mass, which enables a scale of effort that individual firms would not be able to achieve – in spite of strong funding for firm innovation. The partners share risk, rewards and responsibility for shared investments.

The main *a priori* conditions for forming a rational partnership are common objectives, mutual benefits, and complementarity of human and financial resources. There are other motivations such as:

- optimising the use of resources by sharing costs and risks in addressing specific necessities of the productive sector and societal challenges
- capitalising on the respective strengths of the partners as well as interdisciplinary co-operation
- economies of scale (e.g. reaching a critical mass in research) and scope (cross-discipline and cross-sectorial benefits)
- internalising knowledge spillovers and overcoming informational and behavioural barriers typically limiting the interactions between public research and the business sector
- securing higher quality contributions from the private sector to government mission-oriented R&D and increasing opportunities for the commercialisation of public research.

Box 5.9. **Strategic public-private partnerships in OECD countries** (*continued*)

In recent years, novel forms of PPPs in science, technology and innovation, which appear to be more "strategic", have emerged in OECD countries. Strategic PPPs address specific challenges in industries or technology sectors and have longer term horizons than traditional instruments for public-private collaboration, e.g. at least four years of funding support.

Strategic PPPs revolve around specific problematics in industries or technology sectors (e.g. Canada's large co-operative programmes in the aerospace sector, the United States' National Additive Manufacturing Innovation Institute, the Netherlands' Top Sector policy), or in emerging scientific and technological fields, such as nanotechnology and climate change-related technologies. They are usually aligned with national innovation and industrial strategies (e.g. re-industrialisation, green growth and competitiveness strategies). Selected examples include China's industry-research strategic alliances, Canada's strategic network grants, the Netherlands' Top Sectors, Germany's innovation alliances, Israel's Magnet Consortium, and France's Strategic Industrial Innovation Programme).

While there is no one-size-fits-all model for PPPs, several factors recurrently appear as fundamental in the design and implementation of successful PPP schemes. In particular, good governance and public leadership are key factors ensuring the success of PPPs. These include setting clear, well-defined objectives and activities/responsibilities for each participant, operational rules and implementing regular monitoring and evaluation, transparency, consultation with stakeholders and the establishment of dispute settlement and exit strategies.

Other important factors are: 1) clear identification of systematic failures to tackle; 2) long-term (open-ended) stable commitment by the government; 3) careful selection of participants and definition of their alignment/complementarity; 4) appropriate planning, task/responsibility definition, and information-sharing mechanisms; 5) inclusion of an education objective and equal emphasis on all four major objectives (research, collaboration, education and outcome application); 6) a clear management structure; 7) a board of stakeholders chaired by an independent industry/research sector actor; 8) partnership scale and resources; and 9) staff stability, among others. The success of PPPs in many cases also depends on complementary regulatory frameworks shaping interactions between public organisations (e.g. academia) and industry.

Most countries have seen a rise in PPPs in the STI area that are strategic, long-term, large-scale, high-risk and multidisciplinary and involve diverse stakeholders (government, business, universities, non-governmental organisations). Examples of recent initiatives launched in the last few years include:

- Ireland's Research Centres Programme, which aims to develop a set of world-leading, large-scale research centres on a themed basis in order to align this major investment to areas which can generate maximum economic and societal benefit for Ireland.
- Germany's Research Campus Programme is a competitive funding scheme under the High-Tech Strategy to strengthen co-operation between science and industry.
- In Spain, Feder-Innterconecta is a programme for the financing of large-scale experimental development integrated projects in less favoured regions aimed at promoting industry and public-private partnerships in the domain of grand challenges.

Source: OECD (2016b), *OECD Science, Technology and Innovation Outlook 2016*, http://dx.doi.org/10.1787/sti_in_outlook-2016-en.

Supply of technological services: Intermediate institutions

As already noted, unlike other countries such as Chile, Mexico or Peru, Costa Rica has not developed public technological institutes dedicated to applied research and technological development, technology transfer, and the supply of technological services.[75] In these countries, most institutes were established between the 1950s and 1970s during a phase of S&T public infrastructure development and it is probably too late for Costa Rica to replicate these initiatives which, unfortunately, the state and private universities are only partially able to emulate. The MICITT's innovation managers programme is too small to address the latent demand and provide the scope of services to the variety of SMEs, and more particularly to those that already show a good potential for technological upgrading. A possible avenue to address the needs of this type of enterprise would be through intermediary institutions, such as publicly supported foundations, which could constitute a network of technological services providers that could include public and private partners at national and international levels (Boxes 5.10 and 5.11).[76]

Box 5.10. **The United Kingdom's catapult centres of innovation**

Since 2011, the United Kingdom has developed a network of important world-class research and technology centres. These centres aid to foster co-operation and collaboration between business, research institutes and universities, and encourage the UK's innovation capabilities in different specific areas, as well as to promote economic growth. These institutes offer businesses with resources, equipment and expertise, while they offer research centres and universities with funding and state-of-the-art facilities.

The catapult centres were created by the United Kingdom's innovation agency, Innovate UK (former Technology Strategy Board). Funds mainly come from three different sources: public funding, collaborative applied R&D projects (public-private funded, and won competitively) and business-funded R&D contracts (won competitively).1 Since 2014, there are 11 centres focused on different potential areas: cell and gene therapy, compound semiconductor applications, digital, energy systems, future cities, high-value manufacturing, medicines discovery, offshore renewable energy, precision medicine, satellite applications and transport systems.2

Regarding their governance, every centre will be established as a company ltd by guarantee, which is a separate legally entity from Innovate UK. Every centre will have a board of directors and an executive management team in charge of its daily management.

Notes: 1. https://catapult.org.uk/about-us/funding. 2. https://catapult.org.uk/about-us/about-catapult.

Sources: Hepburn, N. and D.A. Wolfe (2014), "Technology and innovation centres: Lessons from Germany, the UK and the USA", http://munkschool.utoronto.ca/ipl/files/2015/01/Technology-and-Innovation-Centres-Haltech-Report-2014_1.1.pdf; https://catapult.org.uk.

