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# Exploring knowledge spillover through labour mobility from multinationals to domestic firms in the information technology sector in Costa Rica

Ricardo Monge  
Luis Rivera



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## Abstract

In this study we explore knowledge spillovers through labor mobility from MNC to local firms in the IT sector of Costa Rica. In doing so, we use a novel matched employer-employee database for 2001-2012 and various fixed effects models to estimate the existence of a wage premium for workers in domestic firms with previous working experience in MNCs, incorporating a gender dimension. We found that the IT sector in Costa Rica shows salient characteristics from a firm and worker perspective. General data show relatively low mobility (in terms of the share of workers that moved from a MNC to other firms) in the IT sector. The share of women in employment experienced a relative increase during the period studied, both for MNCs and domestic firms. However, worker participation is still unbalanced from a gender perspective, notwithstanding the higher relative participation of female workers in MNCs. From the econometric analysis we found that current workers at ICT domestic firms with previous working experience in IT MNCs have a wage premium, which we interpreted as evidence of knowledge spillover from labor mobility. Besides, tenure is an important dimension in receiving this wage premium since only employers with a tenure of more than one year obtained it. In addition, knowledge acquired in MNCs is to some extent industry specific. Furthermore, workers with previous experience in domestic local suppliers of MNCs receive a wage premium when they move to ICT domestic firms as well. Finally, we found a gender bias in the wage premium in all model specifications.





## Introduction

The extent to which Multinational Corporations (MNCs) generate knowledge spillovers to local firms has been widely studied (Aitken and Harrison, 1997; Javorcik, 2004; Branstetter 2006; Keller and Yeaple, 2009). Such spillovers contribute to productivity growth of local firms and host economies at large (Smeets, 2008). Knowledge spillovers may occur through three channels (Saggi, 2002): (i) *demonstration effects*, which include imitation or reverse engineering of products or practices of MNCs by local businesses; (ii) *forward and backward vertical linkages* between MNCs and their local buyers and suppliers, and (iii) *labor mobility*, which allows former employees of MNCs working in local firms to apply skills from their previous work experience and training.

The empirical exploration of these knowledge spillovers in developing economies is difficult, as this process happens within “black boxes” (Görg and Strobl, 2005). Many studies validate the existence of knowledge spillovers, though without an in-depth exploration of the ways in which these actually occur, the type of knowledge that is transferred from the MNCs to local firms, or the way in which the latter use the transferred knowledge to improve their own productivity (Smeets, 2008).

Few in-depth investigations on knowledge spillovers have been carried out focusing Latin America. Kugler (2006) found positive backward vertical linkages between MNCs and local manufacturing firms in Colombia, while Markusen and Trofimenko (2007) found positive impacts of labor mobility from MNCs in the same country and sector. In addition, Poole (2013) found positive externalities of workers who moved from MNCs to local businesses in Brazil. In empirical research, labor mobility is traditionally analyzed through matched employer-employee datasets (Görg and Strobl, 2005; Balsvik, 2011; Poole, 2013), where workers are tracked individually. In this study we follow the same methodological approach.

In Latin America and the Caribbean, Costa Rica has been one of the most successful countries regarding FDI attraction during the past three decades (Monge-González and Rivera, 2020). In the service sector most MNCs set up affiliates in two key activities of the IT sector: information and communication technologies (ICT) and IT-enabled services (ITES). The latter

supply services to clients abroad in the areas of information technology outsourcing (ITO) or business processes outsourcing (BPO) (Monge-González, 2011; ECLAC, 2014). This successful FDI attraction strategy resulted in higher shares of Free Trade Zones' exports from high-tech MNCs. The IT sector is intensive in high-skilled labor and thus creates opportunities for labor diversification and productivity improvement.

This paper explores if MNCs affiliates in ICTs and ITES industries (IT sector<sup>1</sup>) in Costa Rica have generated knowledge spillovers through labor mobility to local ICT firms. Furthermore, we test for differences from a gender perspective. For this purpose, we first analyze labor rotation from MNCs to domestic firms between 2001 and 2011. Subsequently, we estimate the knowledge spillover of employees who moved between the two firm segments, approximated by the *wage premium*, using data from 2007-2012.

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<sup>1</sup> IT sector includes: (a) Telecommunications —companies which own, operate, and/or use voice and data networks to provide communications services between people and devices; (b) Software —businesses which are primarily dedicated to the creation and sales of relatively standardized applications and software tools (BIOS firmware, operating systems, application software, etc.) for horizontal or vertical market niches, or for individuals; (c) Solutions providers —businesses which offer consulting, assistance, training, custom software development, systems integration, or any other of a large number of services which are closely related to the creation, implementation, and maintenance of information or telecommunications systems; and d) Hardware —businesses which carry out activities related to the design, manufacture and/or assembly of electronic devices such as computers and their peripherals, telephones, network devices (routers, switches, etc.) and various types of integrated circuits. There were almost no domestic firms involved in the design and/or manufacture of hardware in Costa Rica. Therefore, “hardware” domestic companies are not included in our analysis.

## I. Policies for the development of the ICT sector in Costa Rica

The Costa Rican government has not focused industrial (vertical) policy towards the development of the ICT sector. Notwithstanding, policies intended to improve general aspects of the society and the economy could have positively contributed to the ICT sector growth. We briefly discuss the most important policies below.

The government of Costa Rica has promoted widespread public education for more than a century. The country achieved universal primary education more than 50 years ago, and currently provides free secondary education up to 11th grade, with mandatory attendance until 9th grade. The public education system was also a pioneer among developing countries in introducing public school students to the use of computers, through the creation of the National Program of Educational Informatics (PRONIE) supported by the Omar Dengo Foundation (FOD). Thus, since the 1980s primary students had access to basic “digital literacy” computer usage skills, as well as introduction to programming and logical problem solving. By 2011, these programs covered almost two-thirds of primary and secondary public schools (FOD, 2011).

These efforts have created the foundations for a well-educated workforce and a supply of workers both for the ICT sector itself and for other types of businesses which make use of ICT products and services. However, some studies have shown the need for further efforts to meet ever-increasing demands by domestic and foreign firms for technically skilled workers (Monge-González and Hewitt, 2010; Monge-González, Rivera, and Mulder, 2020). In order to respond to this need, the government of Costa Rica created a multi-sectorial Human Resources Working Group in 2011 led by the Costa Rican Investment Promotion Agency (CINDE), to develop new human resource development strategies, and more recently CINDE with the support of CRUSA Foundation and IADB has been developing a strategy called “bola de cristal” tended to train people already demanded by MNCs.<sup>2</sup>

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<sup>2</sup> For more information see [http://wapes.org/fr/system/files/panel\\_2-3\\_vanessa\\_gibson\\_es.pdf](http://wapes.org/fr/system/files/panel_2-3_vanessa_gibson_es.pdf).

