ILO Americas
TECHNICAL
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2017/8

International
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Moving Up the Global Value Chain: The case of Intel Costa Rica

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First published (2017)

Monge-González, Ricardo

Moving Up the Global Value Chain: The case of Intel Costa Rica. Lima: ILO Regional Office for Latin America and the Caribbean, 2017. 56 p. (ILO Technical Reports, 2017/8).

12.07.1

Value chains, multinational enterprise, development policy, Costa Rica.

ISBN: 978-92-2-130312-1 (print)
ISBN: 978-92-2-130313-8 (web pdf)

Also available in (Spanish): *Ascendiendo en la Cadena Global de Valor: El caso de Intel Costa Rica. Lima: OIT, Oficina Regional para América Latina y el Caribe.* (ISBN: 978-922-330959-6 (print); ISBN: 978-922-330962-6 (web PDF)), Lima, 2017.

ILO Cataloguing in Publication Data

Printed in Peru

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This study was undertaken by the Regional Office for Latin America and the Caribbean of the International Labour Organisation, located in Lima, Peru in the context of its priority of working regionally on "Productive Development Policies for Inclusive Growth with More and Better Jobs". This work benefitted from the valuable collaboration and support of the Fundación CAATEC and Intel Costa Rica. The author would like to thank Timothy Scott, Roberto Granados, Pilar Chaves, Sergio Pacheco, Magdalena Inces and Alexander Espinoza, all officials of Intel Costa Rica. Without their valuable contributions it would have been impossible to collect the necessary statistical information in this report. Henry Vargas and Alonso Alfaro, officials from the Central Bank of Costa Rica, provided valuable information on the relative importance of Intel Costa Rica's operation on the economy of Costa Rica. Eduardo Lizano, Anabel González, Gabriela Llobet, José Manuel Salazar-Xirinachs, Keilor Rojas, Alejandro Cruz, Roberto Granados and Timothy Scott provided valuable feedback on early drafts. Any errors are the sole responsibility of the author.

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Preface

In Latin America and the Caribbean, the goal of achieving more and better jobs includes policies in the area of labour market rules and institutions, but it is hardly complete with those policies. Instead, that goal, as well as that of reducing poverty and informality, is directly and fundamentally linked to productive development strategies and policies, the promotion of investment, and productivity growth and all that this entails.

That is why, since 2015 at the Regional Office of the ILO, we have defined the theme of "Productive Development Policies (PDPs) for inclusive growth with more and better jobs" as the first priority of work at the regional level.[1] This includes the classic objective of employment promotion of the ILO, but with strongly anchored in the policy space of PDPs.

The purpose of PDPs is to transform and strengthen the productive structure of a country. These policies include measures, policies or programmes aimed at improving the growth and competitiveness of large sectors (industry, agriculture, services); specific leading sectors (textiles, software, high technology, etc.); or the growth of certain activities (research and development, other innovation activities, exports, foreign direct investment, productive chains, others).[2]

PDPs are an indispensable and central ingredient in influencing the pattern or "model" of economic growth toward one that is higher, more sustained, more inclusive and sustainable, and with greater traction in labour markets. PDPs and the accompanying instruments are the main tools for influencing the pattern of growth and employment in a developing economy. These policies, set aside during the adjustment period after the 1980s, are now subject to renewed interest, and this is not surprising in light of the poor performance of the region in terms of productive diversification and productivity.[3]

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1 See *Desarrollo Productivo, formalización laboral y normas del trabajo: Areas prioritarias de trabajo de la OIT en América Latina y el Caribe,* OITAmericas Informes Técnicos #4; link: http://www.ilo.org/wcmsp5/groups/public/---americas/---ro-lima/documents/publication/wcms_534139.pdf

2 Melo, A. and A. Rodríguez-Clare. 2006. Productive Development Policies and Supporting Institutions in Latin America and the Caribbean. IDB Research Department Competitiveness Studies Series. Working Paper C-106.

3 Crespi, G.; Fernández-Arias, E.; Stein, E. 2014. *¿Cómo repensar el desarrollo productivo? Políticas e instituciones sólidas para la transformación económica.* (BID); Salazar-Xirinachs, J.M.; Nübler, I.; Kozul-Wright, R. 2014. *Transforming economies: Making industrial policy work for growth, jobs and development.* (Geneva, ILO).

One case that has attracted much attention for its success in terms of productive transformation associated with the attraction of investment and the insertion in global value chains is that of Costa Rica.

In the last 30 years, Costa Rica has gone from having an economy based mainly on traditional productive activities to one based to a large extent on industries and services of medium and high technology. That is to say, it went from having a productive matrix connected to traditional global value chains, predominantly agricultural value chains with relatively low value added and low level of qualifications (coffee, sugar, bananas and later textiles), to an economy with increasingly solid connections with global value chains with higher value added and higher qualifications and quality of employment.

The most conspicuous and widely commented case of this productive transformation, recognized in the world literature on these subjects, was the beginning of operations in 1998 of a plant to assemble and test microprocessors by Intel Corporation that led initially to the creation of more than 2,200 direct jobs with wages higher than the national average in the manufacturing sector, a figure that exceeded 3,000 jobs a few years later.

But the impacts of Intel's operations in Costa Rica go far beyond a simply quantitative view of the number of jobs and include positive impacts on aspects such as human resources training and interactions with vocational training systems; knowledge spillovers via interactions with the supply chain, mobility of skilled workers, and collaboration between firms; wages and productive linkages. The arrival of Intel also helped to strengthen an idea, a highly valuable intangible asset: a broad national consensus on the importance of promoting medium- and high-technology activities, and the complementary productive development policies to achieve this goal.

As is natural in these narratives, although 1998 is a milestone, the story did not begin in that year. Nor does it end with the announcement in 2014 of the alleged "withdrawal" of Intel from Costa Rica. This document recalls the well-known history of the establishment of Intel in the country, but its added value, in which this study constitutes a first, is to show that, far from retiring after 2014, what has happened with Intel Costa Rica is that the country has climbed in the global value chain with respect to the position it had with Intel in the first stage of assembly and testing of microprocessors.

In terms of Productive Development Policies, and with respect to the period prior to 1998, it is important to note that beginning in the 1980s and deepening into the 1990s, Costa Rica understood that continuing to compete based on low value-added production lines and low-skilled sectors such as textile and apparel, or continuing to

rely on a few primary products such as coffee, bananas and sugar, was not a winning strategy. This was particularly clear in an environment where the neighbouring countries had stabilized politically after the turbulent decade of the 1980s and had much lower labour costs than those of Costa Rica and abundant low-skilled labour, which helped those countries to become important destinations for FDI flows in the 1990s, particularly for the textile and clothing industry in the context of the trade preferences granted by the Caribbean Basin Initiative. In that context, Costa Rica understood that it had to find new engines of growth that would take advantage of the country's competitive advantages, particularly in terms of human resources, and economic and political stability, among others.

Starting in the mid-1980s, and with greater focus and clarity in the 1990s, the country set out to insert itself into new value chains through selective policies to attract investment and promote non-traditional exports. Intel's decision to open a microprocessor assembly and test plant in the country, which was a result of investment attraction efforts and Intel's corporate strategy, was a turning point. That decision not only led to the creation of direct jobs with higher qualifications and wages than the industry average at that time, but also provoked a demonstration effect that led to the establishment of many other companies in the software sector, medical devices, back-office services and others. This set the country on a new, more solid and sustainable growth path.[4]

In April 2014, Intel announced that its processor assembly and testing operations would be moved to Asia. The Corporation also announced that it would maintain Engineering and Design operations in Costa Rica and that it would expand its shared services activities. However, in several international media this news was reported as if Intel was closing operations and leaving Costa Rica.[5] In fact, what happened was a repositioning of Intel's operation, which has subsequently led to climb the global value chain (CGV), a move that has benefited Costa Rica in a number of ways, including greater domestic value added in exports of this multinational, an increase in the wages paid by this company, and greater possibilities for productive linkages that generate knowledge and technology spillovers towards the rest of the economy.

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4 Costa Rica's success in attracting investments does not mean that the country is generally successful in terms of productive development or development in general. Despite its achievements, the country has serious deficiencies in terms of infrastructure, education, innovation and public management capacities. Some analysts consider that the country is in the so called "middle income trap". In addition, consistently proactive policies to attract foreign direct investment contrast with the lack of continuity and proactivity in the development of local businesses. See for example Paus (2014) "Industrial development strategies in Costa Rica: When structural change and domestic capability accumulation diverge", in Salazar-Xirinachs, J.M., et. al., op. cit. Chapter 6.

5 As an example see: The Economist, Intel Outside, April 19, 2014 (http://www.economist.com/news/americas/21600985-chipmaker-shuts-factory-slicing-away-one-fifth-countrys-exports-intel-outside)

This study tells in detail the story of Intel Costa Rica repositioning and climbing in the CGV. It raises and answers two fundamental questions: "What are the impacts of this transformation on the Costa Rican economy?", and "What are the policy implications that can be derived from such a transformation?" And at the end the study makes some recommendations to help Costa Rica avoid the middle income trap in which it seems to be.

This experience and its lessons are not only relevant to Costa Rica. What the reader will find in this publication is of great relevance in the current debate on how to generate more and better jobs in Latin America and the Caribbean, how to insert and ascend in global value chains capturing greater added value, and what conditions, some unique, but others reproducible, contribute to these objectives. All of these are key issues around the fundamental question of how to achieve a better future of work and production in Latin America and the Caribbean.

That is why I am pleased to present this study to the Latin American and Caribbean community, as well as the world, as a contribution to rigorous analysis and informed conversation about the type of strategies that work in employment policies, productive development and productivity growth. I reiterate my gratitude to Intel Costa Rica for its openness in providing information for the realization of this study.

José Manuel Salazar-Xirinachs

ILO Regional Director
for Latin America and the Caribbean

1. Introduction

During the past three decades, the Costa Rican economy has achieved reasonable economic growth and an unprecedented productive transformation. This is the result of the successful implementation of a consistent and continuous foreign trade policy that combined the gradual opening of the economy with proactive steps to promote exports and attract foreign direct investment (FDI) (Monge-González et al., 2016). These and other policies adopted since the mid-1980s, as part of Costa Rica's integration into the international economy, have brought about stable economic growth. However, the economy has not grown as much as other nations that have achieved greater progress towards economic and social convergence with developed nations (CEPAL, 2014).

According to Monge-González (2017), by attracting FDI and promoting exports, Costa Rica has achieved a significant productive transformation and repositioned itself for more skilled, better paid, and higher value-added activities, which is clear from the broad diversification of its exports. According to the author, data from the Foreign Trade Ministry (Ministerio de Comercio Exterior, COMEX) reveals that in 2015 the country had 2,447 exporters, who sold 4,355 products to 150 markets. These policies achieved a rate of export growth above that of the GDP (nine per cent compared with an annual average GDP of three per cent between 1990 and 2012). They also enabled the country to progressively shift the composition of its exports from primary products to high-technology manufacturing and more sophisticated services. These increased from 1.2 per cent in 1980 to 41.4 per cent in 2012 (CEPAL, 2014).