Demand for technological services: The voucher system

Due to information asymmetries, SMEs with low innovative experience tend to have a limited number of exchanges with providers of technological services. Innovation vouchers given to enterprises such as those used in the Netherlands and a number of other European countries (Box 5.12) constitute an incentive that can effectively activate demand and drive SMEs to access service providers. Voucher schemes tend to have low administrative costs and are not subject to government failures.

Box 5.11. **Technology extension programmes: The importance of technology transfer**

Technology extension programmes provide a wide array of technology transfer services to small and medium-sized enterprises (SMEs) to facilitate absorption and adaptation of technology (equipment, new managerial skills), improve their productive processes and products, increase quality standards, jumpstart new product development processes, or innovate via the transfer of new knowledge from scientific institutions to firms and industries. These services can be provided by public institutions, private or public-private entities. In many countries, firms are directed to public financing (co-financing or credit lines) to finance these services.

International experience points to several key features of success, such as: 1) multi-sources of funding matching public funding (federal and regional), own financing (revenue) and private sector participation; 2) performance-based incentives (e.g. achieving financial sustainability); 3) a network of extension consultants; 4) multi-sector governance mechanisms (in board; overseeing; planning activities) involving universities/public research institutions, the private sector, government agencies and other relevant stakeholders; and 5) monitoring schemes and medium- to long-run technology agendas, allowing for a continuous improvement of productive capabilities of firms.

Examples of manufacturing extension programmes from developed countries include:

- Mexico: The Technological and Business Assistance System (SATE) was created in 2001 as a FUMEC programme (the US-Mexico Foundation for Science) funded by the Ministry of Economy's Fondo PYME. Its mission is to provide managerial and technological assistance for the technological upgrading of SMEs through a network of certified advisors. Initially focused on the automotive and machinery industry, it extended its activities in 2004 to cover all technology-based SMEs, to include services related to certification and intellectual property, and to facilitate the integration of these SMEs in regional or national value-added production networks. SATE also has an important role in facilitating technology-based SMEs' access to sources of knowledge in research institutions and to federal and state sources of support for innovative investment. SATE built its competencies through the adoption of best practices for the provision of technology assistance and transfer services developed in North American institutions.
- United States: The Manufacturing Extension Partnership focuses on direct interventions at the firm level to increase the productivity, competitiveness and innovation potential of SME manufacturers. With 1 300 technical experts operating out of over 60 regional centres, the Manufacturing Extension Partnership provides resources and in-depth audits to SME manufacturers across the United States.
- Japan: Manufacturing extension programmes in Japan are provided by some 262 kohsetsushi centers (public industrial technology research institutes), which offer a range of services to Japanese SME manufacturers, including technology guidance; technical assistance and training; networking; testing, analysis and instrumentation; and access to open laboratories and test beds.

Sources: Innovation Policy Platform; Andes, S., S. Ezell and J. Leal (2013), *Beyond Mercantilism: Manufacturing Extension Programs in Latin America*.

Connecting multinational enterprises to domestic SMEs: Linkages and cluster programmes

Domestic technology intensive firms have emerged in Costa Rica over the last two decades in a limited number of manufacturing and service areas such as ICT, medical devices, aerospace and the food industry. This development has been facilitated by market opportunities offered by MNEs, knowledge spillovers, the availability of high-skilled personnel and an S&T infrastructure with an effective knowledge development and technological diffusion capacity in these areas. Further enhancement of

Box 5.12. **The Netherlands' innovation vouchers scheme**

Introduced in 2006 the Innovation Vouchers Scheme is an initiative of the Dutch Ministry of Economic Affairs. The scheme arose in response to the widely held view that knowledge sharing between small and medium-sized enterprises (SMEs) and research institutions in the Netherlands was inadequate. Accordingly, the scheme aims to stimulate interaction between the knowledge suppliers and SMEs. Although the scheme has a relatively small budget (around EUR 26 million in 2009), the leverage effects appear to be significant. There are two types of innovation voucher available, a small voucher and a large voucher.

1. The small voucher is worth EUR 2 500. Each SME may be granted a "small" voucher only once. The objective is to encourage the enterprise to approach a knowledge institution (the voucher being redeemed against services of equivalent value from the research body). A total of 3 000 small vouchers are available.
2. The large voucher is worth EUR 7 500. To qualify for these vouchers an enterprise must contribute one-third of the total project costs. The government will provide an amount not exceeding EUR 5 000. A large voucher allows the enterprise to submit a more extensive request to a knowledge institution. Enterprises may obtain one large voucher each year. A total of 3 000 large vouchers are available.

Source: OECD (2011a), *Business Innovation Policies: Selected Country Comparisons*, http://dx.doi.org/10.1787/9789264115668-en.

the innovative capacities of firms in these sectors could benefit from those programmes aiming to connect MNEs to the domestic business sector (Boxes 5.13 and 5.14). These include clusters policy (Box 5.15) aiming at facilitating co-operation among firms belonging to the clusters, fostering knowledge exchanges, sharing common information services, encouraging co-operation and human capital mobility. Such policies, usually developed in co-operation with industrial associations, are widespread in OECD countries both at national and regional levels (OECD, 2009b; 2001) and could be emulated at a low cost in Costa Rica, possibly with the collaboration of CINDE, which could play an active role in harnessing MNEs' know-how and experience in the development of clusters that would include local SMEs in knowledge-intensive areas.

Box 5.13. **The Czech Republic's Supplier Linkage Programme and the European Quality and Organisational Framework**

The potential benefits spurred by international investment on a host economy can range from employment and income growth to diffusion of know-how, and innovation. OECD and non-member country experiences reveal that apart from broad, macro-level policies, countries can undertake other business-friendly measures to maximise the benefits of international investment. Some of these measures include fostering commercial linkages between multinational enterprises (MNEs) and local firms. Linkages between foreign firms and the local private sector serve as a critical conduit for the transmission of skills, knowledge and technology. Typically, investment promotion agencies have tended to take the lead in brokering contacts between multinational and local businesses in the hopes of establishing sustainable commercial partnerships.