The creation of the PRONIE and the FOD shows that the government has been largely aware of the necessity of increasing the access to, and use of, ICTs in all areas of Costa Rican society (Monge-González and Chacón, 2002). More recent elements of the national strategy for increasing access to and use of ICTs are the development of a national Internet broadband plan; improved connectivity for the educational and health sectors and for disadvantaged segments of the population (including the extension of the national network of community tele centers); and increased use of ICTs in government institutions.<sup>3</sup> The government also facilitated “e-commerce” through legislation of digital signature.

In addition, after more than 50 years of state monopolistic control, Costa Rican authorities opened the telecommunications market to competition in 2009 and as a result new local and international operators began to provide private network services, Internet access, and mobile telephony. As a result of this opening, the proportion of homes with Internet connectivity and the proportion of cellular telephony accounts almost doubled between 2010 and 2020. All of these policies and actions have the potential to increase the size of the local market for ICT products and services.

The 1980s witnessed the implementation of a number of policies related to trade liberalization, FDI attraction and access to international markets, which have had important implications for the development of the national ICT sector (Monge-González and Hewitt, 2010). These policies included the reduction of trade barriers to importing hardware and software, as well as reduction of internal taxes on local purchases of computers and software, thus increasing the use of, and demand for, these products and associated services. They also included a number of successful measures to promote Costa Rican exports of products and services, all of which have the potential to assist national ICT companies to increase their sales abroad. Among these policies are the creation of the Ministry of Foreign Trade (COMEX) and the Costa Rican Export Promotion Agency (PROCOMER), and in the accession to the General Agreement on Tariffs and Trade (GATT, 1990) and the World Trade Organization (WTO, 1994). In addition, the country has signed several Free Trade Agreements (FTAs) with the United States (DR-CAFTA), Canada, Mexico, Chile, Panama, China, Singapore, and the European Union, among others.

The government partnered with the private sector for the creation of the first investment promotion agency in Latin America in 1982 —the Costa Rican Investment Promotion Agency (CINDE). This agency is regarded as one of the world’s most effective organizations on FDI attraction, targeting FDI in specific high-value-added sectors, including ICTs (software), advanced manufacturing (advanced electrical components, automotive components, aerospace), life sciences (medical instruments, pharmaceuticals and biotechnology, new materials), and clean technologies, as well as various types of services outsourcing provision (ITO, BPO, KPO, etc.) (OECD, 2012).<sup>4</sup> This emphasis had the effect of attracting companies which are highly sophisticated producers and/or users of ICTs, offering in both cases the opportunity for domestic ICT firms to supply them with a variety of products and services.

The first Export Processing Zones (EPZs —commonly referred to as “free zones”) began operations in the 1980s, backed by legislation that grants incentives to foreign and domestic companies to invest in the country. To obtain the benefits provided for by the law, those investments must comply with certain conditions, which vary according to the type of company, investment amount, industry and location (inside or outside the major metropolitan area of the country, and inside or outside an industrial park). These incentives include exemption from all taxes and duties on imports, exemption from all

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<sup>3</sup> The strategy is called “Estrategia de Transformación Digital hacia la Costa Rica del Bicentenario 4.0”, for more information see [https://www.micit.go.cr/portaldos/images/imagenes\\_noticias/17-10-2018\\_Estrategia\\_de\\_Transformaci%C3%B3n\\_Digital\\_hacia\\_la\\_Costa\\_Rica\\_del\\_Bicentenario/estrategia-de-transformacio%CC%81n-digital-hacia-la-costa-rica-del-bicentenario-4.0-\(16-10-18\).pdf](https://www.micit.go.cr/portaldos/images/imagenes_noticias/17-10-2018_Estrategia_de_Transformaci%C3%B3n_Digital_hacia_la_Costa_Rica_del_Bicentenario/estrategia-de-transformacio%CC%81n-digital-hacia-la-costa-rica-del-bicentenario-4.0-(16-10-18).pdf).

<sup>4</sup> See also <https://www.cinde.org/es/noticias/press-release/costa-rica-cuenta-con-la-agencia-de-atraccion-de-inversion-mejor-calificada-del-mundo>.

municipal taxes and licenses for a 10-year period, and additional exemptions from income taxes for those companies that make further investments in the country years after they started operations.

It is important to note that in the implementation of the free zone regime, the Costa Rican government has not attempted to create special economic areas, zones, or industrial parks dedicated specifically to foreign and national ICT-related businesses, which have been associated with activities related to the attraction of FDI in many other countries (Mohan, 2006; Gregory, et al. 2009). Likewise, it has not made systematic efforts to promote the formation of a “national ICT cluster” in which domestic and foreign companies could interact in a mutually beneficial fashion among themselves and with academic and research organizations, financial institutions, and other vital actors within an industrial cluster.

The free zone initiative has been extremely successful, supported by the country’s long-standing reputation for well-educated workers and political stability. Most high-technology multinational corporations (MNCs) in the country operate under the free zone regime, where they generated almost 10.4% of GDP in 2014. In keeping with the government’s emphasis on attracting investment in high-value-added sectors, the composition of free zone exports has evolved from natural resource-based and low-skilled labor-intensive activities to more advanced high-technology production systems, based on highly-skilled labor (Monge-González and Rivera, 2020). Thus, the electronic and electrical goods sector, and medical devices and pharmaceutical products sectors accounted for almost 74% of free zone exports in 2014 (more recent cite), while exports of international services (BPO, call centers, etc.) increased rapidly.

While these results may benefit the national economy as a whole, it is not clear whether FDI attraction has had a uniformly positive impact on domestic ICT firms. The increased presence of MNCs might actually have negative effects for local firms, such as the generation of shortages of technically trained human resources, with associated higher employee turnover rates and salary inflation (Gereffi, et al., 2012).

Other studies have concluded that even though Costa Rican authorities have made specific efforts to promote linkages between local and foreign companies in Costa Rica, few positive results have been obtained (Monge-González et al, 2010; Monge-González, 2018). These results could be explained by the limited coordination and ineffective program design on the part of the government, and to certain aspects of the MNCs and domestic firms themselves, including the globally-oriented strategy of MNCs, a weakly developed domestic production system, lack of international certifications and standards and concerns over economies of scope, trust, and quality control practices.

On the other hand, there is evidence of positive spillovers from MNCs to domestic ICT companies. Monge-González and Hewitt (2010) found that almost half of all domestic ICT firms had at least one owner that had previously worked for MNCs in Costa Rica (and significant numbers of managers, engineers, and programmers as well), while some of these domestic ICT firms received substantial benefits from acting as value-added resellers of the products and services of MNC ICT companies.

The promotion of science, technology, and innovation has become increasingly important for Costa Rican authorities as the world economy becomes more globalized and competitive. This situation has created an environment in which the country cannot compete based on the availability of abundant natural resources and low wage labor force but must rather compete based on the creation of innovative new products and services.

Given this situation, there is a pressing need for effective policy actions in critical areas which could have beneficial results for domestic and international ICT firms. These areas include new sources of financing for businesses; creation of technology parks which bring together the public, private, and academic sectors; improved access to intellectual property protection; business incubation; innovation in small businesses; improved cooperation between universities and the private sector; promotion of entrepreneurship; and the creation of a national innovation agency.