The transformation of the Costa Rican economy was made possible by the unilateral and gradual opening of the economy starting in 1986. This was combined with direct incentives to export non-traditional products (through export contracts and the temporary admission regime, as per Law 6955) and proactive measures to attract FDI. The latter included a free trade regime and the incentives provided by the duty free regime (Laws 6955 and 7210), which has been in effect since 1984 (Monge-González et al., 2016).[6] These policies enabled Costa Rica to skip some stages in its development

6 In addition to these policies, the cited authors point out the importance of negotiations for multilateral and bilateral trade agreements with the main trading partners and numerous key complementary policies (for example, in subjects like education and infrastructure). They also mention the evolution of foreign trade institutions in Costa Rica, such as the creation of the Costa Rican Coalition for Development Initiatives (Coalición Costarricense de Iniciativas de Desarrollo, CINDE) in 1982 as the agency that attracts foreign direct investment and, in 1996, both the Minister of Foreign Trade (COMEX) and the Foreign Trade Promotion Office (Promotora de Comercio Exterior, PROCOMER).

(a process economists refer to as leapfrogging), transforming its economy from one based mostly on traditional products to one largely based on medium and high-technology industries and services.

Intel's arrival in Costa Rica in 1998 marked an important milestone for FDI in the country. It sent a message to other multinational corporations that setting up technologically sophisticated operations in a small and open economy was a viable option, especially for efficiency seeking corporations that need medium- to high-competency labour. The goals of Costa Rica's policies for attracting investments were to achieve knowledge spillovers and technology transfers from the multinationals on the frontiers of technology for the rest of the economy in order to increase growth and productivity in the economy on the whole.

In April 2014, Intel announced that it would be moving its assembly and test operations for microprocessors to Asia. It also announced that it would keep its engineering and design operations in Costa Rica and that it would expand shared services activities. Nonetheless, some international media reported the news as if Intel were closing its operations in Costa Rica.[7] In reality, what occurred was a repositioning of Intels's operations, which bumped the operations in Costa Rica higher up in the Global Value Chain (GVC). This has benefitted Costa Rica in numerous ways, including generating a greater domestic added value for Intel Costa Rica's exports and higher salaries for its employees.

This study provides a detailed account of the repositioning and ascent on the GVC of Intel Costa Rica. It also poses and answers two fundamental questions: "What has been the impact of this transformation on the Costa Rican economy?" and "What are the policy implications that can be gleaned from this transformation?".

This document is divided into seven sections, including the introduction. The second section is an overview of Intel Corporation. The third describes its arrival in Costa Rica. The fourth section reviews the impact of Intel's operations on the Costa Rican economy. The fifth section describes the ascent of Intel Costa Rica on the GVC since 2014 and its impact on the economy. The sixth section presents the principal findings that emerge from the study of Intel Costa Rica's ascent on the GVC. Lastly, the seventh section makes recommendations for policies to promote GVC ascents for multinational and local corporations operating in Costa Rica. It also makes recommendations for using these ascents to move Costa Rica out of the middle income trap. This is a situation in which a country faces potential growth deceleration because it is trapped between low-paying manufacturers and high-value innovators (Lee, 2013; Paus, 2017).

7 As an example, see The Economist, Intel Outside, April 19, 2014 (http://www.economist.com/news/americas/21600985-chipmaker-shuts-factory-slicing-away-one-fifth-countrys-exports-intel-outside)

2. Intel Corporation

The Intel Corporation was founded in 1968 in California. From the outset, it positioned itself as a high-impact technology company that is known around the world for its role in developing microprocessors.

In 1971, the corporation presented the first microprocessor to the world. By 1995, world production of computers was worth 237 billion dollars, 13.5 per cent more than in 1994, making Intel one of the most profitable companies in the world with more than 85 per cent of worldwide microprocessors sales (Spar, 1998). Over time, as Intel became increasingly specialized and competition increased, the company continued to update its products with the latest technology.

At the same time, the corporation underwent many changes, employing a "virtual factory" method, in which all of its production and sales facilities around the world were integrated, despite their geographic separation. As a result, all of the important decisions relating to technology and productive capacity, among others, were made through negotiations between managers in different parts of the world (Sánchez-Ancochea, 2012).

Intel is known as a central player in the global electronics industry and has led the way for technological innovation in the semiconductor and computer markets (Spar, 1998). More recently, since 2016, this corporation has sought to transform itself from a producer of microprocessors to a developer of memory, processors, and the Internet of Things, in order to diversify its operations and bring about a fundamental internal revolution (Krzanich, 2016). One of the most important implications of this transformation is its work focus based on business units that are established according to productive activities.[8] This has had significant implications for headquarters and for subsidiaries around the world.[9]

8 This concept involves a group of activities within a company that share a common strategy that is distinct from the rest of the company's activities.

9 Interview with Roberto Granados and Timothy Scott, of Intel Costa Rica.

3. Intel's presence in Costa Rica[10]

On November 13, 1996, Intel announced its decision to set up a factory in Costa Rica to assemble and test microprocessors (González, 1997; Spar, 1998), making it the company with the largest investment in Costa Rica at the time. According to Spar (1998), the opportunity for Intel to invest in Costa Rica emerged because Intel was seeking to expand its production capacity. Starting in 1996, it began evaluating potential locations for the assembly and testing of microprocessors, which would then be exported to the rest of the world. The plant requirements were a 400,000 square feet space for 2,000 workers to assemble and test the latest Pentium microprocessor. An important characteristic of these kinds of factories is that they are relatively cheap and labour intensive, requiring workers with medium-level qualifications. Cost of labour is therefore the most important variable when choosing where to set up a factory of this kind.

The Intel officials in charge of the site selection process decided to locate the operation in a country where it did not already have operations, in order to geographically diversify its assets and sales. Intel officials knew that for a new factory to operate cost-effectively it needed to be located in a place where there was sufficient human capital with two characteristics: a certain level of skill and a low cost. The new operation would need to be able to hire enough qualified engineers and to maintain employee turnover to a reasonable minimum.

Intel put together a long list of possible locations for the new plant in both developing and developed countries. Initially, Costa Rica was not considered a strong contender on this list. In fact, according to Spar (1988), its inclusion on the list was a result of lobbying efforts by Costa Rican government officials responsible for attracting investment. For many years, the Costa Rican Investment Promotion Agency (CINDE) had been approaching large electronics corporations in the United States. CINDE believed that the country had important comparative advantages for attracting foreign investment in electronics as a result of its abundance of qualified and bilingual workers and their relatively low cost, precisely the characteristics that electronics companies around the world were looking for. The government had also concluded that Costa Rica was no longer competitive for textile factories, which had proliferated in the 1980s to take advantage of the incentives of the Caribbean Basin Initiative. By the mid-1990s,

[10] This section is largely based on Spar (1998).

the government, working with CINDE, had begun to focus on an aggressive policy to reposition Costa Rica internationally.

In 1993, CINDE began courting Intel and other large companies from the US electronics sector. In 1995, Intel invited the director of CINDE in New York to its headquarters in Santa Clara, California. CINDE officials designated a team of executives to put together an informational packet to present to Intel, which resulted in Costa Rica landing on Intel's long list of potential locations for its new assembly and test site for microprocessors.[11]

There were various criteria for the selection of the country where Intel would locate its new plant. Notable among these were: (i) a stable government and economy; (ii) sufficient availability of technical and professional human resources; (iii) a reasonable cost structure (labour, taxes, tariffs, among others); (iv) a pro-business environment (government interest in supporting foreign investment and economic development); (v) logistics and appropriate fabrication times; and (vi) an expedited process for the permits needed to construct the new factory. Based on these criteria, Intel officials began to eliminate candidates from the long list, reducing it from twelve to seven. Along with Costa Rica, Indonesia, Thailand, Brazil, Argentina, Chile and Mexico made the short list.

At this point, Intel officials in charge of the selection process proceeded to visit these seven countries for on-site information gathering and to get a better idea of the conditions in these countries relative to the needs of the new plant. According to Spar (1998), the positive recommendations from foreign companies and expert residents in the country, the impression of the Intel team that visited Costa Rica, and the participation of the President himself during the selection process were all critical factors for selecting Costa Rica as the location for the new plant.

It is important to mention that while the quantity and complexity of the paperwork and procedures required for Intel to set up shop in Costa Rica were high, the President, in conjunction with relevant public institutions, established a special mechanism to accelerate the process. The mechanism was one "in which a liaison was designated to coordinate the process with all of the government institutions involved and, most importantly, to produce answers quickly to any questions that arose. The president's intervention and the characteristics of those in charge of this process were key factors that ensured that this mechanism worked effectively." (González, 1997, p. 16). As a result of these efforts, on November 13, 1996 Intel announced its decision to construct its new assembly and test site in Costa Rica.

11 According to Spar (1988), on the longlist were countries like Argentina, Brazil, Chile, China, India, Indonesia, Korea, Mexico, Puerto Rico, Singapore, Taiwan and Thailand.

4. Intel's impact in Costa Rica

This section presents the macroeconomic impact of Intel's operations in Costa Rica; the knowledge spillover effect that this multinational has had on the host country's economy; and its contribution to increasing productivity in the Costa Rican economy.

4.1. Macroeconomic impact of Intel's operations in Costa Rica

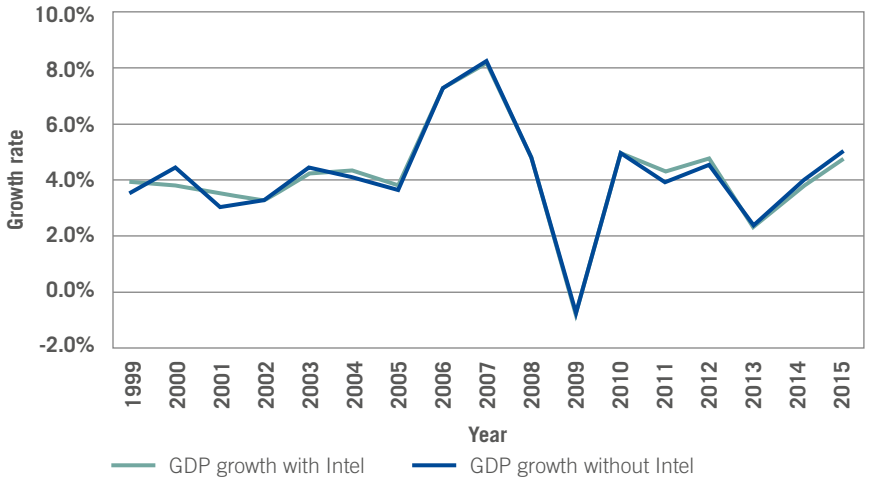
According to Rodriguez-Clare (2001), when Intel made the decision to set up a plant in Costa Rica, its projected investment was somewhere between US$300 and US$500 million. By 1999, Intel had invested $390 million and contracted over 2,200 workers with salaries higher than the national average for the manufacturing sector. The author also says Intel's investment was extraordinary, considering that Costa Rica's economy had a production of $13 billion in 1997 and a workforce of just over one million. Fifteen years later, it is appropriate to ask: what has been the impact of Intel's operation in Costa Rica at a macroeconomic level? To estimate that impact, one must analyse the growth of Costa Rica's economy (GDP in real terms) with and without Intel Costa Rica's contribution. Figure 1 shows the real GDP for the period 1999 to 2015 for both series.

First, it is important to point out that the Costa Rican economy has only had one period of contraction during only one of the 15 years in this time period (2009). This episode was related to the global financial crisis that started in the United States. Second, during the period of analysis, there is only a marginal difference between the behaviour of Costa Rica's GDP with and without the contribution of Intel. In other words, the behaviour of the country's real production is very similar with and without Intel during the entire time period.