Box 5.13. **The Czech Republic's Supplier Linkage Programme and the European Quality and Organisational Framework** (*continued*)

For instance, from 2001 to 2005, the Czech Republic's Supplier Linkage Programme supported nearly 150 companies. The programme resulted in a 10% increase in local firm productivity, a 15% expansion in turnover and a 40% growth of Czech exports. Part of the success of the Czech programme was selecting the right domestic firms.

The selection of local firms was based on a set of pre-defined criteria that included the local firm demonstrating the relevance of its industrial sector to the needs of MNEs; being registered in the Czech Republic; financial stability and performance; commitment of the company's management to improving; and ISO certification. In addition, Czech Invest applied the European Foundation for Quality and Management (EFQM) model to assist in identifying potential deficiencies in its local suppliers as part of its respective supplier linkage programmes.

The EFQM model provides a good mechanism to conduct strategic audit. It is the most widely used organisational framework in Europe and has become the basis for other quality awards. The EFQM model provides a methodology that can be used for: 1) self-assessment; 2) benchmarking with other organisations; 3) guidance for improvement; 4) common vocabulary and way of thinking; and 5) structuring the organisation's management system. The EFQM model is a non-prescriptive framework based on nine criteria: five of these are enablers which centre on people, policy and strategy, partnerships and resources, leadership and processes; and four are results focusing on people, customers and society. The enabler criteria cover what an organisation does, while the result criteria cover what an organisation achieves.

Source: OECD (2002), *Foreign Direct Investment for Development: Maximising Benefits, Minimising Costs*, http://dx.doi.org/10.1787/9789264199286-en.

New technology-based firms post-incubation stages

In Costa Rica there is a dynamic of young graduates with scientific and/or engineering competencies who seek to develop new technology-based firms mainly in the ICT, energy, health and food industries. The success of initiatives such as "Yo Emprendedor" (Box 5.16) that seek to develop entrepreneurship and an appropriate ecosystem to facilitate the creation of new businesses in Costa Rica (Monge-González, 2016) has led the SBD to support the incubation and seed capital stages of promising projects. However, this support has fallen short of supporting the following critical stages that are sanctioned by the market test. Following the example of other Latin American countries suffering from risk-adverse financial institutions, more comprehensive institutional support programmes and novel funding mechanisms involving the private sector should be developed to ease start-ups' access to financing past the seed capital stage. Following best practices, the private sector should retain the main responsibility in the project assessment phase and the management of venture capital funds co-financed by the public sector.[77]

Box 5.14. International examples of programmes to foster linkages between multinational enterprises and local firms

National supplier development programmes

Supplier development programmes are designed to overcome the main barriers to developing buyer-vendor linkages between multinational enterprises and domestic firms (World Bank, 2014). Successful examples include the Czech Supplier Linkage Programme from the early 2000s, the Singaporean Local Industry Upgrading Program from the 1980s, the Supplier Development Programme implemented by CORFO in Chile, or the Tractor Programme in Mexico. Supplier development programmes typically combine the following:

- The development of relationships with local senior managers of multinational enterprises (MNEs) to encourage co-ordination of purchasing plans and pool information about future demand.
- The establishment of a database of qualified domestic suppliers with information on products, customers and benchmarking of suppliers' performance, organised by industry/sector or commodity/product. Such a database reduces the search costs for MNEs in sourcing potential domestic suppliers.
- A process for assessing the need of upgrading small and medium-sized enterprises (SMEs) capabilities in various aspects of company performance – management, production, sales and commercialisation, innovation, human resources and overall productivity. The development of a network of mentors/consultants to assist in upgrading, e.g. through regular visits to the company to help the company monitor its implementation.
- Co-financing or direct assistance for SME upgrading, including management training and other improvements in efficiency. Eligible costs typically include the salary of the supply chain champion and the fees of the external advisors or mentors.

Programmes that rely on groups of companies working collectively together, the case of STAC in Scotland

The Scottish Technology and Collaboration Initiative (STAC) is an example of an initiative that is not primarily transactional, i.e. that is not primarily a supplier-customer relationship. STAC is an initiative based on fostering relationships between SMEs and MNEs in which there is strong mutual learning for both parties involved. In STAC's approach, firms collaborate to exploit a business opportunity by focusing on different aspects of the value chain. It involves the establishment of a "stac", that is a group of companies that work jointly towards an innovative outcome, usually a new product offering. A stac typically involves a "pillar" MNE subsidiary and two SMEs. An early learning outcome for STAC was the utility of identifying and involving a potential customer in the collaborative effort (Prashantham and McNaughton, 2006).

Dedicated small enterprise support centres, technology centres in Ireland

Ireland's technology centres are collaborative R&D entities established and led by industry. They are resourced by researchers associated with public research institutions which undertake market-focused R&D for the benefit of industry. The Technology Centres Programme is a joint initiative between Enterprise Ireland and IDA Ireland allowing Irish companies and multinationals to work together in these centres. There are currently 15 industry-led research centres in the Technology Centres Programme, each of which focuses on a different sector or technology area. Each technology centre can be multi-site and geographically dispersed, to bring together relevant MNEs, SMEs and public research organisations.

Sources: OECD (2016c), *OECD Reviews of Innovation Policy: Malaysia 2016*, http://dx.doi.org/10.1787/9789264255340-en; https://www.djei.ie/en; World Bank (2014), "Czech suppliers of multinational corporations: benefits and challenges", http://documents.worldbank.org/curated/en/504861468026113344/pdf/908070WP0Box380efits0and0Challenges.pdf.

Box 5.15. Cluster development in Brazil and Peru

Over the last decade, cluster development programmes have been growing in many Latin American and Caribbean countries. Cluster policy can be used as a catalyst for new investment projects. Cluster policies can also help attract more locally embedded foreign direct investment. Clusters can help facilitate business linkages trough collective actions such as bulk purchasing, collective certification, training, and facilitating information about demands and supply and supportive services, etc. Cluster-level initiatives help also small and medium-sized enterprises overcome size-related constraints such as access to knowledge and specialised technological services, or to solve common technological bottlenecks.