## II. Literature review: the impact of MNCs on domestic firms

While there is abundant discussion of the impacts of foreign MNCs on the economies of host countries, there are few studies that focus on the nature and impact of the interactions between ICT and IT-enabled MNCs and domestic ICT firms. In general, MNCs have technological superiority and strong management skills which can be transferred to local firms in the host country, especially in the case of developing countries. This phenomenon is referred to as knowledge spillover, defined as a positive externality for local firms stemming from the attraction of FDI, which may result in labor productivity growth for these firms (Caves, 1974; Blomström, 1986; Spencer, 2008; Alfaro-Ureña, Manelici and Vasquez, 2019).

Moreover, MNCs might raise domestic productivity in the sectors where they are present through transfer of knowledge, organizational structures and practices, spillovers such as learning and demonstration effects, reverse engineering, or movement of personnel (Blomström and Kokko, 1998; OECD, 2003). However, their impact varies from country to country depending on host country conditions (Paus and Gallagher, 2008). Abramovitz (1979) used the term "absorptive capacity" to refer to domestic capabilities to absorb spillovers of foreign technologies, while others highlight the complementarities between human capital and technology, both of which are influenced by endogenous policy choices (Paus, 2005; Paus and Gallagher, 2008).

Previous studies in this area have arrived at mixed or even contradictory results regarding knowledge spillovers related to FDI in developing countries or emerging economies. Some studies have found evidence of positive effects stemming from spillovers to local firms (e.g., Blomström, 1986; Buckley, Clegg, and Wang, 2007; Tian, 2007; Wei and Liu, 2006), while other studies have found that FDI has not produced any knowledge spillovers, or that if they do occur, their effects have been negative for local firms (Feinberg and Majumdar, 2001).

According to Zhang et al. (2010), these contradictory results can occur for at least two reasons. First, the approach adopted by the empirical studies about knowledge spillovers associated with FDI are focused simply on whether or not the presence of FDI affects local firms' productivity. In Görg and Strobl's (2005)

words, one of the limitations of such studies is that they treat the range of specific mechanisms through which knowledge spillovers are supposed to occur as a single “black box,” although the importance and impact of different mechanisms may vary in different cases. Without evaluating the effects of particular mechanisms in different situations, studies with similar objectives may easily produce apparently contradictory results. Secondly, knowledge spillovers imply a process through which local firms learn from foreign firms, and the effects of knowledge spillovers associated with FDI may vary depending on local firms’ capacity to absorb and adapt knowledge; without taking differences in this absorptive capacity into account, results may well appear to be contradictory (Lim, 2001).

In an effort to clarify this situation, Saggi (2002) identified three channels through which knowledge spillovers from multinational to local firms can occur. First, demonstration effects, which include emulation or reverse engineering of multinational companies’ products and practices by local firms. Second, labor mobility, which allows for employees trained by multinational companies to apply their knowledge in local firms once they leave those multinationals. Third, forward and backward vertical linkages between multinational companies and their local suppliers. The identification of these channels is important since studies which have clearly identified the channel through which knowledge spillovers occurs offer the most solid results about the presence of positive externalities from such spillovers.

On this regard, Farole and Winkler (2014) present a comprehensive conceptual framework for the identification of mediating factors for FDI spillovers, and the channels through which these spillovers occur. Among other things, the authors point out various characteristics of the MNCs, such as their motives for establishing operations in the host country, their global production and sourcing strategies, entry models, and the amount of time they have been present in the host country, all of which determine MNC spillover potential. It is also necessary to take into account the capacity of domestic firms to absorb knowledge and technology through their direct and indirect interaction with MNCs (absorptive capacity of domestic firms), as well as host country factors and institutional framework, such as labor market regulations, intellectual property rights, access to finance, and learning and innovation infrastructure. Finally, the authors point put three channels through which FDI spillovers may impact the host economy: (i) supply chains, (ii) labor turnover, and (iii) market restructuring.

An important aspect of this framework is that the set of mediating factors influencing the relationship between MNCs and domestic firms is not static, but dynamic. This means that the composition of the set of factors (FDI spillover potential, domestic firm absorptive capacity, host country factors and institutional framework, and transmission channels) can change through time and therefore should be taken into account in any analysis of the relationship between multinationals and local firms.

There is few research on the effects of ICT and IT-enabled MNCs on domestic ICT firms in their host countries. The body of literature related to the formation of ICT clusters is especially interesting because it is often assumed that the association of domestic firms with MNCs strengthens the former. However, the evidence shows that successful cluster formation depends heavily on the previous existence of favorable conditions such as market demand for the products or services produced by a cluster’s members and the proximity of large numbers of skilled workers (Porter 1998, Wadhwa 2010). Thus, the simple act of placing MNCs and domestic ICT firms in proximity to each other in clusters, or technology or software parks, does not guarantee the formation of productive linkages or spillovers.

Mohan (2006) found that in Malaysia’s Multimedia Super Corridor (MSC), ICT MNCs tended to be highly self-sufficient and generated few linkages with local suppliers. Gallagher and Zarsky (2007) also reported a similar result in the case of Mexican clusters centered on hardware manufacturing. Tessler et al. (2003) found that in Ireland, local employees of ICT MNCs tended to work in lower-level positions such as technical support and software testing, rather than in areas which would allow the workers to develop their own entrepreneurial capabilities. These authors also found that the most successful local companies forming linkages with MNCs were most often “low-margin, low-tech businesses like printing and packaging.”



Governments in countries which are leaders in the promotion of large-scale ICT clusters have made specific efforts to promote productive relationships between MNCs and domestic ICT firms. For instance, in Malaysia, the government required MNCs to provide benefits for domestic ICT firms through training and joint development projects, among others. This led to actions such as the creation of a Technopreneur Development Center by Sun Microsystems which provides assistance to small domestic ICT firms that develop applications using the Java programming language (Blogspot, 2005). In the case of China, admission of ICT MNCs to Special Economic Zones (SEZs) often involves a commitment to assist domestic ICT companies to develop their capacities (Gregory et al., 2009).

Zhou and Xin (2003) analyzed the interactions between MNCs and local technology actors in China's leading information communication technology (ICT) service cluster in Zhongguancun, Beijing. They found that the relationship between MNCs and local firms is hierarchical, interdependent, and evolutionary. Local firms' collaboration with MNCs provided them with vital technological and organizational training, that local firms use strategically to develop their market networks and innovative capacities in their home markets. The learning capacity of local firms is greatly improved by the presence of other related enterprises, research and development facilities, and an advanced developmental state of the countries hosting market-oriented spatial clusters.

Hewitt and Monge-González (2007) carried out the first mapping of the Costa Rican ICT sector. The authors analyzed 125 firms, both local and multinational, working in the areas of components/hardware, software products, direct ICT services and IT-enabled services (ITES), mostly MNCs operating in free zones. With respect to factors affecting the knowledge absorptive capacity of domestic firms, the authors found that most of these companies were exporters, employed high skilled workers, were involved in innovation activities, had certifications for quality control, and faced strong competition from other firms operating both in Costa Rica and abroad. The authors identified two main obstacles in this area: low labor availability, especially of highly-skilled workers, and access to various types of financial assistance. The scarcity of highly-skilled workers was viewed as a possible indicator of a crowding-out effect in the labor market due to the operation of MNCs in the country.