This result is in contrast with other studies of this topic that were undertaken at the beginning of the century. For example, a World Bank (2006) study found that Costa Rica's growth was largely dependent on Intel's production in the country. There is an explanation for this discrepancy. In earlier years, Costa Rica's central bank included the primary materials Intel Costa Rica imported on consignment and all the transfer costs the company reported in its calculations of Intel's production. Put another way, earlier studies evaluated Intel's gross rather than net contribution to the economy.

With the publication of the new manual for national accounts in 2008, this practice changed and only the service of transforming products imported by Intel Costa Rica was counted. This new method is considered more appropriate because it provides for a more precise measurement of Intel's (or any multinational's) contribution to national production.[12]

Figure 1. Real GDP growth in Costa Rica with and without Intel, 1999–2015 (Base year 2012)



Source: The author, based on data from the Central Bank of Costa Rica.

Having made the above clarification, it makes sense to assess the relative impact of Intel's activity on production in Costa Rica measured in net and real terms. Figure 2 shows the series of data for this variable for the period 1998–2015.

The numbers in Figure 2 demonstrate that Intel's contribution to Costa Rican production has oscillated between 0.29 and 0.90 per cent during the period 1998 to 2015. Put another way, Intel's production represented a maximum of one per cent of Costa Rica's GDP during that time period. On average, it represented 0.61 per cent of the GDP of the Costa Rican economy. According to statistics from the Central Bank of Costa Rica, there is no other multinational corporation operating under the free trade regime that has a comparable impact on the country's GDP.

12 Interview with Henry Vargas, Director of the Macroeconomic Statistics Department of the Central Bank of Costa Rica.

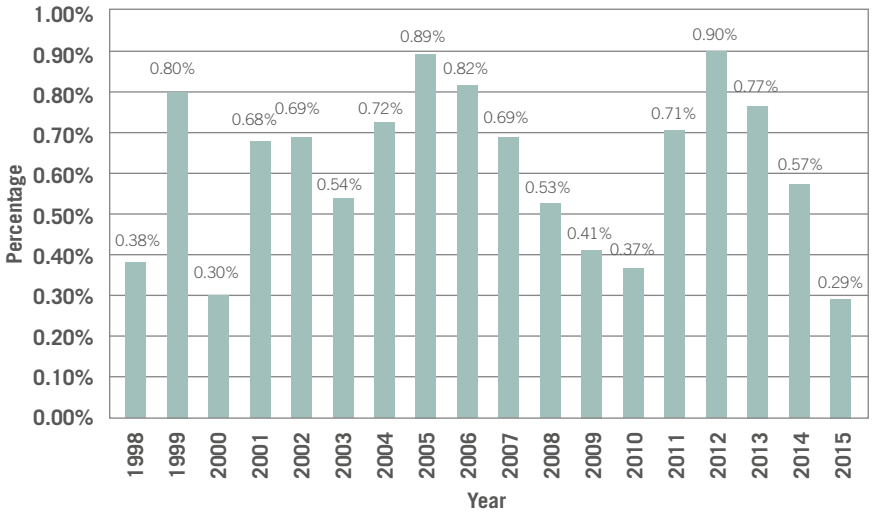
Costa Rica has a special regime for attracting foreign and national investments called Free Trade Zone Regime, which was established by Law 7210. A free trade zone is a geographic area of the country inside of which companies can import foreign merchandise (e.g. raw materials) free of all duties and other taxes.

The companies allowed to apply to the free trade area are (a) service export companies that export at least 50 per cent of their total sales; (b) companies in strategic sectors, as defined by Cost Rican authorities, located outside of the Greater Metropolitan Area (Gran Area Metropolitana, GAM); (c) scientific research companies and organizations; and (d) important suppliers whose sales to companies in the free trade area are at least 40 per cent of their total.

Companies within the GAM are exempt from 100 per cent of the tariffs on their imports and exports; taxes on dividends, honoraria and royalties; income from interest; taxes on local purchases of goods and services; and stamps. These companies can also obtain 100 per cent exemption for ten years on property taxes, taxes on transfers of property and municipal operating licenses. In addition, projects for services or for manufacturing-only companies can obtain a 100 per cent exemption on income taxes for the first eight years and 50 per cent for the following four years.

Companies outside of the GAM receive a 100 per cent exemption on tariffs on imports and exports, taxes on royalties, expenses and dividends; income from interest; taxes on local purchases of goods and services; and stamps. These companies can also receive 100 per cent income tax exemption for the first 12 years and then 50 per cent for the next six years.

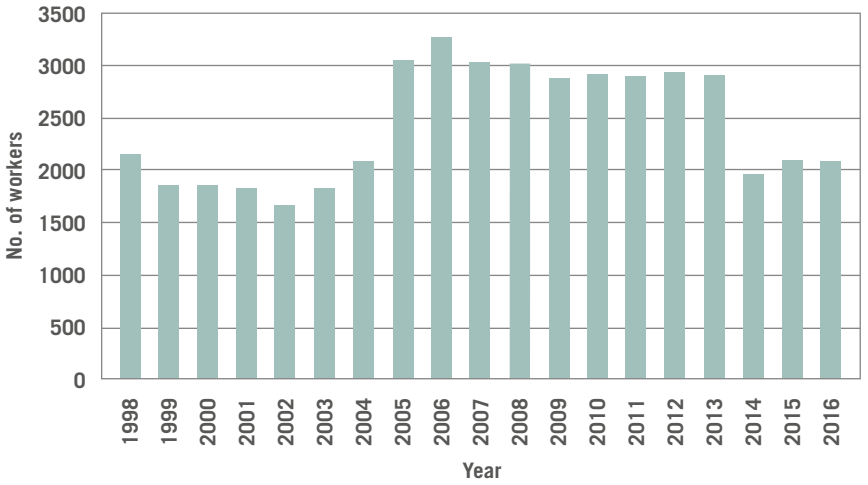
Figure 2. Intel's contribution to Costa Rica's GDP (1998–2015) (percentage)



Source: The author, based on data from the Central Bank of Costa Rica.

When it comes to generating employment, Intel Costa Rica has had three clear periods of job creation, as depicted in Figure 3. During the first period, 1998–2003, there was a relatively stable rate of job creation. In the second period, 2004–2013, the number of jobs Intel created was far superior to the previous period. Lastly, it was during the third period, 2014–2016, when Intel transferred its manufacturing operations to Asia, increased its shared services, and began research and development (R&D) activities in Costa Rica. In this period, employment levels returned to those seen in the first period of its operations in Costa Rica, but the personnel hired were more qualified. This topic is further elaborated upon in Section five.

Figure 3. Number of employees in Intel Costa Rica per year (1998–2016)

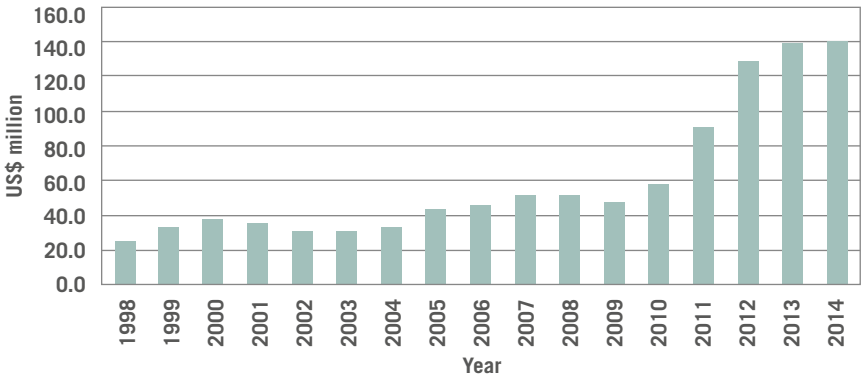


Source: The author, based on data from Intel Costa Rica.

A complementary way to see the importance of Intel's operation in Costa Rica is to analyse its employee compensation rates. Figure 4 shows growth in this variable during the period 1998 to 2014, with significant growth starting in 2011. One important characteristic of Intel Costa Rica's operation is that its compensation has always been above the manufacturing industry's average in the country. In fact, as Figure 5 shows, during the period between 2003 and 2014, the average salary paid by Intel Costa Rica was on average triple that of the manufacturing sector average. In addition, the difference between these has increased since 2011. This result confirms the findings of a previous study by Rodríguez-Clare (2001) on this issue for the year 1999. In conclusion, Intel's operation in Costa Rica has generated more and better sources of employment over the years.

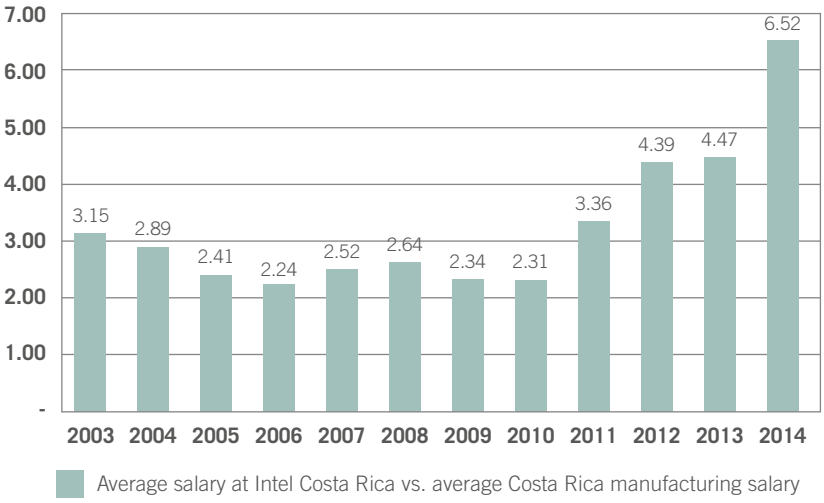
International Labour Organization

Figure 4. Employee compensation at Intel Costa Rica (1998–2014) (US$ million)



Source: The author with data from the Central Bank of Costa Rica.

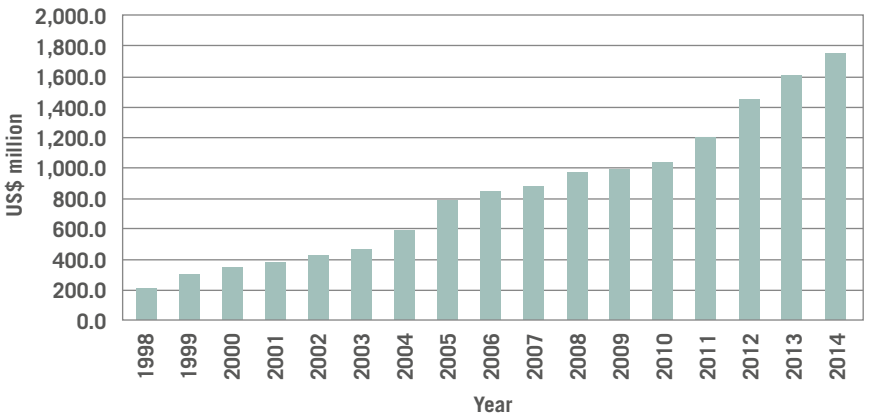
Figure 5. Average Intel Costa Rica salary versus the average salary in the Costa Rican manufacturing sector (2003–2014) (absolute values)



Source: The author, with data from the Central Bank of Costa Rica. Statistics for employees, workers and salaries, from Costa Rica Social Security and Intel Costa Rica.