Based on international experience, several factors have been identified as key components of cluster development. Among them are political support from the top, involvement of the private sector in the conception and implementation of policies, definition of short- and long-run objectives, institutional capacity with a long-term view, monitoring and evaluation of progress and outcomes, and public-private co-ordination, among others.

The Aranjos Productivos Locais in Brazil

In Brazil, the programme Arranjos Productivos Locais ("Local Productive Factors", APL) targets clusters of firms within the same jurisdiction (e.g. municipality) that share a particular specialisation. Under this approach, ministries as well as governmental and non-governmental agencies design and implement several instruments to support APL development. Policy actions consist of two main components. First, private and public agents jointly elaborate strategic development plans. At this stage, the main role of public agents is to facilitate interaction between the various agents involved and designate local leaders to be responsible for co-ordinating each plan's execution. The focus is on the development of methodologies for the organisation and consolidation of the APLs. Second, once each plan is completed, public agents support consolidated APLs through different instruments aimed at increasing the competitiveness of the productive chains. This stage includes direct investment in infrastructure, equipment, specific training and technology transfer programmes, implementation of sectoral technology centres, design offices, export promotion programmes, and information systems for monitoring and evaluation.

Agribusiness for exporting in Peru

Building on the Cluster Excellence Programme from the European Union, the National Program for Maturated Cheeses aims to make the production of ripened cheeses in the Peruvian Sierra reach the "Premium" label. The programme began evaluating 156 plants in March 2012 and currently has surpassed 200 plants. The purpose of this first stage is to identify potential firms that could serve as "locomotives" of change. The methodology then uses the "check list" model used in audits of industrial plants to define an upgrading programme for a selected group of firms: 17 plants (rated category "A") were shown to be able to meet the challenge of hitting the road for excellence and consolidate a range of quality cheeses ripened to be offered to more demanding markets. Under the guidance of a mentor and a group of technical experts, the programme has worked mainly in developing health and safety processes and products to achieve the sanitary certification of facilities and plans to validate the DIGESA license, which makes firms suitable for exporting.

Subsequently, this achievement will be replicated in the following 43 firms rated "B" with the aid of a national technology transfer specialist and senior experts from the European Union, and a Uruguayan dairy technician (since 2013) who provide personalised advice for the gradual adaptation of plants to improve both materials and equipment, implementation of systems of quality management, adoption of the manual BPM and HACCP plans, and finally, to achieve standardisation of products and processes.

Sources: OECD (2015b), *Innovation Policies for Inclusive Growth*, http://dx.doi.org/10.1787/9789264229488-en; Figal, G. et al. (2015) "Cluster development policy, SME's performance, and spillovers: evidence from Brazil", http://dx.doi.org/10.1007/s11187-014-9620-2; Zuniga, P. et al.(2016), "Conditions for innovation in Brazil: A review of key issues and policy challenges", http://repositorio.ipea.gov.br/bitstream/11058/7352/1/Discussion%20Paper_218.pdf; www.sierraexportadora.gob.pe.

Box 5.16. **Yo Emprendedor: Promoting entrepreneurship in Costa Rica and Central America**

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

Yo Emprendedor is a non-profit organisation 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 which formalises the economy and contributes reducing poverty and increasing equal opportunities.

To develop such an ecosystem, Yo Emprendedor identified those elements that were missing to facilitate adequate business development, and developed a model based on five work areas:

1. Encourage: Yo Emprendedor works to promote entrepreneurial culture in the general population and investors, seeking to raise awareness on the subject and position it as a real alternative in life.
2. Educate: Yo Emprendedor's goal is to provide entrepreneurs with easy access to relevant documents, tools, seminars, training and videos.
3. Visualize: Aimed at giving entrepreneurs exposure and visibility through the media, and promoting interaction with judges, investors, mentors, non-governmental organisations and technical assistance organisations, among others.
4. Finance: This area focuses on encouraging the creation and promotion of sources of capital for early-stage businesses.
5. 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.

Yo Emprendedor expects to select an average of 30 projects per year. A panel of experts and potential investors evaluates these 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.

Source: Background report provided by the government of Costa Rica to the OECD.

Public procurement

In the context of the evolving balance between supply and demand, mixing innovation policy with public procurement can be an important policy tool to promote innovation at national and regional levels (Edler and Georghiou, 2007). Indeed, a wide array of OECD countries and regions are increasingly using public procurement as an integral part of their policy mix to foster business R&D and innovation activities and promote industry/science collaboration, notably in areas such as energy, health and transport equipment. Such policy initiatives could be fruitfully emulated in Costa Rica given its knowledge assets in the areas of biomass energy and tropical health research. This would require close co-operation between the MICITT and sectoral ministries, which presently have neither the resources nor the technical competencies to devise innovation-enhancing procurement policies.

Monitoring and evaluation of science, technology and innovation policy programmes

Law 7169 broadened the scope of government action in support of the development of S&T capacities and the diffusion of knowledge in terms of both policy areas and resources. It is, however, difficult to ascertain the extent to which the application of that law fulfilled its objectives in the years that followed its promulgation. This difficulty is mainly due to important deficiencies concerning the monitoring and evaluation of the programmes established in the framework of this law, and more generally to a lack of reliable information about the nature and the allocation of public expenditures dedicated to STI-related activities.[78]

One important provision of the law was the creation of an S&T Registry to be set up and managed by CONICIT.[79] This registry was to include up-to-date information about *inter alia*:

- technology-based enterprises
- public and private R&D centres
- S&T research projects
- S&T personnel, including researchers in public and private institutions
- public expenditures on S&T
- technology transfer contracts with foreign enterprises.