Ciravegna (2012) studied the linkages between MNCs and domestic ICT firms in Costa Rica. The author claimed that although some linkages were found and generated positive effects, such as providing access to new clients and opportunities to learn new organizational practices, linkages in the ICT cluster were still scarce. Moreover, interviewed MNCs argued that local firms lack the necessary abilities to work with, while MNCs could import all their inputs tax-free (echoing the findings of Giuliani, 2008; and Paus and Gallagher, 2008).

Mata and Mata (2008) claim that the FDI strategy followed by Costa Rica had more negative than positive effects for domestic ICT firms, due to the lack of spillover effects from ICT MNCs to local firms. They point out two major negative effects of the FDI strategy on the domestic ICT firms. First, MNCs can pay higher wages than domestic ICT firms to recruit qualified human resources in a competitive labor market. Second, domestic ICT firms have a cost and infrastructure disadvantage compared to MNCs operating in the country: For example, MNCs operating in free zones benefit from streamlined government procedures and customs processes, while domestic ICT firms have to deal with the full range of bureaucratic procedures and processes. In short, the authors argue that domestic ICT firms face a more challenging business environment than MNCs operating in Costa Rica.

Nicholson (2008) described the human resource development policy of Costa Rica in the context of software exports. The author concludes that in general Costa Rica has a small labor pool and compared to competing countries, relatively high labor costs. He also claimed that the English-speaking skills of technical workers in Costa Rica are generally weak, as were linkages between universities and industry. All of this supports the idea of a potential for crowding out in the labor market as a result of attraction of FDI in the ICT sector.

Monge-González and González-Alvarado (2007), on the other hand, illustrate the contribution of ICT multinationals to skills development in Costa Rica, based on the cases of Intel, Microsoft, and Cisco, who worked cooperatively with businesses, universities, and training and research institutes to develop curricula that better respond to the demands of the productive sector. Monge-González and Hewitt (2010) found that most domestic ICT companies have been involved in a wide range of product/services innovations, organizational innovations, and marketing innovations. Levels of activity in these areas ranged between 27% of domestic ICT firms in the case of introducing a new product/service in the international market, to 89% of domestic firms in the case of improving an existing product or service. Most of these companies are highly involved not only in R&D activities, but also in other important innovation-input activities such as training of human resources, product, or process design, receiving consulting services and technical assistance, carrying out organizational changes, and patenting. This suggests that the absorptive capacity of domestic ICT firms may be relatively high.

Domestic ICT firms interact very little with private and public educational and research institutions and do so mostly for training purposes. On the other hand, there is a stronger relationship between domestic ICT firms and the suppliers and clients with whom they were involved in the productive chain. In fact, more than half of domestic ICT firms have MNCs as clients in Costa Rica. Regarding knowledge spillovers through worker mobility between MNCs and domestic ICT companies, almost half of all domestic ICT firms had at least one owner who had previously worked for MNCs in Costa Rica, while 26% of managers, 9% of engineers, and 5% of programmers in domestic ICT companies had previous work experience in MNCs as well.

## A. Research questions

For local firms, buying from or selling to foreign affiliates of MNCs may be a source of *knowledge transfers* and *spillovers*. In this sense, the presence of MNCs may provide a positive externality for the rest of the host country's economy. At the micro level, a spillover occurs when knowledge created by a MNC is used by a local company without a payment (Javorcik, 2004). Some examples are: exchange of best practices, access to specialized equipment resulting from this relationship, acquisition of technology and know-how, acquisition of information processing systems, access to exclusive and specialized databases, acquisition of specialized productive processes, exchange of lessons learned in MNCs' affiliates in other parts of the world, quality certifications, specialized audits and access to capital markets (Monge-González, 2010).

Monge-González and González-Alvarado (2007) found evidence that high-tech MNCs operating in Costa Rica provide training, education, and work experience to their employees. Monge-González and Hewitt (2010) found that 36% of managers, 28% of engineers, and 31% of technicians who work in local ICT companies that are suppliers to MNCs had previously worked in MNCs. Moreover, 28% of local ICT suppliers have at least one owner with previous work experience in one of the MNCs operating in the country. This empirical evidence is useful, but insufficient to proof generalized knowledge spillovers from MNCs to the rest of the Costa Rican economy through employee mobility.

Using a novel micro-level database for the 2001-11 period, we explore knowledge spillovers through labor mobility in the ICT and ITES sectors in Costa Rica by answering the following questions:

- (i) What share of workers in MNCs moved to local firms? How equal is the share of women?
- (ii) Are there differences in occupational categories between men and women that move from MNCs to local firms?
- (iii) How old were employees when they stopped working for these MNCs? Are there differences in this regards between men and women?

- (iv) Do former employees of MNCs receive a wage premium in domestic companies for the knowledge acquired while working at MNCs? Are there differences between men and women regarding this dimension?
- (v) What role does the time worked in the multinational (tenure) play in estimating the wage premium? Are there differences between men and women regarding this dimension?
- (vi) Is the knowledge acquired in multinationals and then used in local companies specific to the ICT industry? Are there differences between men and women regarding this dimension?
- (vii) Is there some differential impact of MNC in ICT with respect to the rest of the economy on the wage premium? Are there differences between men and women regarding this dimension?
- (viii) Do workers who now work in a domestic company but were employed before in another local firm which was a supplier of multinationals also receive a wage premium? Are there differences between men and women regarding this dimension?

## B. Data

To answer the above questions, we construct a novel matched employer-employee data base for both ICT domestic firms and MNCs in the ICT and ITES sectors with monthly observations from 2001 to 2012. The data set is constructed with administrative records from the Costa Rican Social Security System (CCSS), the Ministry of Foreign Trade and the Ministry of Finance. Additional sources were used to double check and complete the classification of domestic and MNC firms by the CCSS: the Chamber of Information and Communication Technologies (CAMTIC), the Export Promotion Agency (PROCOMER), the FDI attraction agency (CINDE) and the Costa Rican-US Chamber of Commerce (AmCham Costa Rica).

This dataset allowed firms to be classified as ICT domestic or ICT and ITES multinational. The final panel data set contains 587 domestic ICT firms, 164 ICT MNCs and 122 ITES MNCs.

The matched employer-employee database has records for employees working in any of those firms between 2001 and 2012.<sup>5</sup> In addition, the database includes a variable on the type of occupation and skill levels of every worker for the 2007-2012 period, following ILO's International Standard Classification of Occupations (ISCO).<sup>6</sup>

The following tables describe salient characteristics from the firms and workers of the database. The share of women in employment experienced a relative increase during the period both for MNCs and domestic firms. However, worker participation is still unbalanced from a gender perspective. On the other hand, data show a higher relative participation of female workers in domestic firms (table 1).