Intel's continued investment during its years operating in Costa Rica is another variable that demonstrates the company's impact on the country. Figure 6 shows a sustained growth of accumulated investment year after year. The total investment grows more significant after 2010 when, according to statistics from Intel Costa Rica, 96 per cent of investments were for machinery, equipment and improvements to buildings.

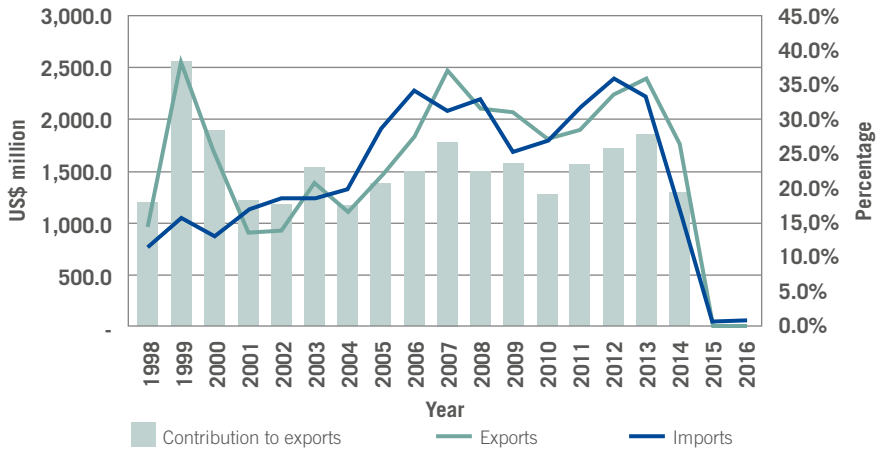
Figure 6. Accumulated investment in Costa Rica (1998–2014) (US$ million)



Source: The authors, with data from the Central Bank of Costa Rica.

Figure 7 shows the exports and imports of Intel in Costa Rica. Here one can see that both exports and imports of goods for Intel's operations have led to significant growth in foreign trade for Costa Rica. In fact, in 1999, exports of Intel's goods represented 38.5 per cent of total exports of goods from Costa Rica (right side, vertical axis). This contribution was between 17.5 per cent and 38.5 per cent up until 2013. During the period in which Intel Costa Rica was dedicated to the assembly and testing of micro-processors (1998–2013), both imports and exports demonstrated a growth trend. Since 2014, due to Intel Costa Rica's climbing the GVC, there has been a significant drop in Intel's imports and exports of goods.

Figure 7. Intel's exports and imports (absolute terms and as percentages of total exports)

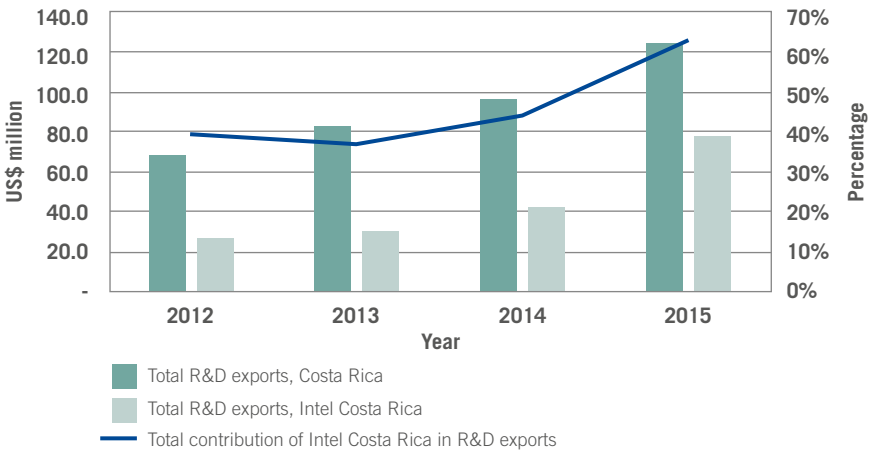


Source: The authors, with data from the Central Bank of Costa Rica.

Figure 8 shows that while Intel's contribution to foreign trade has all but disappeared, its contribution to exports of R&D services has grown significantly, becoming the principal source of these kinds of exports.[13] Of a total of $124.8 million in R&D exports in 2015 from Costa Rica, 60 per cent (right vertical axis) are from Intel Costa Rica. This shows that Intel Costa Rica's new operations could constitute an important catalyst to the extent that they demonstrate to other multinationals in and outside of Costa Rica that the country is a good location for R&D operations. This is precisely what Intel did in 1996 by showing the world that the country was a suitable location for manufacturing operations for efficiency-seeking multinationals.

13 According to the Central Bank of Costa Rica, exports of R&D services are sales, transfers or donations of services related to basic research, applied research and experimental development of new products and processes by a resident or non-resident. In the case of Intel Costa Rica, the exports of R&D services refer to test units that underwent revisions in their lifecycle and the different validation steps this involves, including post-sales support and error correction.

Figure 8. R&D exports, Intel Costa Rica and Costa Rica



Source: The author with data from the Central Bank of Costa Rica.

While the above result is very positive for Costa Rica, it also highlights a significant challenge for the country. To maintain and attract more R&D investments, Costa Rica needs to make big improvements to innovation and technology capabilities, as some authors have pointed out. (Paus, 2014; Freund and Moran, 2017). Furthermore, the country must bring about significant progress in its technological capabilities and increase its productivity if it wants to harness the potential externalities of the multinational corporations' R&D operations to break out of the middle income trap. This is a situation, as mentioned above, of low economic growth, in which a middle income country cannot compete internationally in standard labour intensive products because its salaries are relatively high, but cannot compete in high value-added products at a big enough scale because it lacks the technological and productive capabilities to compete with the most advanced countries.[14]

Another outcome that is useful to analyse at the macroeconomic level is Intel Costa Rica's generation of domestic value added (DVA) for the host country. To understand how important the DVA is, one must answer the following question: for each dollar that Intel Costa Rica produces and exports, how many cents stay in the country in the form of payments for domestic production factors (e.g. labour) and the purchase of local inputs (e.g. electricity)?

14 See Paus (2017) in Salazar-Xirinachs and Cornick (eds) (2017).

Estimates of the DVA were calculated for 2013 and 2016, so as to include both of Intel's operations in Costa Rica (the first for the assembly and test operation and the second for shared services and R&D). To the value for each of these reference years, several expenses were added, including: total wages and salaries; purchases of inputs (goods and services) from Costa Rican companies; and the consumption of electricity, because it is supplied by a local company. The values obtained for each year were divided by the total value of Intel's sales in each of these years, respectively.

The results of this exercise show that for 2013, the DVA for Intel Costa Rica was 18 per cent, while for 2016, for the new operation in shared services and R&D, the DVA had increased to 44 per cent. In other words, for each dollar that Intel Costa Rica produced and sold outside of the country in 2013, 18 cents stayed in the country in the form of payments for the factors of production and inputs produced by Costa Rican companies. In 2016, for each dollar exported, 44 cents stayed in Costa Rica for these same purchases. As will be discussed at greater length in Section 5, this outcome is a result of Intel Costa Rica's climb up the GVC of the Intel Corporation.

In conclusion, during the 19 years in which Intel has operated in Costa Rica, the company has had a significant and positive macroeconomic impact on areas like growth of production, foreign trade, direct foreign investment, employment, salaries, contributions to social security, and by increasing the DVA.[15]

4.2. Externalities of Intel's business in Costa Rica

The operation of medium and high-tech multinational corporations in a host country can become an important source of knowledge acquisition for local companies. This can take the form of knowledge transfers, through commercial agreements between multinationals and local suppliers, or knowledge spillovers from the multinationals to the local companies.

The kinds of knowledge that can be transferred or spill over include the exchange of best practices; the acquisition of specialized equipment to which locals would not have access if it were not for a relationship with the multinational; acquisition of technology and know-how; acquisition of systems that process information; access to specialized databases to which other companies do not have access; acquisition of specialized production processes; exchange of lessons learned in subsidiaries in other parts of the world; quality certifications (e.g. ISO); specialized auditing; and access to capital

15 This last variable is directly associated with growth of salaries of the employees of Intel Costa Rica.

markets. The underlying reasoning for this is that the technological and administrative superiority of the medium and high-tech multinationals can be transferred, or spill over to the business class of the host country (Zhang et al., 2010).

In contrast to knowledge transfers, in which a multinational receives compensation for the knowledge transferred, knowledge spillovers are a positive externality. The spillover is defined as knowledge created by a multinational company that is utilized by a local company in the host country, without the multinational receiving any compensation for the use of this knowledge (Javorcik, 2004).

According to Farole and Winker (2014), a good conceptual framework is essential for studying the determinants of externalities (knowledge spillovers) associated with a multinational operating in a host country. They say there are three important mediating factors that determine the nature and extent of these spillovers. These are: the potential for spillovers from the multinational company (particularly in the context of investments within the global value chain); the absorptive capacities for knowledge by domestic agents (companies and workers); and the institutional environment in the host country. In addition, one must take into account the fact that these spillovers occur within specific transmission channels from the multinational to the local economy. These transmission channels exist in the links of the supply chain; in labour markets (labour mobility); and through the effects of competition, demonstration and collaboration between multinationals and domestic companies.

Taking Farole and Winkler (2014) as a reference, Monge-González, Hewitt and Torres-Carballo (2015) say that the productive links between domestic and multinational companies in the Information and Communications Technology sector (ICT) to which Intel belongs, are limited by the poor absorptive capabilities of domestic companies (i.e. technological and innovation capabilities); some limitations in the institutional environment in Costa Rica; and certain characteristics of the multinational companies. The work of An, Oh and Monge-González (2015) supports this finding.

When it comes to the characteristics of the multinationals in the ICT sector, the cited authors say that the country has to improve its strategy of attracting foreign investment to ensure that the multinationals it does attract have the right profiles for generating knowledge and technology spillovers. In this sense, the global strategy of production and purchases is a fundamental issue.

When it comes to global purchasing and production strategy, if a great portion of the added value is considered a basic competency of the multinational, it is probable that this company will have little interest in local suppliers beyond any non-commercial or standard supplies, such as packaging materials (Paus, 2005; Paus and Gallagher,

2008). In contrast, if the multinational is focused on high value activities, such as R&D, marketing, branding or design, there are greater possibilities that domestic companies can participate in other activities in the value chain and get involved with the production systems of the multinationals (Phillips and Henderson, 2009). Indeed, Giroud, Jindra and Marek (2012) found evidence in a sample of five emerging countries that the external integration of a technology company has positive impacts on the intensity of the links of the productive chains moving backwards in the hosting countries. (This external integration refers to collaborating with local suppliers or clients on the multinational's R&D and innovation activities.)

It is important to recall that Intel's operation in Costa Rica in 2013 was focused on the assembly and testing of microprocessors and that since 2014 it has been focused on higher value-added activities, principally on R&D. According to what Paus and Gallagher (2008) assert, one would expect that during the first period of Intel's operations in Costa Rica (1998–2013) its domestic purchases across productive chains would be smaller than during the second period, during which the operations are more focused on higher value-added activities. To validate this assertion, one can analyse Costa Rica's inputs for the years 2013 and 2016, which are presented in Table 1.

Table 1 shows that in 2013 the purchases of local supplies represented 26 per cent of Intel Costa Rica's total purchases and in 2016 these represented 69 per cent. This increase is a result of the productive transformation of operations that took place in 2014. In addition, while the number of international suppliers decreased significantly from 231 to 99, in the case of domestic suppliers, these shrank from 190 to 150. The type of suppliers are different in these two years because the company was involved in different productive activities at these times.