However, in the absence of a well-conceived conceptual and statistical apparatus to collect S&T according to international standards (see Box 3.2 in Chapter 3), this task was largely beyond CONICIT's capacity. In fact, CONICIT was able to maintain databases on only the first two items, and it was not until 2008 that the MICITT issued a decree[80] that officially launched the development of an S&T statistical system inspired by OECD and UNESCO standards.[81] There are therefore no reliable diachronic data on financial and human resources inputs to public and private S&T activities prior to 2008. Moreover, there are no systematic reliable data on budgetary and non-budgetary resources effectively allocated by the government in support of S&T activities, in particular those that were supported by the Incentives Fund.[82] Finally, as was mentioned above, the law did not have any provision requiring either the monitoring of policy or programme implementation or the evaluation of their impact or outcome. In 2014, the State of the Nation Programme launched the platform Hipatia that conducts several surveys and generates strategic information on the country's capabilities on science, technology and innovation, one of the inventories records the country's stock of professionals formed in STEM disciplines since 2000 (Hipatia, 2016). The extended temporal series allows for estimations on the annual average increase of STEM professionals in the country, according to the Frascati classification.

Stimulating social innovation

A large proportion of innovation is mediated by mechanisms which are centred on markets and business enterprises. Nonetheless, innovation is also required and necessary in order to meet the needs of low-income groups. Innovation can help provide adequate healthcare, aid disadvantaged rural communities so as to improve agricultural production, as well as to meet the needs of excluded urban communities. The idea of social

innovation as a distinct domain of STI policy is relatively new (Box 5.17). Costa Rica, along with a growing number of OECD and emerging countries, is starting to develop a social innovation policy framework and is trying to move into a policy area that is still relatively underexplored.

Box 5.17. **What is social innovation? An OECD perspective**

Social innovation implies conceptual, process or product change, organisational change and changes in financing, and can deal with new relationships with stakeholders and territories:

- "Social innovation seeks new answers to social problems by: identifying and delivering new services that improve the quality of life of individuals and communities; identifying and implementing new labour market integration processes, new competencies, new jobs and new forms of participation, as diverse elements that each contribute to improving the position of individuals in the workforce.
- Social innovations can therefore be seen as dealing with the welfare of individuals and communities, both as consumers and producers. The elements of this welfare are linked with their quality of life and activity. Wherever social innovations appear, they always bring about new references or processes.
- Social innovation is distinct from economic innovation because it is not about introducing new types of production or exploiting new markets in themselves but is about satisfying new needs not provided for by the market (even if markets intervene later) or creating new, more satisfactory ways of insertion in terms of giving people a place and a role in production.
- The key distinction is that social innovation deals with improving the welfare of individuals and communities through employment, consumption and/or participation, its expressed purpose being to provide solutions for individual and community problems."

Sources: Adopted by the Forum on Social Innovations of the OECD Local Economic and Employment Development Committee. OECD (2010c), *SMEs, Entrepreneurship and Innovation*, http://dx.doi.org/10.1787/9789264080355-en; OECD (2014a), *OECD Reviews of Innovation Policy: Colombia 2014*, http://dx.doi.org/10.1787/9789264204638-en.

There is still little systematic experience that can guide policy making and that can be used in developing policy approaches. Therefore, the extent to which Costa Rica can draw on existing models and frameworks is relatively limited. Despite the great amount of case material on several kinds of social innovation around the world, there appears to be very little systematic evaluation of social innovation programmes. In addition, even if the scope for policy practice could be adequately defined, there are still few answers to questions regarding which kinds of practice are likely to work and generate relatively high returns.

While policy development in the area of social innovation might move quite quickly to well-defined programmes of action, in many cases policy experimentation is a necessary step, where policy would be more exploratory, involving support for small-scale experiments as well as to learn about areas of social innovation in which more active policy might be developed in the future. The concepts and the initiatives to promote social innovation in some cases overlap with the policy discourse around inclusive innovation (Box 5.18).

Box 5.18. **Examples of social and inclusive innovation policy initiatives in China, Colombia, India, Indonesia and South Africa**

China: "Inclusive innovation" initiatives in China fall under the headings "science and technology for public well-being", "poverty alleviation through science and technology" and "science and technology for rural development" (CASTED, 2014). These initiatives consider how a growing urban population can benefit from these services. "Pro-inclusive" innovations are discussed more particularly in the context of supplying affordable healthcare, education and sanitation. Grassroots initiatives have also been adopted, e.g. in agriculture, with the science and technology demonstration programmes helping small farmers to modernise their activities thanks to technology.

Colombia: Colombia's National Development Plan for 2010-14 aimed to "align its economic development to its social development" by providing incentives and removing barriers to social innovation. The country's social innovation policy (the "National Node on Social Innovation") defines social innovation as "the process through which value is created for society through practices, management models, and innovative products or services that satisfy a need, take advantage of an opportunity and resolve a social problem in a more efficient way than the existing solutions, producing a favourable and sustainable change in the system in which they operate". It emphasises the potential for scalability and replicability, which are understood to promote community empowerment. The initiative is a result of intergovernmental co-operation of the National Agency for Overcoming Extreme Poverty, Colombia's National Planning Department and the Administrative Department of Science, Technology and Innovation (COLCIENCIAS).

South Africa: Policy discussions emphasising the empowerment of excluded populations – where exclusion relates not only to poverty, but also to race, gender and disability – focus on innovation's contributions to inclusive development. "Innovation for inclusive development" can be inclusive both in terms of output/outcomes and the process itself. It encompasses: 1) pro-inclusive innovations, especially insofar as they develop access to "basic services" (health, education and human settlement), with the involvement of science councils; and 2) grassroots innovations, as a way to empower excluded groups and generate employment.

India: The term "inclusive innovation" is widely used in India to describe innovations that "solve the problems of citizens at the base of the economic pyramid". Grassroots innovations also receive strong support from, and underpin the activities of, the National Innovation Foundation, which "provides institutional support to grassroots innovators and traditional knowledge holders from the unorganised sector of the society" (NIF, 2014).

