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**Conference Paper**

## The impact of ICTs on employment in Latin America: A call for comprehensive regulation

26th European Regional Conference of the International Telecommunications Society (ITS):  
"What Next for European Telecommunications?", Madrid, Spain, 24th-27th June, 2015

**Provided in Cooperation with:**

International Telecommunications Society (ITS)

*Suggested Citation:* Garcia-Murillo, Martha (2015) : The impact of ICTs on employment in Latin America: A call for comprehensive regulation, 26th European Regional Conference of the International Telecommunications Society (ITS): "What Next for European Telecommunications?", Madrid, Spain, 24th-27th June, 2015, International Telecommunications Society (ITS), Calgary

This Version is available at:

<https://hdl.handle.net/10419/127139>

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# The impact of ICTs on employment in Latin America: A call for comprehensive regulation

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## INTRODUCTION

The purpose of this study is to determine the manner in which employment will evolve in Latin America as a result of information and communication technologies. Prior research has shown that both communication and automation are displacing certain types of employment, mainly those with middle-level skills. Given the evidence from countries with a greater penetration of information and communication technologies (ICTs), we expect Latin America to follow the same path and potentially be negatively affected by the elimination of some professions.

Researchers who have analyzed the impact of ICTs on employment have found that there has been a gradual move from agriculture to manufacturing and services, with service economies' being the latest iteration in development. The economic prospects for these service economies, however, depend on the composition of the service professions. Ideally, we should want people

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<sup>1</sup> This research was conducted with the support from the Barcelona Institute of International Studies (IBEI) through their faculty research fellowship Cátedra Telefónica IBEI de Política y Regulación de Telecomunicaciones e Internet.

to be employed in professions that require higher-level skills, as these should result in higher incomes and productivity.

ICTs are actually generating employment in the Latin American region, and this is likely to be the case for some years, as these technologies make business and government operations more efficient.

In the long term, however, the problem for Latin America is that without the “knowledge and innovation policies” that invest in education, as well as research and development, the region may be relegated to providing elementary services that pay low wages, which could reduce the region to poverty.

Using statistics from the International Telecommunications Union, the World Bank and the International Labor organization, I constructed a panel of 200 countries over a 20-year period to allow for comparisons across regions, specifically Europe and Latin America, to determine if countries that have invested in education and R&D have also benefited from service employment with higher-level skills.

This paper is organized as follows: Section 2 presents the opportunities and potential challenges presented by ICTs. The following sections are then organized to address the different macro factors that are likely to affect employment and potentially contribute to, or counteract, the effects of technology. Section 3 discusses the role of education. Section 4 examines the impact that research and development are likely to have on this process. Section 5 focuses on the role of businesses and on how they are likely to contribute to the creation of jobs in the region. Section 6 focuses on two elements of regulation that are also associated with

employment: one is the role of labor regulation in the adjustment of labor to technological development, and the other concerns more general aspects of governance, such as bureaucracy and corruption, which can also affect employment. Section 7 presents an analysis of the data. Section 8 provides some implications of the results, as well as a discussion of limitations and a conclusion.

## THE IMPACT OF TECHNOLOGY ON EMPLOYMENT

Information and communications technologies (ICTs) are becoming an essential part of everyone's life. An increasing amount of economic activity now takes place with the support of these technologies. They give people the ability to quickly obtain information anytime and from anywhere in the world. Data that can be accessed through networks and software applications have made works tasks much easier.

Over 2 billion people now own phones with an Internet connection, and these have brought a wide range of conveniences to average people. These connections now allow people to control their home thermostats, track their exercise and heartbeat, monitor their diets, share their homes and cars, and have groceries delivered to their door. These technologies have also expanded capabilities for companies and governments. In the private sector, companies are able to control a building's energy consumption, allow access to it, find failures in production and, of course, automate many tasks that were previously done by humans, which has reduced the cost of production (Chorafas, 2011).

It is clear that technology has brought about significant changes in our lives, including, of course, the types of employment available to us. This is often desirable. We want to be able to engage in employment that is less routine and repetitive and more stimulating. People also rely on jobs for their livelihood, but the skills they possess are only able to give them access to a certain portfolio of opportunities.

A question of increasing interest is the impact technologies have on employment. Countries that have a greater penetration of ICTs are more likely to experience labor disruption faster than those with lower penetration. A 1989 study of the labor market, which looked at the impact of ICTs on employment in the United States Anderson and Harris (1989), concluded that technological trends would not drastically affect employment until the year 2000. At the time, analysis indicated that any effects on employment might not have been noticeable because many companies had not yet begun to exploit the full potential of automation tools and high-speed communication networks (Anderson & Harris, 1989). Thus, it was found at the time that ICTs were creating new jobs requiring higher skill levels, while low-skill, low-wage jobs were diminishing in industries that heavily used communications.

It has been argued, however, that the rate of unemployment is greater now than in previous periods of technology advancement. A recent book by Chorafas (2011) shows that over the last two decades, unemployment in the European Union has increased substantially for those with limited skills.

We are still in the early stages of the transition toward more highly connected and automated societies. The purpose of this paper is to determine the impact that ICTs can have on Latin America, a less-developed region.