Table 1. Intel Costa Rica's imported and domestic inputs, 2013 and 2016

Purchases of Inputs	2013			2016		
	No. of suppliers	US$ million	Percentage of purchases	No. of suppliers	US$ million	Percentage of purchases
Imported	231	143.1	74%	99	10.2	31%
Domestic	190	49.5	26%	150	22.4	69%
Total	**421**	**192.6**	**100%**	**249**	**32.6**	**100%**

Source: The author, with data from Intel Costa Rica.

During the period up to 2013 in which Intel Costa Rica was focused on the assembly and testing of microprocessors, it imported its strategic inputs from abroad, because in Costa Rica there was no local production of these inputs such as the silicon wafers, the main input in the assembly and testing of microprocessors.[16] For this reason, the three most important inputs purchased by Intel in Costa Rica were electricity, maintenance and nitrogen. In other words, the inputs that Intel acquired in Costa Rica were not directly related to the core productive activity of this company because the strategic inputs were not produced there.

Nevertheless, it is important to point out that one of the positive aspects of the generation of productive chains is that the decision on where to buy inputs is principally up to Intel Costa Rica, after consulting headquarters, even in the case of non-commercial services and standard inputs. At the same time, it is positive that it was not a problem for this subsidiary to acquire these inputs in the host country.

In summary, it is clear that knowledge and technology spillovers from Intel to the rest of the Costa Rican economy do not only depend on the characteristics of the operation in the host country itself. They also depend on the absorptive capacities of local agents and the institutional framework in which both Intel and the agents operate. Below is a review of the existing literature on Intel with regard to spillovers in the Costa Rican economy for these three channels, taking into account the abovementioned issues.

(i) Knowledge spillovers from linkages in the supply chain

In the first study on this topic, Larraín, López-Calva and Rodriguez-Clare (2000) found that a significant percentage of Intel Costa Rica's suppliers said that they had received training from Intel, had changed their organizational practices, or introduced changes in the variety of their products as a result of Intel's requirements. According to this study, Intel Costa Rica's suppliers generated changes in the inputs markets that have benefited other client companies.[17] For example, some said they had improved the quality of their products or services after Intel's arrival. This is the case for companies that manufacture packing materials. They reported producing these inputs in a more sophisticated fashion as a direct or indirect result of Intel's demand for this kind of a product.

Rodriguez-Clare (2001) says another important impact related to linkages that resulted from Intel's arrival in Costa Rica was the fact that FedEx and UPS initiated operations

16 See https://youtu.be/GMvQ4igmo1Q

17 It is important to remember in the discussion of Table 1 that Intel Costa Rica had 190 local suppliers in 2013.

in Costa Rica to service Intel.[18] This resulted in new logistics services for the rest of the Costa Rican economy by way of direct flights to various destinations in the US.

Despite these changes, it is clear that the overall impact of Intel Costa Rica in terms of technological externalities has been relatively small, mainly because of the type of investment Intel made in the country – assembly and testing of microprocessors – and because the strategic inputs were not produced in Costa Rica, especially during the first period of analysis (1999–2013). Clearly, another reason that Costa Rica was not able to take advantage of the potential knowledge spillovers from Intel or other high-tech multinationals is because it did not transform institutions or adopt substantial policies to improve the absorptive capacity of local companies and workers. (Paus, 2014; Monge-González, Rodríguez-Álvarez and Leiva, 2015; Monge-González, Hewitt and Torres-Carballo, 2015). This became an important issue for the second period of operations of Intel Costa Rica after 2014.

According to the authors cited above, the low absorptive capacity of Costa Rican agents limited the knowledge and technology spillover potential from multinational corporations, like Intel, in the ICT sector. Even though the authors do not categorize these limitations on absorptive capacity, they do indicate that they are associated with relatively low levels of productivity, low participation levels of qualified workers in the labour force, low levels of innovation and exports, and the small scale of production. When it comes to the institutional environment for facilitating productive linkages, the same authors find negative factors in access to financing, telecommunications infra-structure, lack of innovation promotion, deficient development of human resources, and deficiencies in the design and implementation of policies governing foreign trade, investment and industry (Monge-González, Rodríguez-Álvarez and Leiva, 2015). More research is needed on absorptive capacity and on the institutional environment to determine which of these limitations are most significant and prioritize efforts to eliminate them.

According to Paus (2014), during the recent decades in which Costa Rica has promoted the transformation of its productive structure, the public sector has under-invested in education, infrastructure and R&D. This is in stark contrast to its levels of investment in the development of social capabilities during the era of import substitution. Since the beginning of this century, the Costa Rican government has increased investment in education, measured as a percentage of the GDP (close to eight per cent), and in public universities, in order to increase the teaching capacity in high demand areas like sciences, technology and engineering. Through large loans from international

18 Other logistics companies that initiated operations in Costa Rica after Intel's arrival are DHL and Deutsche Post.

organizations such as the World Bank and the Inter-American Development Bank, it has also invested in technology infrastructure (Monge-González, 2016).

Despite these efforts, when it comes to the quality of education, PISA evaluations show clear educational deficiencies in Costa Rica. The statistics for 2015, presented in the PISA 2016 report, show that the test results in sciences, mathematics and reading comprehension in Costa Rica are much lower than the average for the Organisation of Economic Co-operation and Development (OECD) countries.[19] In 2015 Costa Rica had a score of 420 in sciences, much lower than the OECD score of 493. In mathematics, Costa Rica had an average of 400 points, while the OECD had 490. In reading comprehension, the results for Costa Rica were also much lower than the average for the OECD (427 and 493, respectively).

Another way to analyse the results of the PISA evaluations is to look at the percentage of 15-year-old students who have performance levels of 1 or lower. According to De la Rica and López (2010, p. 4), "PISA considers that a student at level one or lower is at risk of not being able to face the formative, labour and civic challenges after the end of compulsory education with a sufficient likelihood of success".

According to the most recent statistics published by the OECD on competence in sciences, Costa Rica performed poorly as compared to the average of the OECD countries. In fact, according to the OECD report for 2015, the percentage of students who are in performance level 1 or lower is 18.5 per cent for the average OECD country, while for Costa Rica this figure is 29.4 per cent. The outcome is similar for the results of the PISA mathematics exams in which the OECD average was 20.2 per cent, while for Costa Rica it is 39.7 per cent. For reading comprehension, the OECD average for levels 1b, less than 1b, and less than 1a, was 17.5 per cent, while the average for Costa Rica was 25.7 per cent. In other words, compared to the average for the OECD, between one and a half and double the number of students in Costa Rica are at risk of not being able to face the formative, labour and civic challenges that they will encounter at the end of their years of compulsory education with a sufficient assurance of success.

As a result, it is clear the social capabilities that Paus (2014) refers to are in need of improvement, something that can be achieved by improving the quality and coverage of education. Further, due to the low absorptive capacity of Costa Rican companies documented recently by Monge-González, Rodríguez-Álvarez and Leiva (2015), local

19 Costa Rica's results are compared with the average of the OECD because the country is in the process of joining this group of countries.

companies need to create and sustain a high-performance learning process (Nübler, 2014). All of these challenges constitute significant barriers that Costa Rica needs to overcome to free itself from the abovementioned middle income trap.

Intel Costa Rica's climb up the GVC beginning in 2014 offers significant opportunities for increasing local purchases in specialized services such as information technology and R&D, as international experiences in this area have demonstrated. Now that Intel Costa Rica operates in high value-added activities these are more apt to generate externalities – knowledge and technology spillovers – for the rest of the economy (Farole and Winkler, 2014; Giroud, Jindra, and Marek, 2012).

To address this point, it is useful to analyse the relative importance and the composition of Intel Costa Rica's purchases of local services in 2013 and 2016, before and after the company's climb up the GVC. Table 2 shows that in 2013 services constituted 81 per cent of Intel Costa Rica's purchases and by 2016 these accounted for all of the local purchases as a result of the transfer of assembly and test operations to Asia. As a result of the climb up the GVC, the purchases of specialized, local services have increased in relative importance, specifically Information Technology (IT) services and R&D, which went from five per cent in 2013 to 17 per cent in 2016.

This result is consistent with findings in Castro (2016). The author found that from the perspective of the supply chain, the structural change in Intel Costa Rica's operation has changed the kinds of suppliers the company uses, from packaging and label manufacturers to higher value-added engineering services. Indeed, the author points out that a significant number of Intel Costa Rica's linkages are now in software development companies, including outsourcing from contractors, custom software development for internal products and purchases of software (licenses and permits).

Table 2. Intel Costa Rica's local purchases for 2013 and 2016 as a percentage of the total

Type of Purchase	2013	2016
Corporate services (construction, maintenance, facilities, electricity)	71%	77%
Consultancy services in finances	1%	3%
Consultancy services in human resources	4%	2%
Information technology services	4%	7%
R&D services(software, logistics, training and consulting)	1%	10%
Manufacturing inputs (packaging suppliers)	19%	0%
Total	**100%**	**100%**

Source: The author, with data from Intel Costa Rica.

In summary, Intel Costa Rica is dedicated to higher value-added activities that are more likely to create externalities in terms of technology and knowledge spillovers for the rest of the economy. This creates important opportunities for Costa Rica to put into place public policies to help the nation take advantage of them.

(ii) Knowledge spillovers through labour mobility

The arrival of Intel and other multinationals in Costa Rica promoted the creation of a new labour force with more sophisticated capabilities and knowledge than was the case before their arrival. Monge-González and González (2007) found evidence that high-tech multinationals located in Costa Rica provide their employees with a significant amount of training, education and work experience. In addition, a good number of Costa Ricans working for multinationals are outside of the country creating a diaspora of human talent.

Complementary to this, there is evidence of labour mobility from the multinationals that work in Costa Rica to the rest of the productive sector of the country. For example, Monge-González et al. (2005) found that 36.2 per cent of the managers, 27.6 per cent of the engineers and 31.0 per cent of the technicians who work in local companies that supply multinationals had previously worked in multinationals in Costa Rica. The authors also found that 27.6 per cent of the local supply companies have at least one owner with prior experience working in one of the multinationals that operate in the country.

Lastly, Monge-González (2010) identified 15,139 employees of multinationals, including Intel Costa Rica, that stopped working in these companies between 2001

and 2007 and went to work for local companies. An analysis of the kinds of companies to which the majority of these employees transferred revealed that a little less than three quarters of them (72 per cent) are small, medium and large Costa Rican companies. Further, these companies absorbed 86 per cent of all former employees of multinationals who transferred to private companies between 2001 and the end of 2007. According to this author, this is evidence that there could be knowledge spillovers from multinationals to local companies as a result of labour mobility.

(iii) Knowledge spillovers as a result of collaborations between multinationals and domestic actors

Monge-González and González-Alvarado (2007) found that high-tech multinational corporations contribute significantly to the development of skills and knowledge in Costa Rica, in particular in the case of Intel, Microsoft and Cisco. They underscore the importance of the interactions these companies have with the country's learning and innovation infrastructure. They describe how these three multinationals, the universities and the training and research institutes worked together to develop curricula that better responded to the demands of the productive sector. This outcome supports the findings of Ciarli and Giuliani (2005) which showed significant interactions between Intel Costa Rica and the learning system.