Indonesia: Government initiatives dealing with inclusive innovation focus on incremental innovation, with particular emphasis on process innovation. The main governmental actors are ministries, e.g. the Ministry of National Development Planning and the Ministry of Social Affairs, but also non-ministerial governmental institutions, e.g. the National Team for Accelerating Poverty Alleviation. To date, the idea of inclusive innovation has yet to be promoted in the country, so no specific policy to support inclusive innovation currently exists. However, some district governments have started to introduce participatory development planning, which aims to include all communities.

Source: OECD (2015b), *Innovation Policies for Inclusive Growth*, http://dx.doi.org/10.1787/9789264229488-en.

In Costa Rica the discussion on social innovation is only beginning. Nonetheless, as in most countries, there have been significant social innovations in the country throughout its history even if they were not necessarily recognised as such. The current Solís Rivera 2014-18 administration is working to better understand social innovation as a concept and its applications in defining public policy and national strategies to promote it as an

important part of the government's actions. The Presidential Council for Competitiveness, Innovation and Human Talent created a special Social Innovation Committee which focuses on the analysis, design and promotion of social innovation at the highest level of the public policy hierarchy.

This Social Innovation Committee is led by the Ministry of Foreign Trade in co-ordination with the Ministry of Science, Technology and Telecommunications and the Vice-President's Office. It is a public-private-academia committee involving different participants, including: the Social Progress Imperative, VIVA Trust, Yo Emprendedor, IMPACTICO, the Federation of Social Organizations of Costa Rica, the Association of Business for Development, Reinventing Business of All, the Universidad Latina of Costa Rica and the National Univerisity. The first action undertaken by the committee was to define a concept of social innovation (this concept is currently under development and will be validated with different stakeholders of Costa Rica's social innovation ecosystem).

Currently, the Social Innovation Committee understands social innovation as new forms of action arising from the identification of social problems, in order to solve them and improve the quality of life of individuals and benefit the society; a definition that is along the lines of the ones discussed above. According to the Social Innovation Committee, social innovation must also adhere to the following criteria: 1) generate sustainable economic, social and environmental value; 2) create systemic change, break paradigms and change the status quo; 3) be scalable and replicable; 4) consider cultural aspects; 5) social benefit should be equal to or greater than the economic benefit generated by the innovation; 6) change societal interactions through collaborative processes to generate well-being.

The Social Innovation Committee has defined as an overarching objective to promote a social innovation culture as a pillar of human development, social progress and the country's competitiveness and has defined four specific lines of action: 1) encourage the development, management and promotion of social innovation through the National Innovation Policy; 2) measure social progress at the territorial level in order to ensure the improvement of human development and well-being throughout the country; 3) promote the articulation of an ecosystem of social innovation; 4) identify, along with the involved stakeholders, best practices and critical success factors to promote social innovation within the framework of national innovation policies. The government is pursuing different projects as part of this strategy, including: the creation of a National Social Innovation Fund and designing a set of public policies and legal reforms to promote at the National Congress and public entities.

Notes

1. The first of these institutions was the Physical Geographic Institute with a herbarium founded in San José in 1888 by the Swiss geographer Henri Pittier. The Costa Rican Medical Society, founded in 1879, published the first results of its research on tropical diseases in the scientific journal one year later. The first National Agricultural Institute engaged in technology transfer activities was created in the last decade of the 19th century on the model of US and European institutions (Zeledon, 2004).
2. Ley 5048 (Gaceta Nacional, 1972).
3. It should also be noted that by law CONICIT's governing board (*Consejo Directivo*) was entirely composed of academics and that the allocation of funds for S&T activities was not subject to any particular objective or criteria other than scientific importance of the project and the competence of the team.
4. A third "open" university, the Universidad Estatal a Distancia (UNED), which was created in 1977, has less research capacities but has a scientific diffusion mission.
5. For instance, INCIENSA established in 1977 as an autonomous agency attached to the Ministry of Health, and INTA established in 2001 as an autonomous agency attached to the Ministry of Agriculture. As regards technology transfer in the agricultural sector, the role of CATIE, a non-profit research and higher education institute established in 1973 as an autonomous institution with international funding, should also be mentioned.
6. It should be stressed that institutions apparently similar to CONICIT created during the same period in other Latin American countries, such as CONACYT in Mexico which was established in 1970, CONICYT in Chile in 1967, CONCYTEC in Peru in 1968 or COLCIENCIAS in Colombia in 1968, did not show the same bias and supported public research centres with a dual mission of knowledge creation and dissemination (OECD, 2007; 2009a; 2011c; 2014a).
7. Among them, the rapid increase of public debt, the fall of the prices of the main agricultural exports and the collapse of the Central American Common Market in the context of the civil wars which raged in neighbouring Central American countries (Rodriguez-Clare et al., 2003).
8. And not by law as there was probably not enough support in parliament.
9. As recalled by Rodrigo Zeledon, ex CONICIT President (Zeledon, 2014).
10. This loan was approved by Law 7099, which includes provisions allocating funds to CONICIT and CONARE trust funds created for that purpose. Of the USD 34 million, USD 22.1 million came from the IADB and USD 11.9 million from the national counterpart. CONICIT's share was USD 21.6 million and CONARE's USD 12.4 million.
11. For an analysis of the relationships between co-evolutionary approaches to science, technology and innovation and development economics, see Dutrénit, Puchet and Teubal (2011).
12. In 2013, the MICITT took over the responsibility of the telecommunications sector previously attached to the Ministry of Environment and became the Ministry of Science, Technology and Telecommunications, with one vice-ministry in charge of

science and technology and the other in charge of telecommunications. Views expressed in this paragraph concern essentially the vice-ministry in charge of science and technology.

13. If we add public transfers other than those from the MICITT (e.g. resource allocations to autonomous public research institutions, or SBD research grants) this share could reach 0.2%, which is still extremely low compared to countries such as Chile (Maggi, Rivas and Sierra, 2012) or Mexico (OECD, 2009a).

14. A programme managed by the Development Bank System that includes a guarantee fund and subsidised loans.

15. In 2012, Presidential Decree 37121 created an inter-institutional SME Council chaired by the Minister of Economy, Industry and Commerce to co-ordinate policies that contributed to foster SMEs' competitiveness. It is worth noting that the MICITT, although responsible for PROPYME, was not designated as a member of that council.