The main hypothesis of the study is:

*H1: Technology experiences a concave relationship with employment in services.*

FIGURE 1. FIXED BROADBAND INTERNET SUBSCRIBERS  
PER 100 PEOPLE, 2011

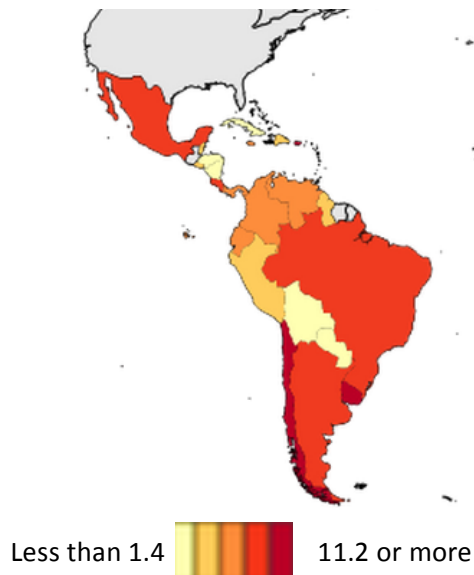
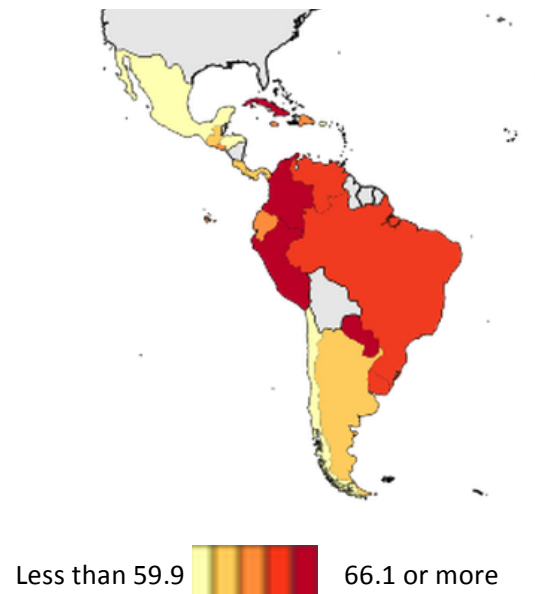
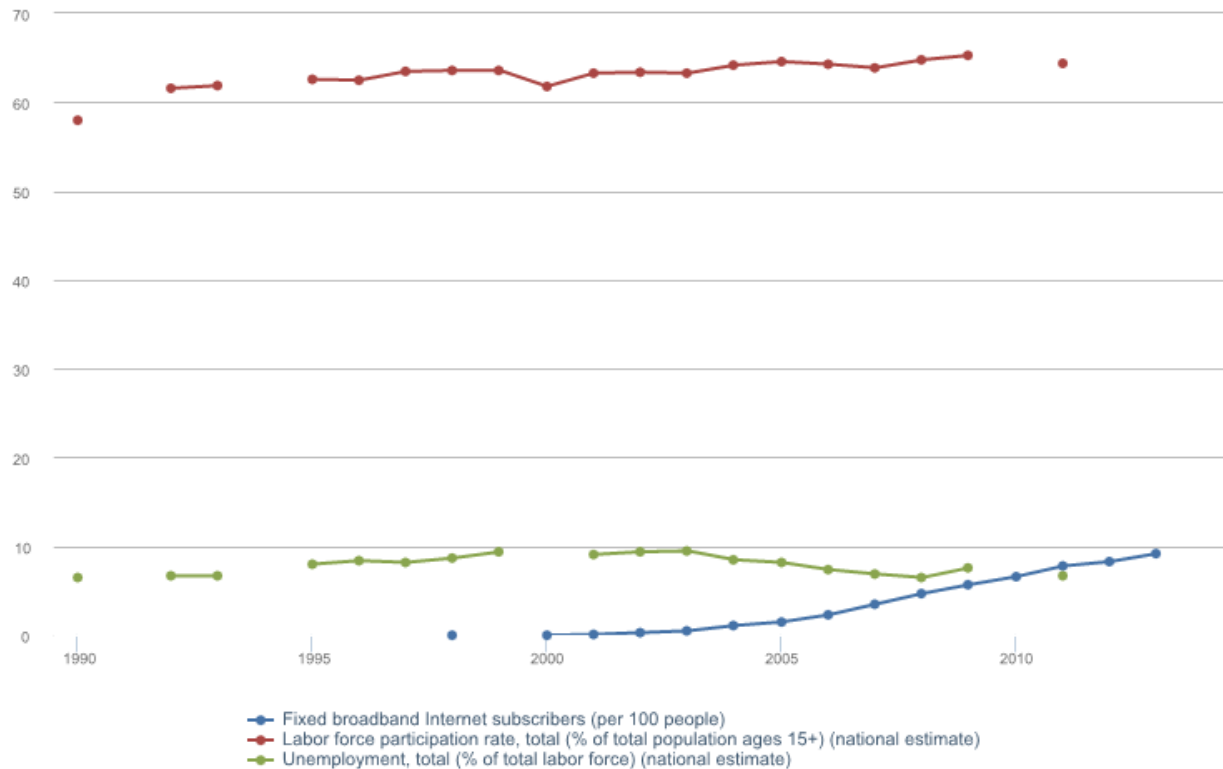


FIGURE 2. LABOR FORCE PARTICIPATION RATE( % OF TOTAL  
POPULATION AGE 15+), (2011





## THE ROLE OF EDUCATION IN EMPLOYMENT AND DEVELOPMENT

Technology has evolved along with human development. Human ingenuity has been made evident since the dawn of civilization, presenting challenges, but also many opportunities. As technologies evolve, they require us to invest in learning to be able to take advantage of the benefits that they can have on productivity and wages. In this section, I present a brief summary of the extensive research that exists regarding the impact of education on employment.

There have been several studies of the impact of education on employment. One of the most cited is Mincer (1991) "Education and Unemployment," which showed, through an analysis of

panel data, that one of the major benefits of education is a lower risk of unemployment, given higher levels of education.

A high level of education has been found to result in three benefits: higher wages, greater upward mobility in both income and occupation, and greater employment stability (Sicherman, 1990).

In 1977 and 1978, a survey by the National Opinion Research Center found that workers with the lowest levels of education expected to experience unemployment at a rate 170% higher than those with the highest levels of education (Sicherman, 1990, p. 6).