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<sup>5</sup> Workers without indication of the firm in which they previously employed are treated as new entrants to the workforce.

<sup>6</sup> The job or type of job. Data from the National Insurance Institute (INS), where employers register their workers for the payment of occupational risk insurance. The data was matched with ISCO in order to classify workers according to low, medium, and high levels of skills (see <https://www.ilo.org/public/english/bureau/stat/isco/index.htm> for a description of the classification).

**Table 1**  
**Number of workers in MNCs and domestic firms by gender**

	Domestic firms				MNCs			
	Total	Male	Female	Share female	Total	Male	Female	Share female
2001	20 095	13 212	6 884	34.3%	6 267	4 390	1 877	30.0%
2002	22 218	14 585	7 633	34.4%	7 114	4 865	2 249	31.6%
2003	24 090	15 664	8 426	35.0%	8 672	5 861	2 811	32.4%
2004	25 668	16 615	9 053	35.3%	11 464	7 732	3 733	32.6%
2005	28 121	18 063	10 058	35.8%	13 728	9 138	4 590	33.4%
2006	30 559	19 429	11 130	36.4%	18 480	12 101	6 379	34.5%
2007	32 613	20 674	11 939	36.6%	23 676	15 430	8 246	34.8%
2008	36 902	23 315	13 587	36.8%	27 847	17 994	9 853	35.4%
2009	37 223	23 471	13 753	36.9%	29 040	18 678	10 362	35.7%
2010	40 314	25 301	15 013	37.2%	32 247	20 768	11 479	35.6%
2011	40 449	25 360	15 090	37.3%	38 168	24 662	13 506	35.4%
2012	40 226	25 212	15 014	37.3%	40 387	25 887	14 501	35.9%

Source: Database processing.

In terms of workers that moved from MNCs to other firms, the data show a low share of those workers. That is, mobility from MNCs both to other MNCs and domestic firms seems to be low, for the period studied (table 2). Moreover, close to two thirds of workers that moved from MNCs to domestic firms are men (table 3). Therefore, low mobility and gender bias of workers from MNCs to local firms are general characteristics of the IT labor market segment.

**Table 2**  
**Number of MNC workers that moved to domestic firms and other MNCs**

Year	Total MNC workers	Movers to domestic firms	Share	Movers to MNCs	Share
2001	6 267	417	6.7%	382	6.1%
2002	7 114	238	3.3%	209	2.9%
2003	8 672	285	3.3%	232	2.7%
2004	11 464	331	2.9%	258	2.3%
2005	13 728	443	3.2%	316	2.3%
2006	18 480	594	3.2%	352	1.9%
2007	23 676	769	3.2%	435	1.8%
2008	27 847	889	3.2%	468	1.7%
2009	29 040	767	2.6%	449	1.5%
2010	32 247	978	3.0%	512	1.6%
2011	38 168	1 036	2.7%	497	1.3%
2012	40 387	1 108	2.7%	494	1.2%

Source: Database processing.

**Table 3**  
**Number of workers from MNCs that moved to domestic firms by gender**

Year	Total MNC workers	Movers to domestic firms	Women	Share women	Men	Share men
2001	6 267	4 17	138	33.1%	279	66.9%
2002	7 114	238	81	34.0%	157	66.0%
2003	8 672	285	103	36.2%	182	63.8%
2004	11 464	331	117	35.2%	214	64.8%
2005	13 728	443	158	35.5%	286	64.5%
2006	18 480	594	207	34.8%	387	65.2%
2007	23 676	769	278	36.2%	491	63.8%
2008	27 847	889	317	35.6%	572	64.4%
2009	29 040	767	271	35.3%	496	64.7%
2010	32 247	978	353	36.1%	624	63.9%
2011	38 168	1 036	356	34.3%	681	65.7%
2012	40 387	1 108	390	35.2%	717	64.8%

Source: Database processing.

Differences from a skill level perspective are present in movers as well. Workers that moved from MNCs to domestic firms are mainly medium and high skilled workers. This result holds for both men and women (table 4). Average age of movers is less than 30 years and slightly higher in the case of men (table 5).

**Table 4**  
**Number of MNC workers that moved to domestic firms, by skill level, 2007-2012**

	Men					
	Low skill		Medium skill		High skill	
	Number	Share	Number	Share	Number	Share
2007	22	4.4%	215	43.7%	142	29.0%
2008	20	3.4%	262	45.8%	155	27.0%
2009	14	2.9%	225	45.3%	147	29.6%
2010	15	2.3%	290	46.4%	199	31.9%
2011	15	2.2%	276	40.6%	256	37.6%
2012	12	1.7%	309	43.0%	265	37.0%
	Women					
	Low skill		Medium skill		High skill	
	Number	Share	Number	Share	Number	Share
2007	10	3.5%	123	44.0%	78	27.9%
2008	10	3.2%	153	48.4%	84	26.7%
2009	5	1.7%	135	49.8%	73	27.0%
2010	7	2.0%	165	46.7%	115	32.4%
2011	5	1.5%	142	40.0%	141	39.6%
2012	9	2.2%	167	42.8%	141	36.1%

Source: Database processing.

**Table 5**  
**Average age of workers from MNCs that moved to domestic firms by gender**  
*(In years)*

	Total	Men	Women
2001	26.1	26.4	25.5
2002	26.1	26.4	25.5
2003	26.3	26.7	25.6
2004	26.7	27.0	26.2
2005	26.8	27.1	26.2
2006	26.8	27.2	26.1
2007	26.9	27.2	26.3
2008	27.2	27.5	26.5
2009	28.0	28.5	27.2
2010	28.1	28.6	27.2
2011	28.7	29.2	27.8
2012	29.2	29.7	28.4

Source: Database processing.

### III. Models to estimate labor mobility impact

Knowledge spillovers are approximated by a *wage premium* former MNCs employees may receive when working for domestic firms after controlling for other covariates. In this context, the *wage premium* equals the difference in salary paid to two employees with similar characteristics except for the work experience in an MNC. The higher wage of the person with experience in MNCs may represent a premium for the unique skills and experience obtained, making workers more attractive for other companies (for instance, domestic firms).

Afterwards, we follow Balsvik (2011) to estimate the impact of MNCs on wages of domestic firms (a proxy of *knowledge spillovers*), while also considering the existence of a possible gender bias in these wages. We use employer-employee linked data to construct firm-specific measures for the share of workers in domestic ICT firms with experience gained from previously working in ICT and IT\_Enabled MNCs. We explore to what extent the experience gained from working in MNCs is rewarded by domestic firms in these sectors. For this purpose, we compare the wages of the *movers* to those of *stayers* in domestic firms.<sup>7</sup> We introduce dummies to indicate workers who are new to the firm and take the reference group to be stayers. Due to data limitations on worker occupations we estimate the following models using data for the 2007-2012 period. Table 6 presents descriptive statistics from the data base, mainly dummy variables.