Generation of technological externalities by Intel and other high-tech multinationals was, however, very limited. The same could be said for the interactions between these multinationals and their suppliers with the national innovation system (NIS). A World Bank study (2006) supported the findings of Carli and Giuliani (2005). A more recent study by Navarro and Morales (2013) highlighted Intel's promotion of investment in education and human capital in Costa Rican society. They report that Intel stood out for its development of various programmes at the secondary and higher education levels in Costa Rica.

Navarro and Morales (2013) also analysed Intel Costa Rica's negative and positive externalities five years after it began operations in the country. They found that, on balance, the results were positive for the country, when the company successfully internalised the negative externalities. This was the case with some environmental impacts for which Intel Costa Rica invested in treatment plants, recycling, and waste exports, among others. The company also made significant efforts to train employees and raise their awareness of occupational health. The company received an award for this work from the National Insurance Institute of Costa Rica.

Specifically, in this last field of action, Intel Costa Rica has carried out a series of health and safety programmes since it renewed its operations at the beginning of 2015.This

work has been focused mostly on its offices and included the programmes "Ergonomics to support the system of procedures for health and safety", "Campaigns for health and safety", "Effective and immediate response to issues and events related to health and safety in support of Intel's management systems", "Implementation of an internal page for team communication which that any employee can consult", and "Projects for active communication with the employee".

As an example of the innovations that these programmes involved, in the ergonomics programme, a team from Intel used a software package called Wellnomics to work directly with the managers of all of the organizations to provide training, monitoring and evaluation for mitigating the risks associated with poor ergonomics. This software was installed in all Intel Costa Rica computers to monitor ergonomic exposure during office activities and to control breaks and rests. It also generated proactive evaluations and a profile to monitor all of the employees.[20]

Lastly, according to Monge-González, Hewitt, and Torres-Carballo (2016), Costa Rica could be facing salary inflation in the ICT sector, to which Intel belongs, due to the increase in the number of companies in the sector and the existence of a significant gap between the demand and supply of qualified labour. This presents a considerable challenge for Costa Rican authorities' quest to attract more foreign investments that are focused on efficiency and asset seeking and in which multinationals want to use the technological or skills-intensive resources in the host country.

In conclusion, Intel has produced positive externalities for the Costa Rican economy. It has served as reference for the rest of the international business sector on the investment climate in the country (Banco Mundial, 2006). It is also a reference for the promotion of high standards in occupational safety, environmental management and investment in education and human capital in Costa Rica (Navarro and Morales, 2013). In addition, Intel Costa Rica has been able to internalise negative externalities (e.g. environmental impacts), showing how a company should address these issues.

In contrast, there have been few technological externalities. This is due to the kind of investment Intel made in Costa Rica. It is also due to the fact that Intel has made few productive linkages with local companies in its core activities (i.e. strategic inputs) because these inputs are not produced in the host country. This was the case during the period in which Intel Costa Rica was an assembly and test operation. Intel Costa

20 More examples are available in the document "Premio Global Preventico. Solicitud de Participación Componentes Intel de Costa Rica. Solicitud de participación para la versión 2016 del premio de la empresa componentes Intel de Costa Rica dentro de la Modalidad A (Anexo1), Programa de Mejora en Seguridad e Higiene Ocupacional." (noelia.gomez.serrano@intel.com / Anibal.Alterno@intel.com).

Rica's climb up the GVC constitutes a valuable opportunity to increase knowledge spillovers and, as a result, technology externalities for the rest of the Costa Rican economy. As mentioned above, this presents considerable challenges for Costa Rican authorities and requires a substantial improvement in the quantity and quality of human resources in sciences, technology, engineering and mathematics (STEM) and a greater absorptive capacity among local companies and in the national innovation system.

The NIS of a country is composed of the elements and the relationships that interact in the production, dissemination and use of new and useful knowledge for the economy (Lundvall, 1992). The NIS has to do with the efficiency with which a country is capable of setting up a system for learning and innovation. In other words, it is the system for the acquisition, creation and dissemination and utilization of knowledge. The central idea of this concept is that companies, universities and research centres acquire external knowledge or create new knowledge in an efficient manner. And also how this knowledge is disseminated and utilized by other institutional actors (Lee, 2013).

5. Climbing the Global Value Chain: Structural transformation in Intel's Costa Rica operation

Since beginning operations in Costa Rica in 1998, Intel has increased its productive activities, going from the assembly and testing of electronic components at the beginning to eventually include global shared services and research and development (R&D) starting in 2014.[21]

Starting that year, Intel Costa Rica focused its production on two groups of activities: (i) shared services, and (ii) the Center for Research and Development.

In April 2014, Intel Costa Rica announced it would move the assembly and testing of processors for laptops and servers to Asia, a process which lasted until the end of 2014. Given the importance of Intel's operations in Costa Rica (e.g. 27.8 per cent of the country's exports and one per cent of its GDP), this news had a high impact on government, the private sector and academia.[22] The justification that Intel Corporation gave for the move was to guarantee the efficiency and effectiveness of the firm worldwide.[23]

In addition to moving assembly and test operations to Asia, Intel Costa Rica later announced that its engineering and design departments in Costa Rica would remain and that it would need to hire a greater number of engineers to fill approximately 200 specialized positions. The company also confirmed its intention to keep its shared global services operation in the country.

Intel Costa Rica announced that it would lay off 1,500 employees before the end of 2014, and did so. By the beginning of 2015, the restructuring of Intel Costa Rica had eliminated the jobs of nearly half of its employees.

The main characteristic of this structural transformation at Intel Costa Rica involved a change of the company's activities along its value chain, specifically a climb to higher

21 According to Intel, in 2004 the Global Services Center in Costa Rica paid 51 per cent of the company's suppliers around the world; the monthly pay to more than 50,000 collaborators of Intel worldwide; and provided technical assistance to 150 offices in various languages (English, Portuguese, German and French).

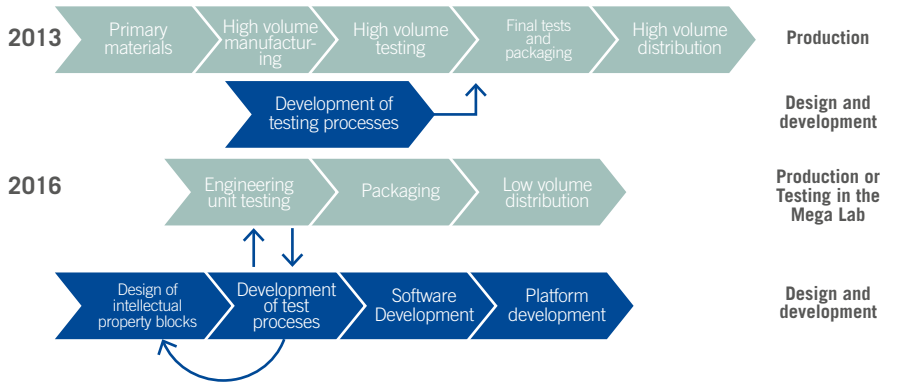
22 According to data from the Central Bank of Costa Rica (see Figures 2 and 6).

23 According to an Intel Costa Rica press release, April 2014.

value-added activities. To demonstrate the significance of this change, Figure 9 shows the activities undertaken by Intel Costa Rica in 2013 and 2016, or the year before and two years after the structural transformation.

As is depicted in Figure 9, the production functions related to assembly and testing were significantly reduced in importance as compared to 2013. This is a result of the fact that with the creation of the R&D centre in Costa Rica, Intel created a new work area for design and development. The shared services activities are not included in Figure 9 because these are support services for diverse activities within the GVC.

Figure 9. Change in Intel Costa Rica's activities on the global value chain (2013 vs. 2016)

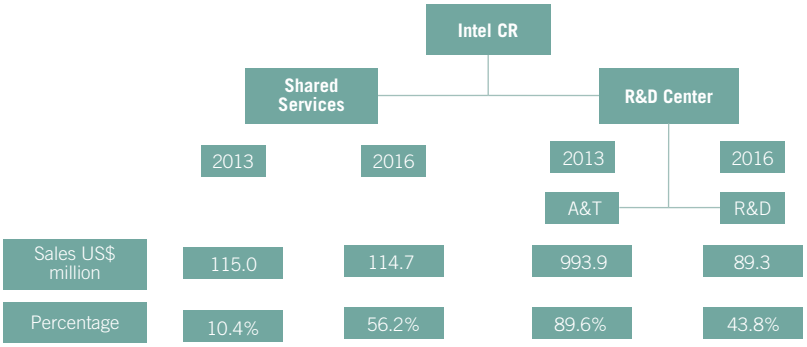


Source: The author, with data from Intel Costa Rica.

This structural transformation can be observed more clearly by comparing Costa Rica's sales, by productive activity, for the years 2013 and 2016. These activities include assembly and testing, shared services, and R&D. In 2013, Intel Costa Rica did not have any R&D activity (this activity began in 2014) and in 2016 the company did not have assembly and test activity (it suspended these activities in 2014). Thus, on the right side of Figure 10 for 2013 there are only statistics for assembly and testing (A&T) and for 2016 only for R&D. In contrast, on the left side of Figure 10 there are values for sales of shared global services for 2013 and 2016, because Intel was dedicated to this activity before the transformation.

In this figure it can also be seen that during 2013, assembly and testing represented 89.6 per cent of Intel Costa Rica's productive activities, complemented by the incipient activity of shared services (10.4 per cent). By 2016, after the structural transformation, shared services increased to 56.2 per cent while R&D represented 43.8 per cent of Intel Costa Rica's sales that year.

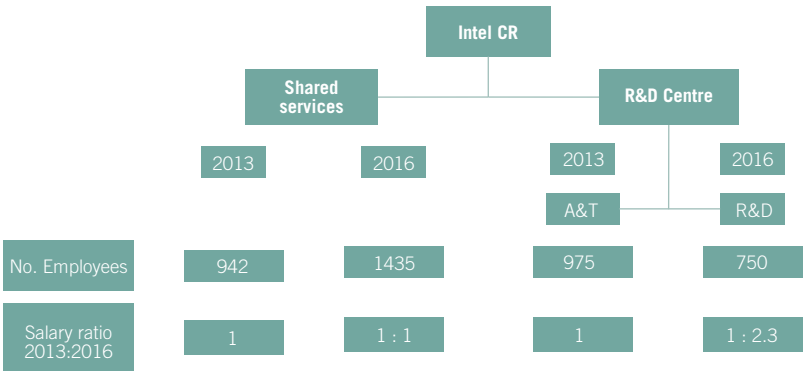
Figure 10. Structural Transformation at Intel Costa Rica, sales (2013 vs. 2016)



Note: At the end of 2014, Intel Costa Rica stopped assembly and test operations and commenced R&D activities on the same date.
Source: The author, with data from Intel Costa Rica.

A complementary way to see the importance of the structural transformation of Intel Costa Rica is to analyse the kind of activities and workers employed in these activities and their average salaries for the years 2013 and 2016. This information is presented in Figure 11.