The effects of education on employment, however, are, when other variables are considered, often not significant. Mincer (1988), however, found that an additional year of education can reduce the the probability of unemployment by 1.3 percentage points at different levels of experience. Similarly Riddell and Song (2012) found that an additional year of schooling resulted in a 2 percentage point increase in the probability of re-employment. There is also some evidence that people with higher levels of education are more likely to secure a permanent job after a temporary position, compared to those with less education (Charlot & Malherbet, 2013; Güell & Petrongolo, 2007) Greater skills and knowledge are also obtained through experience, and, as Sicherman (1990) indicates, there are wage increases related to job experience rather than to schooling. However, Sicherman's study also found that more educated workers engage in more training, and he believes that educated workers have a greater ability to learn and to pay for training. Education and training positively affects skills, as it results in higher productivity.



During a transition period when companies are undergoing a significant transformation, there is likely to be a great need for people educated in relevant areas, and these are likely to be offered higher wages. Companies introducing technologies with a tendency for rapid evolution are also likely to rely more heavily on in-house company training to more rapidly capitalize their investments. Moreover, because of the significant changes that technology brings to all sectors during such a transition period, governments also will have to invest in education and training.

The role of education may be more difficult to discern in the future. Research thus far tells us that the more educated a person is, the more likely he or she will be employed and receive a higher wage. Up to this point, however, researchers have generally presumed that the only way people can acquire skills is through formal education. It is now possible, however, to take classes and obtain the equivalent of a degree (i.e. certifications, for example) over the Internet without an institutional affiliation. From a financial perspective, it may not make sense in the future for some people to take on education-related debt, when much of the knowledge is available practically for free through online courses.

An additional difficulty is the impact that unemployment has on educational decisions. When young people find that college-educated people are having a hard time finding jobs, they, in turn, may decide that getting an education is insufficient for getting a job after graduation. Thus, persistent unemployment can have a detrimental effect on people's decisions about whether or not to become educated.

It should also be noted that in the employment and the education markets, although they are related, it is not always the case that students will steer towards careers that are in high

demand. Consider the perennial problem in the US and other countries, where, for many years, there has been a great need for people with STEM skills, for which the market offers highly paid employment. When they think about education, researchers sometimes assume that the supply of educated labor perfectly correlates with marked demand. This may not necessarily be the case. A study by Chorafas (2011) found that having a college degree did not guarantee a job, because many degree holders focus on professions in soft subjects or earn degrees that are perceived to be less difficult. This may be desirable, though, as people should choose fields in which they are comfortable and competent.

In our model, we will thus try to determine how education impacts employment, assuming that a more educated population is more likely to do better in the face of rapid technological advancement. In this respect, the model will test the following hypothesis:

*H2: A more highly educated population is more likely to find employment.*

FIGURE 3. PUBLIC SPENDING ON EDUCATION, TOTAL (% OF GDP), 2011

FIGURE 4. LABOR FORCE PARTICIPATION RATE, (% OF TOTAL POPULATION AGE 15+), 2011

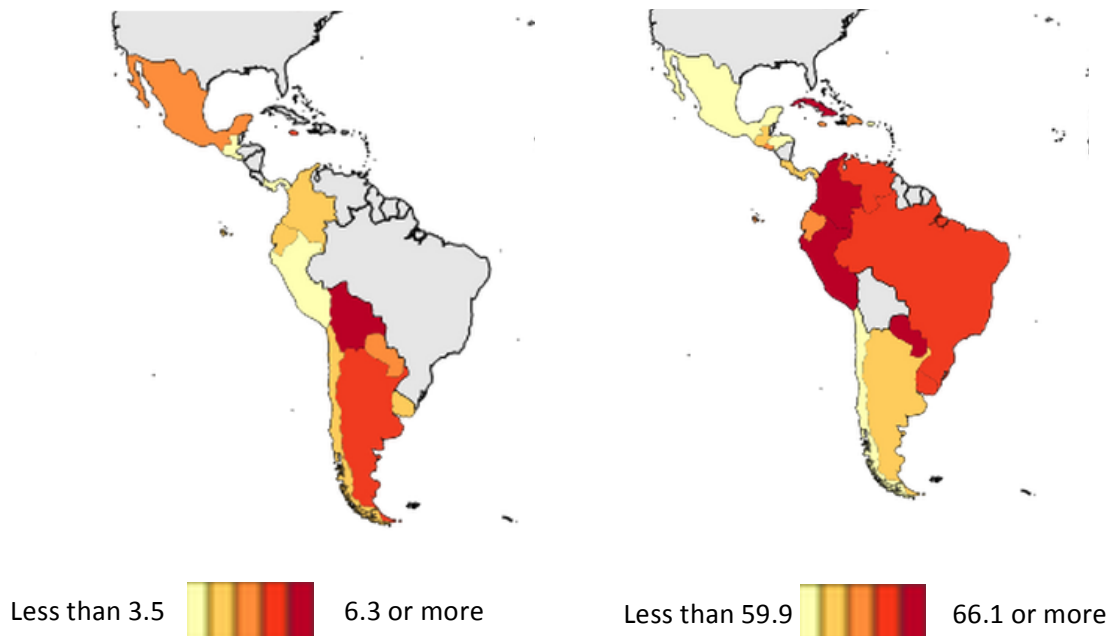


FIGURE 5. LABOR FORCE PARTICIPATION WITH PRIMARY EDUCATION (% OF TOTAL), 2011

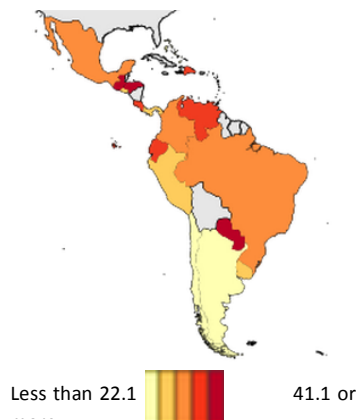


FIGURE 6. LABOR FORCE PARTICIPATION WITH PRIMARY EDUCATION (% OF TOTAL), 2011

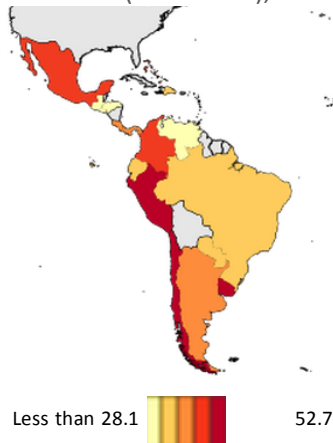


FIGURE 7. LABOR FORCE PARTICIPATION WITH PRIMARY EDUCATION, (% OF TOTAL ),2011



## RESEARCH AND DEVELOPMENT

In a world where technology is changing rapidly, the ability of a country to adapt, embrace and even produce, new products and services may be crucial for its economic survival. This is

particularly true because scholars have found a positive relationship between economic growth and innovation.