16. COMEX also actively participates in a series of inter-institutional initiatives supporting different projects and programmes designed to improve Costa Rica's innovation ecosystem. As a specific example, the Directorate for Capacity Building for Foreign Trade, established since late 2015, actively works on projects related to human capital development, supporting traditional economic sectors in generating more value added to their products and services, and supporting productive organisations engaging in innovation processes.

17. Larger than the share of the MICITT budget allocated to the financing of S&T activities (around USD 5.3 million in 2015).

18. CONICIT's technical evaluation unit is comprised of only 7 professionals for a total staff of about 50.

19. It should be noted that although the amounts of the annual replenishments are determined on the creation of the trust funds or through the budgetary process, the volume of the transfers has been subject to variations. This was notably the case in 2012 and 2015 when the amounts previously determined were reduced. This affects CONICIT's degree of autonomy.

20. Financing through a trust fund may have some advantages, as the schedule of transfers of resources to the beneficiaries is not constrained by the fiscal year commitments requirements. But this lack of constraint may have the disadvantage of inducing the fund managers to adopt conservatory asset management behaviour and delay outlays which, in this case, would reduce the flow of activities to be supported. For the relative advantages and disadvantages of STI support financed by trust funds vs. budgetary appropriations constrained by fiscal year commitment constraints, see OECD (2013b).

21. SDB is managed by a board chaired by the Minister of Economy alternating with the Minister of Agriculture and including representatives from the Chambers of Industry and of Agriculture and Agroindustry, and an independent personality from the Professional Association of Economists of Costa Rica.

22. Law 9274, La Gaceta (2014a).

23. Part of FINADE resources come from a percentage on public banks' profit. This percentage was established at 3% in 2008 and is scheduled to decline regularly to reach 0% in 2017.

24. In March 2016 the SBD approved funding of USD 432 000 for a research project presented by the Ad Astra Research Institute on the production of hydrogen-based fuel for public transportation vehicles. This project was initially to be developed by RECOPE but the Comptroller General determined that RECOPE could not undertake research projects outside of its area of competence, i.e. fossil fuels.

25. It should be stressed that work is currently underway to strengthen capacities for venture capital within the SBD. Work is also underway with the stock market regulator, the stock market and others to update the legal framework to enable the SBD's role in venture capital.

26. In particular, the 1988 IADB/CONARE/CONICIT loan activated in 1990 that funded the FORINVES programme still actively supports public and private research projects; the launching by the IADB/MIF in 2002 of the first phase of the linkages project that gave rise to the CR Provee programme two years later; the 2006 IADB/MIF technical co-operation providing support to the development of incubators and the creation of angel capital networks.

27. IADB loan contract No. 2852/OC-CR (IADB, 2014). The programme is entirely financed by the IADB loan, without any contribution from the government of Costa Rica.

28. This initiative benefited from the support of the Foundation Costa Rica – Estados Unidos de América (Proyecto Estrategia Siglo XXI, 2006).

29. By Decree 33748.

30. Membership of this council established by Decree 35313 included ministers from the MICITT, COMEX and the Ministry of the Environment and Energy whom the decree called to co-ordinate with other ministries (agriculture and health).

31. The CNI and COTIN were abolished by Decree 33748 and the PCCI created by Decree 36024.

32. And including the 2 vice-presidents, 13 ministers including the Minister of Science, Technology and Telecommunications and the Minister of Finance, and chairs of public agencies (INA, the Costa Rican Institute of Electricity and the Costa Rican Institute of Aqueducts and Sewers). Neither CONICIT nor CONARE were included.

33. Despite an increase in 2009, the MICITT's budget remained very low (0.15% of the total budget).

34. Chaired by the President, the PCCI includes six other members: the Minister of the Presidency, the two Vice-Presidents and three members of Costa Rica's Union of Associations of Private Sector Chambers (UCCAEP).

35. Both for the Innovation and Human Talent Council and only the business for the Competitiveness Council. Neither PROCOMER nor CONICIT are represented on these councils.

36. Japan (S&T Basic Plan) and Mexico (PECITI) are among them.

37. The seven strategic areas are: earth and space sciences, new material, biotechnology, natural capital, health (emerging diseases), alternative energy and digital technologies.

38. The Programa Estado de la Nación. This programme involves the five public universities and the participation of civil society, whose purpose is to collect and

analyse information with a view to inform the policy debate on strategic issues pertaining to sustainable development.

39. Such as the programmer devoted to the promotion of intelligent community centres (CECIs) aiming at reducing the digital divide suffered by a fraction of the population, and fostering the access to online training and other community services.

40. As perceived by the IADB, which insisted that an agreement be signed between the MICITT and CONICIT to clarify their respective responsibilities in the management and implementation of the PINN programme before making the first loan disbursement (IADB, 2012).

41. Notably as regards the monitoring and evaluation of programmes managed by CONICIT, such as PROPYME, as mandated by SME Law 8262 (Article 15).

42. The promotion of innovation is not the SBD's main mission. However, through its trust fund FINADE, the SBD can finance a wide array of STI-related activities, including large research projects, the provision of seed capital to incipient new technology based firms and participation in venture capital funds.

43. Between 85% and 90%. The MICITT's and CONICIT's competitive funding of research projects amounts to around to USD 0.5 per year whereas the total R&D expenditures of public HEIs is close to USD 100 million.

44. Approximately USD 226 000 at the 1972 exchange rate.

45. The range of STI activities that can be funded by the SBD through FINADE as listed in Article 14, Section c) heading 4 of Law 9274 is very broad (R&D for innovation, technology transfer, knowledge creation and human resources development). There is a clear overlap between the MICITT's and CONICIT's range of activities. As highlighted above, FINADE has also recently funded a very large applied research project without resorting to project call procedures (the Ad Astra project on the development of hydrogen-based fuel).