Figure 11. Structural Transformation Intel Costa Rica, salaries and employment (2013 vs. 2016)



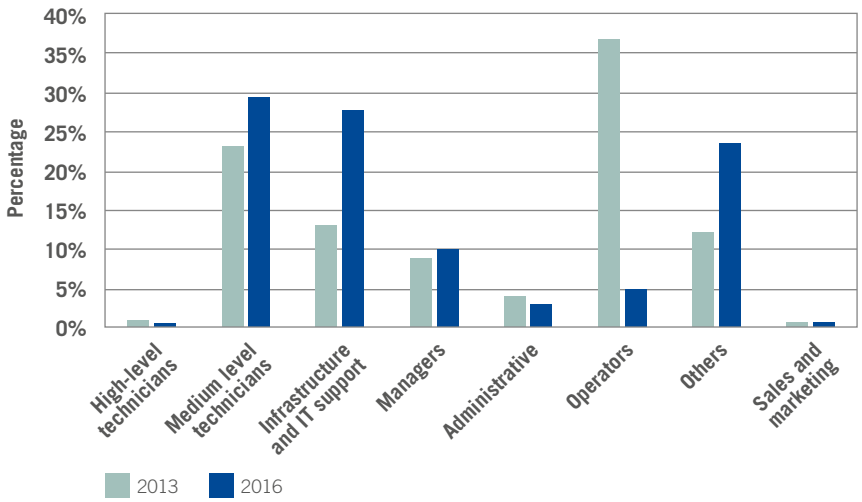
Note: At the end of 2014, Intel Costa Rica stopped assembly and test operations and commenced R&D activities on the same day.
Source: The author, with data from Intel Costa Rica.

According to the data in Figure 11, the activities related to shared services increased between 2013 and 2016, generating a greater number of jobs for 2016 (942 versus 1435, respectively). At the same time, when the assembly and test operation was eliminated and moved to Asia, 975 jobs that existed in 2013 disappeared. However,

750 new jobs for highly-qualified workers (principally engineers) were created by 2016 with the creation of the R&D centre. The main result of the change of activities and sources of jobs at Intel Costa Rica is an increase in the average wage paid to workers, which can be seen by comparing the salaries that were paid for assembly and testing activities in 2013 with those for R&D in 2016 (a ratio of 1 to 2.3).

A more detailed analysis of Intel Costa Rica's structural transformation reveals that the workers who ceased labours in 2014 were factory personnel, operators, basic manufacturing technicians and administrative support for the factory. The jobs created as part of the structural transformation to increase shared services and start R&D were positions in electrical engineering, software engineering, IT, accounting/finances and bilingual administration. These changes are presented in Figure 12. In other words, Intel went from hiring relatively low-skilled labour to highly-qualified labour which increased how much the company spent on salaries. (See Figure 4.)

Figure 12. Change in employment composition at Intel Costa Rica, 2013 versus 2016



Source: The author, with data from Intel Costa Rica.

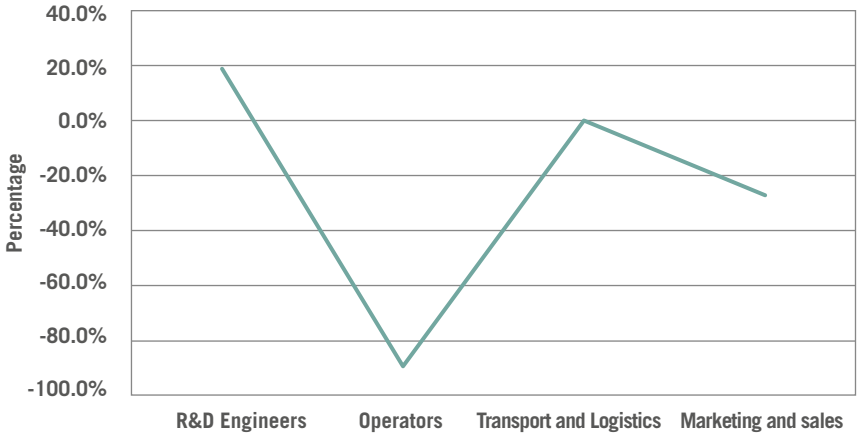
Using Baldwin's smile curve and its empirical implementation by the OECD (2016) to assess the impacts of movements along the value chain for jobs and productivity, one can analyse the changes in employment at Intel Costa Rica during 2013 and 2016. To this end, employees are grouped in the following categories: horizontal support activities; marketing, sales and post-sales services; transportation, logistics, and distribution; manufacturing operations; and research and development, engineering and related technical services.

Figure 13 shows the change in employment in the different areas within Intel Costa Rica. It reveals a pattern of specialization towards higher value-activities. This figure is a representation of the famous smile curve mentioned in the literature on GVC (Baldwin, 2012). There is a smile when the occupations have moved from operations (the middle of the curve and the value chain) towards R&D, engineering and related technical services activities (to the left of the figure) and towards activities of transportation, logistics distribution, marketing, sales and post-sales services (on the right side of the figure). The horizontal support activities (administrative, office services, maintenance and repairs) are not presented in this figure because they contribute to all production links along the value chain.

In Figure 13, one can see the smile curve for the case of Intel Costa Rica's transformation (or climb up the GVC). The number of operations employees (assembly and test) decreased dramatically between 2013 and 2016 (-89.5 per cent). Complementary to this, the jobs lost in operations have been replaced with jobs in pre-production activities (R&D) on the value chain (18.8 per cent).

This change in activities at Intel Costa Rica, or its movement up the value chain, has also resulted in a greater DVA for the company's production in Costa Rica. As was mentioned in section 4.1, in 2013 the DVA for assembly and test and shared services operations was 18 per cent. In 2016, with the new operation of shared services and R&D, the DVA was 44 per cent.

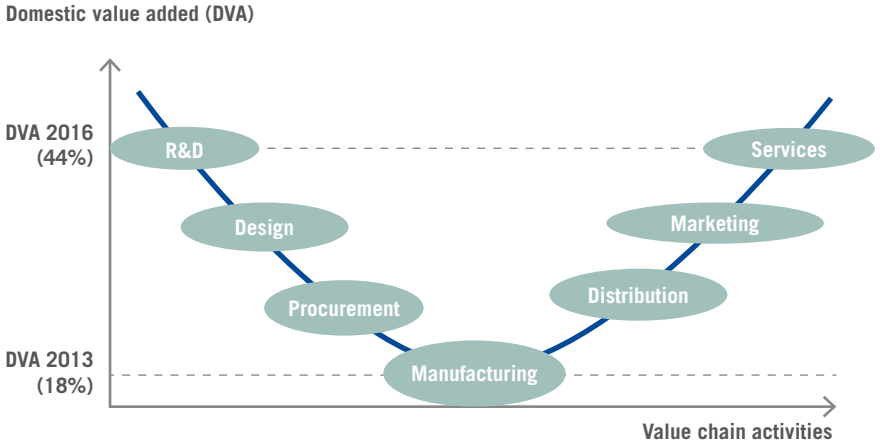
Figure 13. Change in employment at Intel Costa Rica, by roles on the GVC, 2013 versus 2016



Source: The author, with data from Intel Costa Rica.

In other words, for each dollar that Intel Costa Rica produced and sold outside the country in 2013, 18 cents stayed in the country as payment for the factors of production and inputs produced by local companies. For each dollar exported in 2016, 44 cents stayed in the country for the same expenses. Figure 14 depicts this with the theoretical version of the well-known smile curve from Baldwin (2012).[24]

Figure 14. Increase in domestic value added for Intel Costa Rica after GVC ascent, 2013 versus 2016



Source: Adapted from Baldwin (2012).

The change in the composition of the employees of Intel Costa Rica represents a dual challenge for Costa Rican authorities. On the one hand, it produced unemployment for relatively low-skilled labour and, on the other, it generated a demand for more highly- qualified labour. With regard to the first challenge, as will be demonstrated below, there is evidence that a considerable proportion of laid-off employees were hired in the productive sector in Costa Rica, including with other multinationals. This is a result of the flexibility of the labour market, the continued growth of the Costa Rican economy, and the support provided by the company for labour redeployment.

24 There appear to be inconsistencies between the curves in Figures 13 and 14. Figure 14 is the theoretical figure from the economic literature. Indeed, the left side of the smile in Figure 14 is corroborated by the data in Figure 13 and is a result of the increase in employees dedicated to R&D and the decrease in manufacturing operators. The right side of the curve in Figure 14, however, does not agree with the data in Figure 13 because in this figure the number of transport and logistics workers did not vary and marketing and sales employees decreased. Despite all this, it is important to note that in the literature it is common for smile curves to be different from the theoretical version as has been demonstrated in OECD publications depicting the outcomes for many of its member countries (OECD, 2016).

For the second challenge, while it would seem the country was capable of supplying enough highly-qualified workers for Intel to be able to move into R&D, Monge-González, Hewitt and Torres-Carballo (2016) find that Costa Rica may be facing salary inflation as a result of the significant gap between the supply and demand for highly-skilled labour, particularly in the ICT sector, to which Intel belongs. A significant and sustained increase in the supply of this type of human resource continues to be a fundamental task for Costa Rican authorities if they want other national and foreign companies to get involved in higher DVA activities like R&D and to prevent the country's skills mismatch from curbing the potential dynamism of these activities.

Intel's support programme for laid-off workers

Intel Costa Rica officials recognized the need to establish a support programme for the workers who would no longer be employed by the company after 2014. The goal of this programme was to reduce the negative impact of job loss and to improve the workers' potential to be hired elsewhere or start their own businesses.

The programme for workers who would be terminated had two components: (i) redeployment and (ii) business ventures.[25] The first included the following activities:

a) *Helping employees find new opportunities in the labour market.* The company held workshops in which experts taught employees how to write a winning Curriculum Vitae and trained them for increased success at job interviews.

b) *Promoting the collaborator*. In this aspect of the programme, the General Manager of Intel Costa Rica visited other multinationals in the country to explain the profile of the employees who would cease working for Intel and offer to put these companies in contact with them. Further, they invited human resources managers from other multinationals to the Intel auditorium to explain to them the DNA of Intel workers and give them a better idea of the kind of worker that was leaving Intel. CINDE providing critical support by inviting multinationals to this event. [26]

c) *Connecting employees with other MNCs and local companies in Costa Rica.* The company held a job fair at a hotel in San Jose. Some 42 companies and the Intel workers who were losing their jobs attended.

25 Interview with Timothy Scott, Public Relations Manager, Intel Costa Rica.

26 CINDE is the government agency responsible for attracting foreign investment to Costa Rica.

The company transported the workers to the job fair. CINDE was also involved in this event.

d) *Leave to attend job interviews.* The company offered workers a flexible schedule so they could attend job interviews. The company communicated with all Intel managers to let them know that the workers had this benefit and that it was a priority for the company.

e) *Financial support.* This area had two components. The company provided workers with financial counselling with experts to help them make better use of their severance pay. Second, the company gave laid-off workers an extra payment on top of the severance pay required by law.

f) *Psychological support.* In cases in which it was necessary, the company provided workers who were losing their jobs with professional counselling at no cost to the employees.

Parallel to these efforts, CINDE created a web page where Intel workers who were losing their jobs could post their CV for other companies to see. About 500 workers placed their CV on this webpage.[27]

While neither Intel nor CINDE had statistics on how many of the 1,500 laid-off workers were hired by companies in Costa Rica or abroad, some references suggest that this process was relatively successful. Intel Costa Rica hired 300 of these workers to occupy higher value-added positions. CINDE is aware of multinational companies like VMware, HPE, HP Inc. and Emerson, in the services sector, and Triquint, Samtec and Boston Scientific, in the manufacturing sector, that hired workers who were laid off from Intel Costa Rica.