The purpose of this paper is not to determine the factors that lead to innovation in Latin America, but to examine how research and development could lead to innovation or increasing labor skills in the presence of increasingly sophisticated information and communication technologies.

There are, of course, many factors that lead to innovations, and, from a regional perspective, theorists have explained innovation on the basis of industry/sector clusters that create creative synergies from being together (Agrawal & Cockburn, 2003; Feldman, 1994; Jaffe & Trajtenberg, 2002). Research in this area also indicates that the more companies and people are involved in similar problems, the greater the inventiveness and productivity in the sector. One could argue that there is a need for a certain number of people to work in an area for them to innovate collectively (Arrow, 1962; Romer, 1986). However there is also evidence that diversity, rather than specialized clusters, is more likely to lead to innovation.

Unfortunately, recent research about research and development in Latin America indicates that the region, even though it generated 8.7 percent of world GDP in 2013, only generated 0.19 percent of patents (Ketelhöhn & Ogliastri, 2013), and the entire region produced the same number of patents as those in Spain.

Given the limited amount of research and development that occurs in developing countries such as those in Latin America, scholars have advocated for innovation to encourage these countries to stop depending on developed countries for their production processes (Stern &

Porter, 2001) . A study of entrepreneurs in Latin America found that individuals produced a certain amount of innovation because of a need for income, rather than as a result of competitive or creative processes. These are called *survival entrepreneurs*. They are found to be unstable (Merino & Vargas, 2004) and do not generally generate advance research and innovation services.

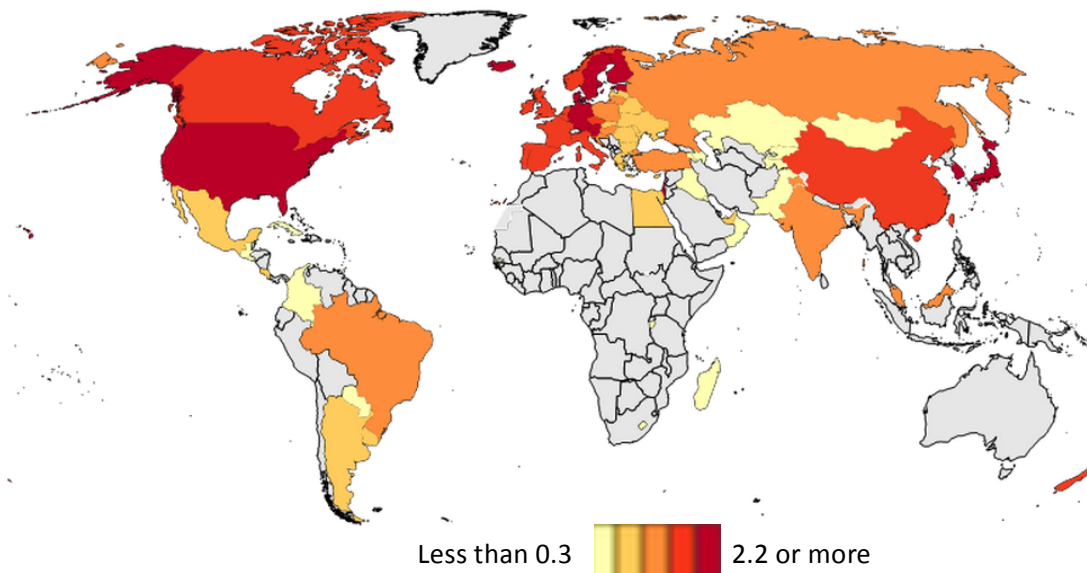
In these studies, scholars found that the processes impeding innovation are related not only to individual factors, but also to more complex systemic elements such as regulation, the educational level of the population, and the level of international competition that local companies face.

There are, therefore, many reasons why greater amounts of research and development in a country can be beneficial at a time when technology is evolving rapidly. A more highly educated population may be more ready and able to retrain themselves to learn skills that become necessary as technology evolves. A faster transition can thus mean that they may not need to be unemployed for a long period of time, as they have been able to keep their skills up to date. The transaction costs of learning a new skill may be smaller than in a society with a limited pool of knowledge that participates in the use of innovative technology.

In this respect, we wish to explore the following hypothesis:

*H3: The greater the amount of research and development, the higher the levels of employment.*

FIGURE 8. RESEARCH AND DEVELOPMENT EXPENDITURE (% OF GDP) 2011.



## THE ROLE OF BUSINESS IN EMPLOYMENT

Even though technology brings great benefits, it also brings challenges. In fact, when new technologies are introduced, society undergoes a major shock, as companies need to change their production practices, equipment and labor skills in an environment of uncertainty. We are undergoing a major transformation as computers and communication networks produce great changes in many sectors of the economy. In developed economies, the service sectors such as finance, wholesale and retail, have facilitated a radical reorganization of business, leading to significant gains in productivity (McGuckin, Spiegelman, & Van Ark, 2005; O'Mahony & Van Ark, 2003).

ICTs can be deployed in practically any field of production, making operations more efficient and potentially displacing some workers. They are also gradually becoming more ubiquitous in the private sector. Given the cost reductions and greater connectivity, and automation, it is likely that certain types of employment will be displaced.