**Table 6**  
Descriptive statistics

Variable	Number of observations	Mean	Standard deviation	Minimum	Maximum
logWage	7 573 957	12.69169	0.9098329	0	19.8943
MoversMNC	7 574 110	0.0121877	0.1097231	0	1
Gender	7 574 110	1.357591	0.4792909	1	2
Age skilllevel	7 574 110	29.67801	8.843506	1.396304	1036.203
Medium	3 723 322	0.4097551	0.4917885	0	1

<sup>7</sup> That is, workers who remain at the domestic firm.

Variable	Number of observations	Mean	Standard deviation	Minimum	Maximum
High	3 723 322	0.5389628	0.4984797	0	1
Sector	7 574 110	6052.088	2239.199	0	9 900
MNCtenure1	7 574 110	0.0068922	0.0827325	0	1
MNCtenure2	7 574 110	0.0037021	0.060732	0	1
MNCtenure3	7 574 110	0.0015935	0.0398863	0	1
ICTtenure1	7 574 110	0.0017638	0.0419602	0	1
ICTtenure2	7 574 110	0.0011283	0.0335715	0	1
ICTtenure3	7 574 110	0.000555	0.0235529	0	1
IT_Etenure1	7 574 110	0.0051284	0.0714289	0	1
IT_Etenure2	7 574 110	0.0025738	0.050667	0	1
IT_Etenure3	7 574 110	0.0010384	0.0322076	0	1
Dom_ICTtenure1	7 600 488	0.001274	0.0356704	0	1
Dom_ICTtenure2	7 600 488	0.0007478	0.0273366	0	1
Dom_ICTtenure3	7 600 488	0.0003223	0.0179512	0	1
OtherFirmstenure1	7 600 488	0.016063	0.1257181	0	1
OtherFirmstenure2	7 600 488	0.0084358	0.0914583	0	1
OtherFirmstenure3	7 600 488	0.0036825	0.060572	0	1
Dom_to_Dom_MNCsupply	7 606 515	0.0003813	0.019522	0	1

Source: Database processing.

## A. First model

In order to explore if former employees of MNCs receive a wage premium in domestic companies for the knowledge acquired while working at MNCs (fourth research question), we construct a model to estimate the impact of movers from MNCs on wages. We control for worker characteristics such as gender, age, skill level and firm sector. Using OLS with firm and time fixed effects as well as cluster-robust standard errors we estimate the following model:<sup>8</sup>

$$w_{it} = \beta_0 + \beta_1 MoversMNC_j + \beta_2 GENDER_i + \beta_3 AGE_i + \beta_4 SKILL_i + \beta_5 SECTOR_j + v_j + v_t + \epsilon_{it} \quad (1)$$

where  $w_{it}$  is the log real wage of worker  $i$  in year  $t$ ,  $MoversMNC$  is a dummy equal to 1 if the worker at the domestic firm previously worked at a multinational firm and zero otherwise.  $GENDER$  is a dummy for worker  $i$  equal to 1 if the worker is a man and two otherwise,  $AGE$  is the age of worker  $i$ ,  $SKILL$  is a dummy for worker  $i$  (low, medium and high skilled),  $SECTOR$  is a variable of 4-digit ISIC categories, and  $v_j$  and  $v_t$  are firm and time specific errors respectively, while  $\epsilon_{it}$  is the "usual" error. We expect in all explanatory variables a positive coefficient with the exception of gender, where we expect a negative relationship meaning a gender bias.

Table 7 presents the results of the first model that incorporate explanatory variables subsequently. We found a positive relationship between wages and previous working experience at MNCs ( $MoversMNC$ ). Workers in domestic firms with previous experience at MNCs receive a wage premium compared to stayers. The result is robust once we control for other covariates and fixed effects. In short, workers in domestic firms with previous experience at MNCs receive a wage premium

<sup>8</sup> We control for factors that may affect the employee's wage at firm  $i$  in year  $t$ , by removing the effect of the time-invariant unobserved characteristics. The error robust option is used to take into account heteroskedasticity and within-panel serial correlation in the idiosyncratic error term (Greene, 2008; Das, 2019).



of 1.8 percent, such evidence support the idea of knowledge spillovers from labor mobility. On the other hand, we found a gender bias (women earn less than men) in the wage premium (-3.7 percent). We also found that workers in domestic firms with a higher skill level receive a higher wage premium. Finally, we found a positive relationship between age and wages. All estimated coefficients have the expected sign and are statistically significant.

**Table 7**  
Impact of labor mobility from MNCs to domestic firms on wages

	logWage	logWage	logWage	logWage
moversMNC	0.1972***	0.1972***	0.1352***	0.0181*
	-0.0036	-0.0036	-0.0045	-0.0096
Gender		-0.0384***	-0.0261***	-0.0376***
		-0.0034	-0.0043	-0.0063
Age			0.0129***	0.0139***
			-0.0003	-0.001
Skilllevel_Medium			0.3062***	0.1967***
			-0.0087	-0.0163
Skilllevel_High			0.8574***	0.4750***
			-0.0089	-0.027
Sector			0.0000***	0.0001***
			0.000	0.000
_cons	12.0287***	12.0807***	11.1088***	11.2403***
	-0.0019	-0.005	-0.0143	-0.1377
Firm fixed effects	No	No	No	Yes
Time fixed effects	No	No	No	Yes
N	334656	334656	163441	163441
r2	0.009	0.009	0.147	0.046
F	2928.0	1528.2	4680.6	73.1
LI	-455002.3	-454938.6	-201302.4	-170003.6
P	0.000	0.000	0.000	0.000

Source: Authors calculation.

Standard errors in parentheses.

\* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

## B. Second model

We now explore the possible impact of the time worked in the multinational (tenure) in the wage premium as well as for possible differences between men and women in this dimension (fifth research question). For this purpose, we estimate the following model:

$$w_{it} = \beta_0 + \sum_{s=l,m,h} \beta_1 moversMNCtenure_{is} + \beta_2 GENDER_i + \beta_3 AGE_i + \beta_4 SKILL_i + \beta_5 SECTOR_j + v_j + v_t + \epsilon_{it} \quad (2)$$

Where  $moversMNCtenure_{is}$  is a dummy equal to 1 if the worker is new to domestic firm  $j$ , comes from an MNC, and has a tenure of  $s$  in that MNC. We divide tenure into low, medium, and high and set the thresholds at less than one year, from one to less than three years, and three years or more, respectively. We use  $tenure$  at the MNC as a proxy of *training* intensity being received in the MNC by local firms' employees.

In table 8 we present the results of the second model. We found that tenure is an important dimension in explaining the presence of knowledge spillovers through labor mobility. In fact, we found that only workers at domestic firms with previous experience in MNCs higher than one year, receive a wage premium compared to stayers. The premium is 7.2 percent for workers with one to three years of experience at MNCs and 5 percent for workers with more than three years of such experience. The result is robust once we control for other covariates and fixed effects. As seen in the previous model, we found a gender bias in the wage premium (-3.8 percent). We also found that workers in domestic firms with a higher skill level receive a higher wage premium and a positive relationship between age and wages. All estimated coefficients have the expected sign and are statistically significant.