46. Proposal made by the Ministry of the Presidency (La Gaceta de la Nación, 2016).

47. MEIC, MICITT, the Ministry of Agriculture and Livestock and COMEX.

48. Such as low appropriability of R&D results, information asymmetries (market failures) and obstacles to knowledge interactions among institutions (systemic failures) (OECD, 2010a).

49. Such as windfall profits, inefficient targeting, conflicting mandates between agencies (Crespi, 2010).

50. With the exception of research centres oriented towards technology transfers in the agriculture and agro-industrial sectors such as CITA and CENIBiot. Also, contrary to other Latin American countries (e.g. Mexico), there is no government support to the development of HEIs' TTO activities (OECD, 2013b).

51. It is to be noted that in the initial profile of the PINN elaborated by the IADB there was an explicit component on innovation managers. In the final version, this component has been subsumed in the "Professional Qualification Programme" (sub-component II.3).

52. The only attempt at assessing the impact of PROPYME between 2003 and 2011 (Monge-González et al., 2013) shows some positive impact on profitability, exports probability and labour demand, but not on innovation output or performance.

53. For reasons that are unclear but may have to do with fiduciary regulations binding the SBD.

54. This is the all the more surprising as industry associations performing a cluster role such as the Chamber of ICT Industries (CAMTIC), whose creation was supported by the IADB/MIF and PROCOMER, play an active role in knowledge diffusion and the exchange of best practices.

55. Such as Mexico's sectoral funds (OECD, 2009b).

56. Apart from this policy portfolio, the law also fostered important initiatives, such as the creation of the System of Scientific Colleges offering free tuition in secondary institutions providing curricula intensive in sciences to a selection of pre-university, high-potential students.

57. In this respect it is not surprising that the actual activation of the loan with its first disbursements took place only in 1990, the year that the new law was promulgated. It should also be noted that the new ministry did not have any responsibility in the management of this loan.

58. After a few years, budget appropriations fell short of the anticipated objectives.

59. One can wonder why the MICITT has not published (paper and/or electronic) an annual catalogue of support programmes with clear and up-to-date information about the purpose of the programme, type of support, potential beneficiaries, process of application and selection, etc. A good example is the catalogue developed, and annually updated, in Mexico by the Consultative Forum on Science and Technology (FCCyT, 2015).

60. Law 8262 on Strengthening SMEs. This law was prepared under the aegis of the Ministry of Economy, Industry and Trade and includes other programmes in support of SMEs that do not focus on technology-related factors of competitiveness.

61. This criterion aiming at fostering relationships between the business and academic worlds proved to raise some difficulties at the implementation stage. It illustrates how a sensible policy objective can be negatively affected by poor policy design.

62. Also, for unexplained reasons ITEC, one of the most qualified academic and research institutions to contribute in these partnerships, was not included as a qualifying institution (Conejo Vargas, 2013).

63. Such as the training of personnel, provision of technological services and support to R&D.

64. The MICITT's portal states that PROPYME focuses on the commercial stage of high-tech scientific projects and on frontier science projects (www.innovacion.cr/donde-consigo-financiamiento), which widely differs from the definition of the focus given in the SME Law and retained by the MEIC and CONICIT.

65. Especially since Law 8262 entrusted the MICITT with the definition of the criteria of eligibility and disbursement and the commissioning of an independent body to evaluate the management of the fund and assess its impact.

66. The MICITT established a programme co-financing participation in training programmes in innovation management developed by the Costa Rica Institute of Technology and the National Technical University. The MICITT also accredited innovation managers.

67. Created in 2008.

68. A further step in moving towards closer co-operation is the proposed initiative to create a new Agency for Productive Development and Innovation (FOMPRODUCE) that would take over all responsibilities currently assumed by the MEIC, CONICIT, the SBD and INA for non-financial support instrument programmes in support of entrepreneurship, SME capacity building, promotion of productivity and innovation.

69. While no co-ordination problems were anticipated for PROCOMER, for reasons of symmetry a similar agreement had to be signed between the MICITT and that institution.

70. Which differ from the sum of annual budgetary allocations because CONICIT trust fund disbursement schedules are not bound by annual budgets.

71. Supply-side policy instruments aim to boost knowledge production and supply in order to accelerate knowledge spillovers and externalities; demand-side policy instruments focus on boosting market opportunities and demand for innovation as well as encouraging suppliers to meet expressed user needs (OECD, 2014b). It should be noted that this is not the official view of the MICITT as expressed in its response to the OECD questionnaire elaborated for the preparation of the 2014 OECD *Science, Technology and Innovation Outlook*.

72. According to a recent study, 27 OECD countries are implementing R&D tax incentives (OECD, 2014b).

73. MNEs would benefit from this incentive after eight years, at the end of the of the tax-exemption period.

74. In this regard it is worth noting that the hydrogen-based fuel research project entrusted to Ad Astra Rocket Company by the SBD with a USD 432 000 grant could be considered as a mission-oriented one. However, as noted above, this project has not been selected in the framework of a competitive call open to all research institutions with specific terms of reference.

75. Public technological institutes in Chile, centres of productive innovation and technology transfer in Peru and CONACYT centres in Mexico.

76. In Mexico, the majority of SME fund projects are delivered through about 600 intermediary institutions, such as state governments, research and technology centres, chambers of commerce, foundations, business associations and universities (OECD, 2013c).

77. Latin American countries' experiences in new technology based firms support policies are reviewed in OECD (2013a; 2013b).

78. Partial improvements regarding public expenditures have followed the development of a system of S&T statistics and indicators using the OECD *Frascati* and *Oslo Manual* concepts and methodologies by the MICITT in 2006. However, this system still suffers from reliability problems related to survey coverage and quality control.

79. Articles 25, 26 and 27. The stated objective of the registry was to "measure the resources allocated to S&T activities be they domestic or foreign, public or private, budgetary or extra-budgetary".

80. Decree 34278.

81. This system needs to be further developed to satisfy the OECD requirements in coverage and reliability.

82. It is worth noting that to this day the budgetary information issued by CONICIT does not give a detailed account of resources allocated to the various programmes it is entrusted to fund with the budgetary transfers received from the MICITT.

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