There is a large body of academic work about the impact that companies have on employment. Special attention has been paid to small and medium enterprises (SMEs), as some researchers have found that they positively contribute to job creation. However, the original research from Birch (1981), which found that SMEs created more jobs than their larger counterparts, has been challenged; subsequent estimates found that they create jobs at levels similar to their larger counterparts, while also paying lower wages, at least according to data in the United States (Brown, 1990). Another study, by Davis and Haltiwanger (1996) in the US, showed that large companies generated most of the jobs that were created and destroyed in manufacturing in the 1972-1988 period. They also found that the amount of jobs created increased as a company increased in size. Research thus finds that both small and large companies generate jobs, and this does not seem to correlate with the size of the enterprise.

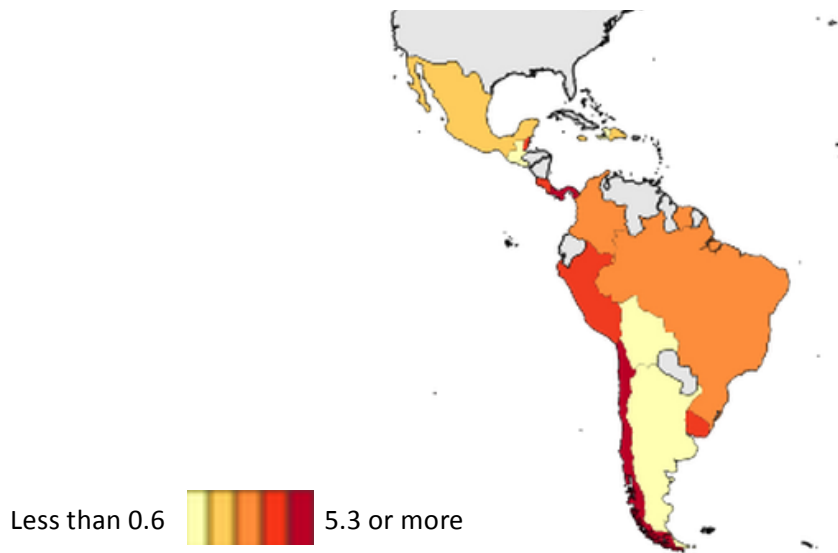
Research also finds that new businesses are more productive than established firms (Foster, Haltiwanger, & Syverson, 2008). This can be related to the fact that new entities are more likely to adopt processes and technologies that make their employees more productive.

Companies can thus be an engine of employment creation or destruction, depending on how they use technology. If they invest in labor-saving technologies, we are likely to see a negative impact on employment. In this respect, I tested the following two hypotheses.

*H4: The creation of new businesses will positively affect employment levels.*

*H5: Capital investments will negatively affect employment, as they are more likely to be labor-saving expenditures.*

FIGURE 9. NEW BUSINESS DENSITY (NEW REGISTRATIONS PER 1,000 PEOPLE AGES 15-64) 2012



## THE IMPACT OF GOVERNMENT ON EMPLOYMENT

There are many ways in which governments can affect employment. In this section, I focus on two areas. One is labor regulation, and the other is a government's ability to facilitate business operations.

### *Labor regulation*



The ability of a company to decide to invest in labor-saving technology or to hire more workers can be affected by labor regulations.

Labor regulations have been adopted in many countries to improve working conditions. These include, among other considerations, social security, pensions, health care, minimum wage laws, workers' compensation for accidents and sick leave for mothers. These, of course, come at a cost, both monetary and potentially in the form of human capital, as these protections may make companies more reluctant to hire workers, thus reducing employment opportunities.

A study by Charlot and Malherbet (2013) showed that labor regulation aiming to protect employment benefits people who have stable jobs, as it reduces the likelihood of being fired. However, they explained, it increases turnover due to the increasing use of temporary jobs. Furthermore, well-intentioned labor regulation that protects employment also has the unintended effect of reducing the will of employers to convert a temporary worker into a permanent employee to avoid burdensome regulations and expenses.

Charlot and Malherbet (2013) also found that countries with few, if any, protections are also not good at job creation, due to job destruction and the lack of a desire to invest in education.

Specifically in Latin America, a paper by Kaplan (2009) reports that employers in the region would increase the number of workers by 2% if labor regulations were more flexible. In this respect, Botero, Djankov, La Porta, López de Silanes, and Shleifer (2003) found that countries with stronger labor regulations also experienced lower labor participation and higher unemployment.

Also in Latin America, Heckman, Pagés-Serra, Edwards, and Guidotti (2000) found that labor laws resulted in lower employment and higher inequality. Ahsan and Pagés (2009) arrived at similar results, finding that labor regulation resulted in both reduced output and employment in the formal sector. In Colombia Kugler (2004) found that reducing the cost of firing an employee also reduced unemployment. A similar result was seen to be the case in Peru Saavedra and Torero (2004). This is because it makes the labor market more dynamic and flexible to respond to changes in technology, for example.

In addition to the effect that these regulations can have on hiring and wage decisions. Bertola (1990) also found that rigid labor regulation makes an economy more vulnerable to economic shocks, as this can affect companies' abilities to respond quickly.

A number of other studies (Gonzaga, Maloney, & Mizala, 2003; Haltiwanger, Scarpetta, & Schweiger, 2008; Micco, 2006) found that labor rigidities also reduce the productivity of workers, because they are not able to change jobs more rapidly to firms where their skills will make them more productive. This inability to move may also limit the learning that they need to better adjust to a new technological environment.