**Table 8**  
Impact of labor mobility from IT MNC to ICT domestic firms according to MNCs tenure on wages

	logWage	logWage	logWage	logWage
MNCtenure1	0.0763***	0.0761***	0.0522***	-0.0142
	-0.0045	-0.0045	-0.0054	-0.0119
MNCtenure2	0.3269***	0.3272***	0.2458***	0.0728***
	-0.0059	-0.0059	-0.0071	-0.0137
MNCtenure3	0.4188***	0.4186***	0.3159***	0.0507*
	-0.0088	-0.0088	-0.0125	-0.0264
Gender		-0.0393***	-0.0275***	-0.0381***
		-0.0034	-0.0043	-0.0062
Age			0.0128***	0.0139***
			-0.0003	-0.001
Skilllevel_Medium			0.3067***	0.1965***
			-0.0087	-0.0163
Skilllevel_High			0.8483***	0.4747***
			-0.0089	-0.0269
Sector			0.0000***	0.0001***
			0.000	0.000
_cons	12 0287***	12 0819***	11 1153***	11 2415***
	-0.0019	-0.005	-0.0143	-0.1375
Firm fixed effects	No	No	No	Yes
Time fixed effects	No	No	No	Yes
N	334 656	334 656	163 441	163 441
r2	0.015	0.015	0.151	0.047
F	1671.9	1287.9	3629.8	59.7
ll	-453 970.7	-453 903.8	-200 895.8	-169 923.2
p	0.000	0.000	0.000	0.000

Source: Authors calculation.

Standard errors in parentheses.

\* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

### C. Third model

It is important to study to what extent the knowledge acquired in multinationals and used afterwards in local companies is specific to the ICT industry. If this was the case, the knowledge spillovers can be reduced only to the industry where the MNC comes from (sixth research question). Thus, we estimate the following model:

$$w_{it} = \beta_0 + \sum_{s=l,m,h} \beta_1 moversICTtenure_{is} + \sum_{s=l,m,h} \beta_2 moversIT\_Etenure_{is} + \beta_3 GENDER_i + \beta_4 AGE_i + \beta_5 SKILL_i + \beta_6 SECTOR_j + v_j + v_t + \epsilon_{it} \quad (3)$$

Where  $moversICTtenure_{is}$  is a dummy equal to 1 if the worker is new to domestic firm  $j$ , comes from an ICT MNC, and has a tenure of  $s$  in that MNC; and  $moversIT\_Etenure_{is}$  is a dummy equal to 1 if the worker is new to domestic firm  $j$ , comes from an IT\_Enabled MNC, and has a tenure of  $s$  in that MNC. We divide tenure into low, medium, and high and set the thresholds at less than one year, from one to less than three years, and three years or more, respectively. We use *tenure* at the MNC as a proxy of *training* being received in the MNC by local firms' employees.

In table 9 we present the results. The evidence suggest that the knowledge acquired in MNCs by workers that moved to local firms afterwards is to some extent industry specific. Indeed, for workers with a tenure between one and three years, the coefficient associated with movers from ICT MNCs is more than two times higher than the one of movers from IT\_Enabled MNCs (12.2 versus 5.4 percent). Besides, we found a wage premium for workers with a tenure of more than three years only in the case of ICT MNCs (10.6 percent). These results are robust once we control for other covariates and fixed effects. Like in previous models, we found a gender bias in the wage premium, that workers in domestic firms with a higher skill level receive a higher wage premium, and a positive relationship between age and wages. All estimated coefficients have statistically significant.

**Table 9**  
Impact of labor mobility from ICT and IT\_enable MNCs to ICT domestic firms according to MNCs tenure on wages

	logWage	logWage	logWage	logWage
ICTtenure1	0.1842***	0.1836***	0.1609***	0.0231
	-0.0083	-0.0083	-0.0098	-0.0184
ICTtenure2	0.4455***	0.4449***	0.3202***	0.1221***
	-0.0103	-0.0103	-0.0123	-0.0309
ICTtenure3	0.4991***	0.4984***	0.3289***	0.1070***
	-0.0146	-0.0146	-0.0207	-0.0248
IT_Etenure1	0.0393***	0.0391***	0.0158***	-0.0254**
	-0.0051	-0.0051	-0.006	-0.0126
IT_Etenure2	0.2750***	0.2757***	0.2139***	0.0547***
	-0.007	-0.007	-0.0083	-0.0135
IT_Etenure3	0.3758***	0.3760***	0.3090***	0.0242
	-0.0108	-0.0108	-0.0154	-0.0336
Gender		-0.0385***	-0.0269***	-0.0376***
		-0.0034	-0.0043	-0.0062
Age			0.0126***	0.0138***
			-0.0003	-0.001
Skilllevel_Medium			0.3088***	0.1970***
			-0.0087	-0.0162

	logWage	logWage	logWage	logWage
Skilllevel_High			0.8455***	0.4740***
Sector			0.0000***	0.0001***
			0.000	0.000
_cons	12.0287***	12.0808***	11.1173***	11.2430***
	-0.0019	-0.005	-0.0143	-0.1381
Firm fixed effects	No	No	No	Yes
Time fixed effects	No	No	No	Yes
N	33 4656	33 4656	16 3441	16 3441
r2	0.016	0.017	0.152	0.047
F	917.2	804.8	2664.7	46.8
ll	-453 730.7	-453 666.5	-200 779.4	-169 890.8
p	0.000	0.000	0.000	0.000

Source: Authors calculation.

Standard errors in parentheses.

\* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

## D. Fourth model

One interesting question is if there are differential impacts of MNC with respect to the rest of the economy on the wage premium (seventh research question). For this purpose, the following model is estimated:

$$w_{it} = \beta_0 + \sum_{s=l,m,h} \beta_1 moversMNCtenure_{is} + \sum_{s=l,m,h} \beta_2 moversDom\_ICTtenure_{is} + \sum_{s=l,m,h} \beta_3 moversOtherFirmstenure_{is} + \beta_4 GENDER_i + \beta_5 AGE_i + \beta_6 SKILL_i + \beta_7 SECTOR_j + v_j + v_t + \epsilon_{it} \quad (4)$$

Where *moversDom\\_ICTtenure<sub>is</sub>* is a dummy equal to 1 if the worker is new to domestic firm *j* comes from a domestic ICT, and has a tenure of *s* in that MNC; and *moversOtherFirmstenure<sub>is</sub>* is a dummy equal to 1 if the worker is new to domestic firm *j*, comes from another firm (rest of the economy), and has a tenure of *s* in that MNC. We divide tenure into low, medium, and high and set the thresholds at less than one year, from one to less than three years, and three years or more, respectively. We use *tenure* at the MNC as a proxy of *training* being received in the MNC by local firms' employees.