Lastly, a prior study by Monge-González (2010) analysed the movements of more than 41,000 employees of 117 high-technology multinationals in Costa Rica, including Intel, between 2011 and 2007. The author found a relatively high turnover rate at manufacturing companies in the sample, about 30 per cent, and that approximately three quarters of the workers who stopped working in an MNC found work in the productive sector of Costa Rica within six months of leaving their previous job. It appears that the absorptive capacity in this sector of the labour market is quite high in Costa Rica, which facilitates mobility from one company to another.

27 Interview with Vanessa Gibson, director of business climate at CINDE.

It is important to note that the workers laid off as a result of restructuring received a compensation package that was higher than the average for the rest of the high-technology multinationals operating in Costa Rica. According to some of the people interviewed for this study, this could have limited the ability of some of the other companies to hire them.

The second programme sought to support those workers who were losing their jobs and who were interested in starting their own business. The programme included an intensive workshop that covered issues like the importance of business plans and investor fairs, etc. This component was executed with the support from the Foundation for Social and Economic Development (Fundación para el Desarrollo Económico y Social, FUNDES), the Chamber of Industries of Costa Rica, the "I am an Entrepreneur" (*Yo Emprendedor*) programme, ParqueTec and the Business Association for Development (Asociación Empresarial para el Desarrollo, AED). It is estimated that 50 Intel Costa Rica employees participated in this intensive workshop and there is anecdotal evidence that some workers who lost their jobs decided to launch their own businesses.

Reactions of the Costa Rican authorities to the announcement of the transfer of assembly and test operations to Asia

The Government of Costa Rica at the time began to promote meetings with Intel officials in the United States and in Costa Rica to try to convince the company to increase its investment in the country in R&D and in the shared services market in Latin America.[28] As explained below, their lobbying efforts were successful.

It is important to mention that when Intel Costa Rica announced the relocation of its assembly and test operations to Asia, Costa Rica was in an electoral campaign and when the restructuring took place in 2014, the new president was about to assume power. This was not a favourable environment for negotiating with a multinational that had announced it was about to relocate part of its operations outside of the country. This situation was only made more difficult by the fact that the incoming administration was from a different party than the outgoing one.[29]

Despite the complexity of the situation, succeeding in getting Intel Costa Rica to significantly increase its shared services operations and make a foray into R&D was, by any measure, a positive outcome. In the opinion of some of the people interviewed for

28 http://www.elfinancierocr.com/negocios/Intel-anuncia-oficialmente-salida-Costa_Rica_0_496150398.html.

29 The incoming administration was from the Partido Accción Ciudadana, while the outgoing government was from the Partido Liberación Nacional.

this study, this outcome is an indication of the strength of Costa Rican foreign trade institutions.[30] The role played by the government, through COMEX and the Ministry of Science Technology and Telecommunications (MICITT), and the role of CINDE, were all very significant factors in achieving this goal.

It is also important to note that the Costa Rican economy was in a period of relative growth, during the time when Intel Costa Rica's structural transformation took place. This made it easier for laid-off workers to find other jobs.

More recently, at the beginning of 2016, Intel Corporation decided to transform its operations worldwide. It will be moving away from the production of microprocessors to the development of memory, processors and Internet of Things technology in a move that will diversify its operations and bring about its first internal revolution in quite some time. One of the most important implications of this transformation is the internal focus on working in business units, according to the productive activities in which the corporation is currently involved. This change will have important implications for the headquarters and the subsidiaries worldwide. According to some Intel Costa Rica officials interviewed for this study, the structural transformation in operations since 2014 will enable the company to be better prepared to face challenges and take advantage of opportunities in Intel Corporation's global operations.

30 Interviews with Gabriela Llobet, former general manager of CINDE and with Anabel González, former Minister of Foreign Trade in Costa Rica.

6. Conclusions

There are numerous conclusions that can be derived from Intel Costa Rica's climb up the GVC. These are summarized below:

- Much the same as the way that Intel demonstrated to the world in the mid-1990s that Costa Rica was an attractive location for medium to high-technology multinationals, its climb up the GVC showed the world that Costa Rica is a good location for higher-value-added activities like R&D.
- The macro effects of Intel's operation on everything from production, to foreign trade, to FDI, employment, DVA, salaries and contributions to social security have been positive throughout the life of the company in Costa Rica.
- Intel has produced positive externalities in the Costa Rican economy, among which are the promotion of higher standards for occupational safety and environmental stewardship, promotion of investment in education and human capital in Costa Rica. In addition, Intel Costa Rica internalized negative externalities (e.g. environmental impacts), setting an example for how it should be done.
- The technological externalities that resulted from the productive links between Intel Costa Rica and local companies have been few. This is principally because of the type of initial investment (assembly and testing of microprocessors) and the absence of local production of the key inputs.
- With its ascent on the GVC, Intel Costa Rica now offers the possibility of greater productive links, but in R&D. Now there is potential for significant technological integration external to Intel in the form of collaboration on R&D and innovation between Intel and its local suppliers and clients. This would bring about greater knowledge spillovers and, as a result, have a greater positive impact on the intensity of productive links with the rest of the economy. Indeed, during 2016 (after its climb up the GVC) local purchases of specialized services in IT and R&D were 17 per cent as compared to five per cent in 2013 when Intel Costa Rica mostly worked on the assembly and testing of microprocessors.

- Nevertheless, it is important to remember that the absorptive capacities of the local suppliers, associated with their relatively low productivity; the participation rate of highly skilled workers in the labour force; low levels of innovation; and small scale production have a negative effect on potential knowledge spillovers. The deficiencies in the institutional framework, such as access to funding, telecommunications infrastructure, the lack of promotion of innovation, deficiencies in human resources development, and deficiencies in the design and implementation of investment and industrial policies also affect Costa Rica's ability to receive significant knowledge spillovers from this multinational.
- Intel Costa Rica's climb up the GVC has not only increased the average salaries of its workers, but also increased the DVA. For each dollar that Intel Costa Rica produced and sold abroad in 2013, 18 cents stayed in the country in the form of payments for production factors and inputs produced by Costa Rican companies. In 2016, 44 cents in every dollar stayed in Costa Rica for these same expenses.
- The institutional strength of Costa Rica in foreign trade and its coordinated work with Intel enabled the country to address the redeployment of workers who were laid off as a result of the move of assembly and test operations to Asia. It also succeeded in enabling Intel Costa Rica to climb the GVC and employ more qualified personnel to undertake its R&D work.
- The structural transformation of Intel Costa Rica in terms of attracting FDI demonstrates that the types of investments a country is able to attract (e.g. efficiency seeking versus strategic asset seeking) depends mainly on the country's level of development, particularly in terms of the capabilities of its human resources and the stage of development of its NIS.
- The relationships that Intel Costa Rica could generate with NIS actors that operate in high value-added stages constitute a potential source of knowledge spillovers and technology transfers. Indeed, Castro (2016) says after the first report on the state of science, technology and innovation (State of the Nation, 2014) found gaps and weaknesses in Costa Rica's NIS, Intel decided to play an active role in resolving some of the problems identified in this report. [31] For example, Intel opened a centre for innovation to promote a space for collaboration with NIS actors and spur innovation and

31 Available at http://www.estadonacion.or.cr/ecti/

capabilities within Costa Rica. In addition, all the employees of Intel Costa Rica can cooperate by volunteering for innovation projects in public sector entities, other companies, universities and with other stakeholders.

- In general, one can conclude that the recent climb up the GVC for Intel Costa Rica and its 15-year experience in the country is a clear example of how multinational corporations can play an important role in the promotion of innovation in a host country. This is consistent with the findings of Paus (2017). Indeed, Intel's experience demonstrates that it was able to contribute to progress in the local capabilities for innovation in Costa Rica through knowledge spillovers and for the climb up the GVC itself. However, there is work to be done for Costa Rica to be able to take advantage of the opportunities that the new Intel operations provide for improving its technological capabilities and innovating in order to overcome the middle income trap in which the country currently finds itself.

7. Recommendations

This section includes a number of policy recommendations:

- Costa Rica should work diligently on improving its technological and innovation capabilities if it wants to take advantage of the potential externalities of multinationals like Intel Costa Rica, which now is focused on R&D activities. Only with a strategy focused on innovation (greater investment in technology and innovation capabilities) and supported by a suite of complementary measures will Costa Rica escape the middle income trap. This is a situation, as mentioned above, of low economic growth, in which a middle-income country cannot compete internationally in standard labour-intensive products because its salaries are relatively high, but cannot compete in high value-added products at a big enough scale because it lacks the technological and productive capabilities to compete with the most advanced countries.
- To improve these capabilities, Costa Rica must promote innovation in domestic companies and strengthen other components and synergies within the NIS. It is fundamental to improve access to financing for local companies, not just for working capital or investment but for R&D activities and other innovation activities. It should also improve telecommunications infrastructure, particularly bandwidth. The country should also improve the design and implementation of policies for foreign trade, investment and industrial policies.
- At the same time, it is important to create and sustain a high-performance learning process for Costa Rican companies to increase their absorptive capacities. To achieve this, it is fundamental that technical and professional programmes are aligned with the demands of the private sector.
- To take advantage of the technological integration of Intel Costa Rica and that of other multinationals, Costa Rica also needs substantial improvements in the area of human resources. This is essential for improving innovation and technological capabilities. Among the measures required to achieve these improvements are: improving the coverage and quality of secondary education; increasing university graduates in STEM; better aligning vocational education with the needs of productive development, especially the medium and high-tech sectors; and improving soft skills (e.g.

problem solving, team work, proactive attitude for decision making and competency in software and languages).

- The new operation that Intel started in 2014 gives Costa Rica an important opportunity for foreign direct investment by demonstrating to other multinationals that it is possible to carry out higher value-added operations in the country. But this opportunity can only be taken advantage of if Costa Rican authorities substantially raise the levels of investment in and quality of education, infrastructure and R&D, (Paus, 2014) and if it is successful in creating and sustaining a high-performance learning process within domestic companies (Nübler, 2014). For example, it is of vital importance for Costa Rica to develop programmes to facilitate studies for Costa Ricans in the professions that medium and high-technology multinationals most demand. These include STEM programmes and higher degree levels like masters and doctorates in these areas.
- The Costa Rican authorities acquired valuable knowledge about how to attend to the needs of laid-off workers during the transfer of Intel Costa Rica's assembly and test operations to Asia. They also learned about the importance of supporting the efforts of these companies to increase the added value of their activities (i.e. shared services and R&D) in the country. This knowledge should be utilized in future negotiations with multinationals as Costa Rica transforms itself from an efficiency based economy to an innovation economy.
- The structural transformation of Intel Costa Rica presents a valuable opportunity for Costa Rica to improve the interaction of this and other R&D corporations with the NIS and the educational system in Costa Rica. In order to achieve this, it should promote the participation of these companies in the development of infrastructure for learning and innovation by way of interactions with universities, training and research institutions, and with Costa Rican authorities in science, technology and innovation.
- Lastly, to continue attracting medium and high-technology foreign investment, Costa Rica needs to set up a broad work plan to address threats to the country's competitiveness, in addition to the already mentioned areas of education, innovation and technology. For example, issues related to road infrastructure, transportation, security, environmental protection and productive linkages are of utmost importance. Only a comprehensive vision will enable the country to retain and increase medium and high-technology foreign investment, generating the technology externalities that will support increased productivity for companies, productive sectors, and the economy as a whole.

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ISBN 978-92-2-130312-1