In spite of the literature that has indicated that rigid labor regulations result in lower employment, a study of Latin America alone found, from a survey of companies in 14 countries in the region, that the majority (83.2%) do not hire or fire workers as a result of rigid labor regulations. The paper argued that one of the reasons for such an unexpected result is that companies may rely on informal labor to get around regulations, but it is also possible that the laws are not actually enforced. Their empirical tests show that a more flexible labor market led

to a greater number of dismissals, but they were unable to determine whether this also led to greater job creation, as the coefficient was not significant. Based on the aforementioned research, I will test the following hypothesis:

*H6: Labor regulation in Latin America negatively impacts employment.*

FIGURE 10. PAID ANNUAL LEAVE FOR A WORKER 5 YEARS OF TENURE (IN WORKING DAYS)

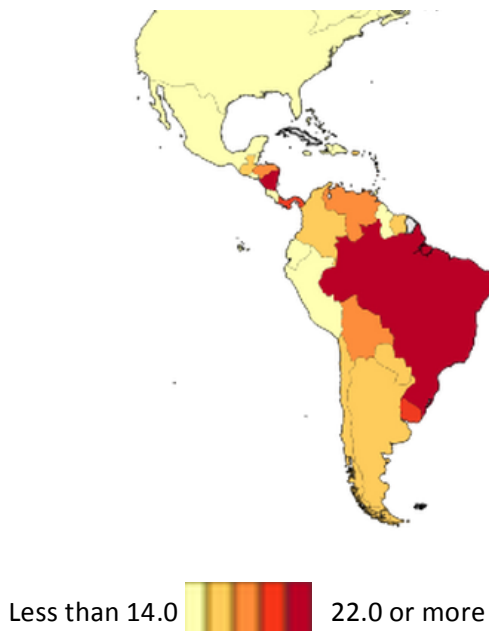
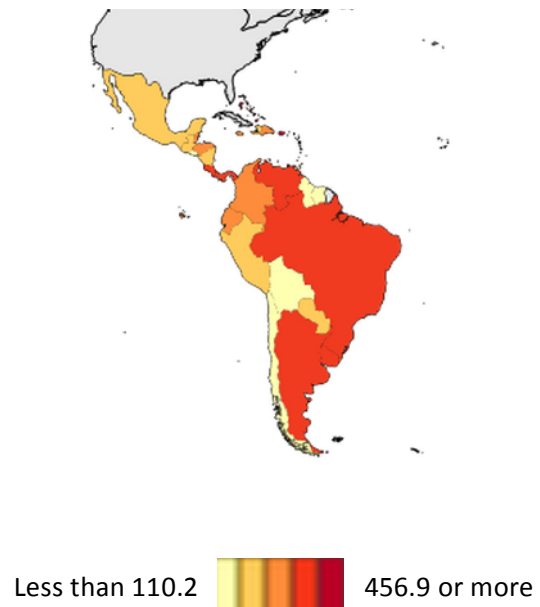


FIGURE 11. MINIMUM WAGE FOR A 19 YEAR OLD OR APPRENTICE (US\$/MONTH) 2010



### *Bureaucracies*

In the previous section, I reported on the literature that focuses on labor regulation and the impact that scholars have found about its relationship with employment creation. Regarding

regulation, there is a long tradition in economics concerning the perverse effects of burdensome bureaucracies on many aspects of economic activity

Regulation, ideally conceived, is intended to protect employers, employees and consumers. It protects employers by limiting their liability when problems with a product arise, by protecting their assets from being stolen, and by protecting them from fraudulent activities on the part of employees, while it provides benefits for employees, such as social security; paid vacations; sick leave; and protection against unjustifiable firing and exploitative labor practices and salaries. It consumers protects from dangerous products or services.

Regulation, nonetheless, can be intrusive and overwhelming to the point of discouraging business creation or forcing employers to hire people informally, in order to avoid paying the costs of labor compliance (Mazumdar, 1976).

In a now famous study by De Soto (1989), the registration of a firm in Peru took 10 months and cost an estimated \$1,037, equivalent to 32 times the minimum monthly salary, and included \$195 for licenses and other regulatory requirements. This was later compared with two cities in Florida in the U.S., where it took three and a half hours, and in New York City, where it took four hours to register a new firm.

In many developing countries, excessive regulation is common, and researchers have attested to this. In the Philippines, even micro enterprises require a lawyer and an accountant to comply with regulatory requirements (Alonzo, 1991), while in Egypt, as observed by Chickering and Salahdine (1991, p. 191), "much of the country's entrepreneurial talent is consumed in circumventing the country's nightmare bureaucratic regulatory system."

Labor laws are complex pieces of legislation that regulate the number of days of annual leave with pay, the number of days of maternity leave, social security contributions as a percentage of wages, minimum wage as a percentage of average wage, and severance pay, all of which can be difficult to comply with unless expert labor attorneys are hired to navigate the process of approvals, even under efficient government processes.

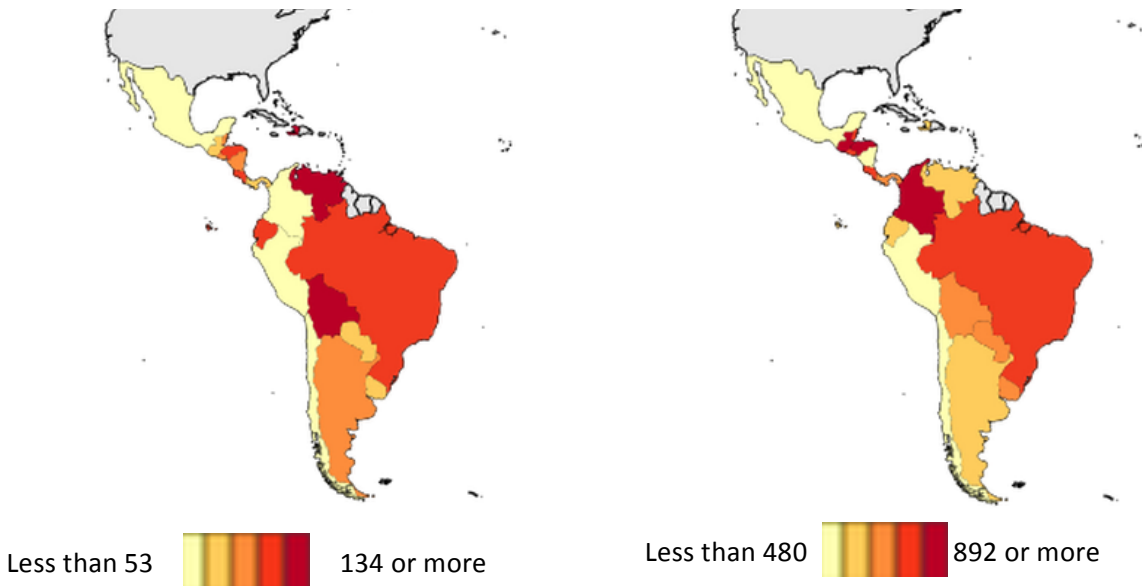
A study of the informal sector in Mexico found that street vendors participated in their own organizations to take care of problems with the government (51% of respondents) and to assign and negotiate spaces for merchants (29% of respondents.) These organizations emerged as a means of overcoming government regulations and red tape. It is much easier for these street vendors to become members of these organizations than to try to navigate government oversight on their own (Rama, 1995).