In table 10 we show the results. It seems that there are differences in the wage premium when workers from domestic firms have previous experience in MNCs with respect to other firms (rest of the economy). In short, we found that the wage premium for workers with tenure of more than one year in a MNCs is higher than the premium for workers with previous experience in other firms. Moreover, only workers with previous experience in other firms and with a tenure between one and three years show a wage premium (8.9 percent). These results are robust once we control for other covariates and fixed effects. Similar to previous models, we found a gender bias in the wage premium, that workers in domestic firms with a higher skill level receive a higher wage premium, and a positive relationship between age and wages. All estimated coefficients have statistically significant.

**Table 10**  
**Differential impact of labor mobility from MNCs and the rest of the economy on wages**

	logWage	logWage	logWage	logWage
MNCtenure1	0.0324***	0.0326***	0.0349***	0.0085
	-0.0086	-0.0086	-0.0088	-0.0133
MNCtenure2	0.2772***	0.2780***	0.2232***	0.0977***
	-0.0094	-0.0094	-0.0099	-0.0155
MNCtenure3	0.3676***	0.3678***	0.2888***	0.0807***
	-0.0114	-0.0114	-0.0142	-0.0253
Dom_ICTtenure1	-0.0563***	-0.0561***	-0.0866***	0.0278*
	-0.0122	-0.0122	-0.0141	-0.0156
Dom_ICTtenure2	0.2501***	0.2496***	0.1510***	0.1275***
	-0.0146	-0.0146	-0.0172	-0.023
Dom_ICTtenure3	0.3111***	0.3097***	0.2501***	0.1725***
	-0.0203	-0.0203	-0.0294	-0.0388
OtherFirmstenure1	-0.1846***	-0.1844***	-0.1239***	-0.0143
	-0.0082	-0.0082	-0.0084	-0.0093
OtherFirmstenure2	0.0707***	0.0719***	0.1023***	0.0893***
	-0.0085	-0.0085	-0.009	-0.0136
OtherFirmstenure3	0.1654***	0.1660***	0.1800***	0.0391*
	-0.0095	-0.0095	-0.0117	-0.0223
Gender		-0.0419***	-0.0305***	-0.0389***
		-0.0034	-0.0043	-0.0061
Age			0.0129***	0.0139***
			-0.0003	-0.001
Skilllevel_Medium			0.2913***	0.1943***
			-0.0087	-0.0162
Skilllevel_High			0.8101***	0.4700***
			-0.0089	-0.0267
Sector			0.0000***	0.0001***
			0.000	0.000
_cons	12.0766***	12.1330***	11.1621***	11.2231***
	-0.0078	-0.009	-0.016	-0.1386
Firm fixed effects	No	No	No	Yes
Time fixed effects	No	No	No	Yes
N	334 656	334 656	163 441	163 441
r2	0.033	0.033	0.163	0.050
F	1 248.2	1 139.5	2 267.1	49.0
ll	-450934.9	-450857.3	-199756.1	-169 683.1
p	0.000	0.000	0.000	0.000

Source: Authors calculation.

Standard errors in parentheses.

\* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

## E. Fifth model

Monge-González, Rivera, and Mulder (2020) found that in the ICT sector of Costa Rica some domestic firms are local suppliers of MNCs. Therefore, we explore to what extent if workers who work in a domestic company at present but were employed before in another local firm which was a supplier of multinationals, receive a wage premium (eighth research question). We estimate this model:

$$w_{it} = \beta_0 + \beta_1 MoversMNC_j + \beta_2 MoversLocalSuppliers_j + \beta_3 GENDER_i + \beta_4 AGE_i + \beta_5 SKILL_i + \beta_6 SECTOR_j + v_j + v_t + \epsilon_{it} \quad (5)$$

Where *MoversLocalSuppliers<sub>j</sub>* is a dummy equal to 1 if the worker is new to domestic firm *j*, comes from another local firm which was a supplier of MNCs.

In table 11 we show the results. It seems that there is a wage premium for workers who previously worked in another domestic firms that was a supplier of MNCs (5.1 percent). This result is robust once we control for other covariates and fixed effects. Similar to previous models, we found a gender bias in the wage premium, that workers in domestic firms with a higher skill level receive a higher wage premium, and a positive relationship between age and wages. All estimated coefficients have statistically significant.

**Table 11**  
Impact of labor mobility from IT MNC and domestic local suppliers to ICT domestic firms on MNCs on wages

	logWage	logWage	logWage	logWage
moversMNC	0.1971***	0.1970***	0.1351***	0.0185*
	-0.0037	-0.0037	-0.0045	-0.0097
Dom_to_Dom_MNCsupply	-0.0136	-0.0109	-0.0048	0.0510***
	-0.0176	-0.0176	-0.0192	-0.0188
Gender		-0.0384***	-0.0261***	-0.0376***
		-0.0034	-0.0043	-0.0063
Age			0.0128***	0.0139***
			-0.0003	-0.001
Skilllevel_Medium			0.3062***	0.1966***
			-0.0087	-0.0163
Skilllevel_High			0.8574***	0.4751***
			-0.0089	-0.0271
Sector			0.0000***	0.0001***
			0.000	0.000
_cons	12.0288***	12.0808***	11.1089***	11.2396***
	-0.0019	-0.005	-0.0143	-0.1377
Firm fixed effects	No	No	No	Yes
Time fixed effects	No	No	No	Yes
N	334 656	334 656	163 441	163 441
r2	0.0087	0.0091	0.1466	0.0458
F	1464.3	1018.9	4011.9	62.9
ll	-455002.0	-454938.4	-201302.3	-170001.0
p	0.000	0.000	0.000	0.000

Source: Authors calculation.

Standard errors in parentheses.

\* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

## IV. Conclusions

The IT sector in Costa Rica shows salient characteristics from a firm and worker perspective. General data show low mobility (in terms of the share of workers that moved from a MNC to other firms). The share of women in employment experienced a relative increase during the period studied, both for MNCs and domestic firms. However, worker participation is still unbalanced from a gender perspective, notwithstanding the higher relative participation of female workers in MNCs.

From the econometric exercises we found that current workers at ICT domestic firms with previous working experience in MNCs have a wage premium. Besides, we also found that tenure is an important dimension in receiving this wage premium since only employees with a tenure of more than one year obtained it. In addition, knowledge acquired in MNCs is to some extent industry specific. Furthermore, workers with previous experience in domestic local suppliers of MNCs receive a wage premium when the move to ICT domestic firms as well. Finally, we found a gender bias in the wage premium in all model specifications.





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This study uses wage premiums to explore knowledge spillovers through labour mobility from multinational companies (MNCs) to domestic firms in the information and communications technology (ICT) sector in Costa Rica. To this end, the authors use a novel employer-employee matched database for 2001–2012 and various fixed-effects models. In doing so, they control for the skill level and age of workers and the firm’s economic activity. The authors found a wage premium for employees in domestic firms with prior work experience in MNCs. The wage premium is related to employee tenure (more than one year) and industry-specific knowledge acquired while working in MNCs. They also confirm a wage premium for workers with experience in domestic suppliers of MNCs who move to domestic ICT firms. Lastly, they found a systematic gender bias in the wage premiums in all model specifications.