Regarding bureaucracies, I will test the following hypothesis:

*H7: The more bureaucratic a country, the lower the level of employment.*

FIGURE 12. EASE OF DOING BUSINESS INDEX  
(1=EASIEST ,185=MOST DIFFICULT), 2011

FIGURE 13. TIME REQUIRED TO ENFORCE A CONTRACT  
(IN DAYS), 2011



## GENERAL ECONOMIC FACTORS OF THE REGION

In addition to these more theoretically based factors, this study also controls for other factors that can affect employment levels, specifically income in the form of GDP per capita, income inequality through the GINI index, and population.

## METHODS

Using data from the World Bank, The International Telecommunications Union and the International Labor Organization, we constructed a panel of 23 countries over a period of 15 years to determine the effects of technology on employment in Latin America. The scarce availability of comparable statistics limits more sophisticated econometric studies across countries, particularly for developing economies.

One of the main weaknesses of country-level data is that variables can be missing. Statistics software that uses listwise deletion discards all observations that contain missing values.

A large number of missing data can lead to less efficient results (larger standard errors, wider confidence intervals, less power) than multiple imputation (MI) results. If only actual data are used, then the results do not represent the population, and biases result from listwise deletion.

The alternative that I chose is to use multiple imputation to fill the gaps where data is missing, in order to make deductions about the nature of the problem in certain countries. I decided to follow this course because, unfortunately, in Latin America, there are several countries for which data are missing. Without multiple imputation, it would have been impossible to perform any type of analysis. The results, thus, need to be viewed with caution, and we suggest that any policy recommendations focus on the factors that are significant, as opposed to the specific magnitude of the coefficients.

Because we are working with panel data, we used a fixed data regression analysis.

### *Model*

Figure 14 shows the relationships of the factors we found in the literature that can affect employment. For this, we set up a two-stage least square model with a fixed-effects regression analysis. The rationale for this is that technology does not affect employment directly. In other words, a technology cannot employ a person, while a business can. It is for this reason that we included in the first stage of the model all of the variables that can affect new businesses and their decision to enter the market.

In the first stage of the regression, I thus included factors that can affect businesses, including the ICT variables *mobile* and *broadband* (See figure 14).

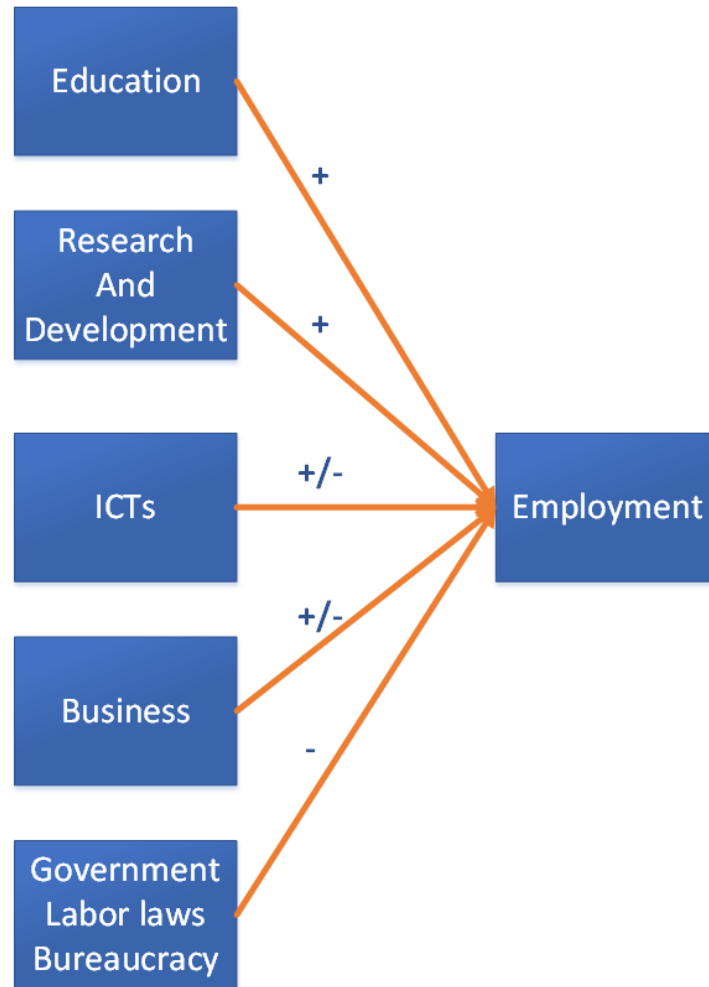


FIGURE 14. MODEL OF THE RELATIONSHIP OF FACTORS TO EMPLOYMENT

## Results

Figures 14 shows the results of the regression for each of the variables we included in the model. We included in the graph only those that were significant.



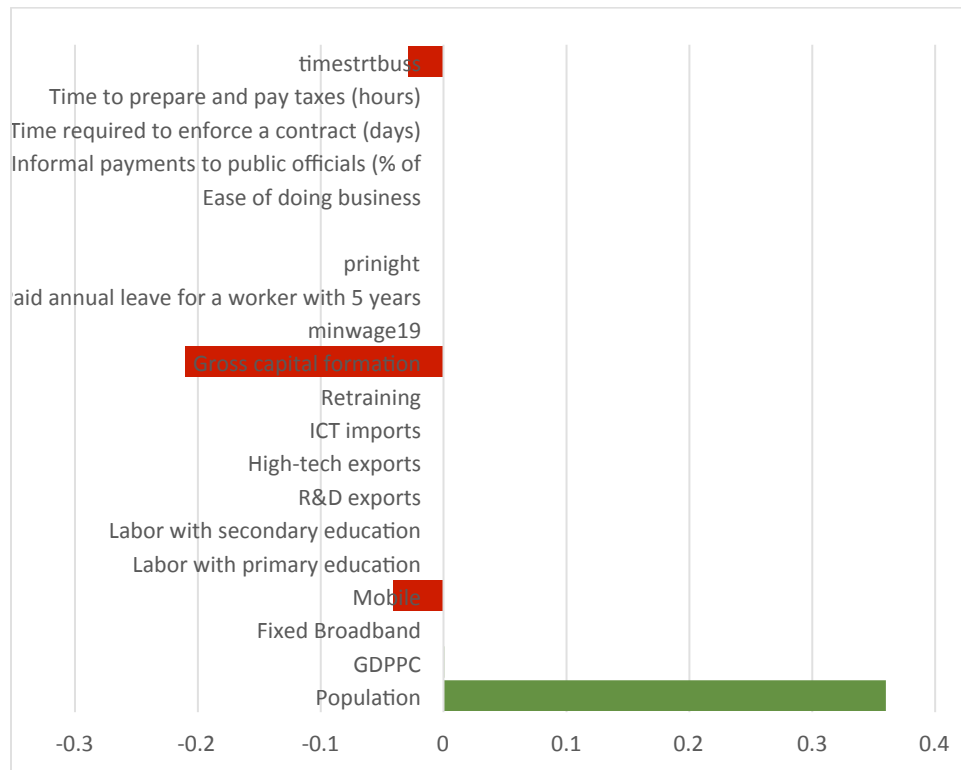


FIGURE 15. SIGNIFICANT FACTORS AFFECTING EMPLOYMENT

The main hypothesis of this study addresses the impact of ICTs on employment. We found first that of the two technologies that we included in the study, only mobile was significant. This was to be expected, as the region still has a very low broadband penetration that barely extends beyond 10 percent of the population. Mobile, on the other hand, is much more pervasive, and mobile apps that have the potential to displace current employment arrangements are still relatively new to the region, but it appears that they are starting to have a negative impact on the service sector of Latin American economies.

This should be seen within the context of the Latin American region, where a large number of the population is employed in the service sector, with tourism being one of the most important segments. Therefore, mobile applications such as Uber, which provides less expensive and

convenient alternatives to taxis, or Airbnb, which expands the number of accommodations to include just about anybody with a spare room, can significantly and negatively affect employment in those sectors.

In the same vein, the introduction of capital, which in this study is assumed to represent the introduction of more automation, is also negative. Of course, this is an assumption that needs to be further explored, taking into consideration that Latin America still has a comparative advantage on labor costs, which makes these results of even more concern, because if the region's labor is considered inexpensive compared to that of the United States or Canada, their most industrialized neighbors, and we see that capital is actually negatively affecting employment, we have a potentially disastrous economic situation for the region.

Another significant variable in the model is the one relating to bureaucracies. This is also not surprising, as we find that there are many countries in the region that suffer from excessive government regulation. It appears that this is particularly true regarding the creation of new businesses, as opposed to all businesses, which are captured through the *ease of doing business* variable. One could interpret this to mean, without being inconsistent with the literature, that once a business is established, it operates with no major disruptions from government. However, entering the market legally appears to be more difficult than entering illegally through the informal sector. This should be of concern to government officials, given the negative impact on employment of technologies like ICTs and automation. Without the ability of citizens to easily enter the market and create their own businesses, or to find employment in a newly established business, the region can be facing deteriorating economic conditions for the population.

Population has a positive effect, meaning the larger the population is, the more people find themselves employed in the service sector.

## **POLICY RECOMMENDATIONS**

The results of this study suggest that, like developed countries, the region has experienced negative effects that can stem from the use of mobile phones, and the negative effect of gross capital formation further suggests that, at least in the short term, we will see a contraction in employment. This can be catastrophic in a region that still suffers from weak governments, some even completely inadequate, ineffective and corrupt, as well as from significant incidents of violence. In the absence of policies that can alleviate potential further erosion in employment, the regions could spiral into economic hardship, potentially followed by social unrest.

The question is, What to do? Research from other countries points to the need for quality education that better matches market demands. For the most part, education has been considered a public good to be provided by the state. However, given the challenges associated with the speed at which technology advances, this role should be expanded to other entities, such as the private and non-for profit sectors, to support a population that will need to be constantly updating its skills to maintain employability over time, as technologies continue to evolve. This means that training should be part of the operations of a company, in order to address the demands of a more technologically sophisticated, global market place.

Greater efforts should be made in the region to improve research and development capabilities. In this area, the region is still in its infancy and is still a net importer of technology, at great expense, both financially and, as is made evident by this paper, in employment. Governments should thus be concerned with enhancing their population's science, technology, engineering and mathematics (STEM) skills, to open up opportunities to contribute to this post-industrial digital economy.

Given the confluence of economic and political challenges that the world and the region are currently experiencing, governments will need to take a much more active, but not intrusive, role to ameliorate the negative impact that technology is likely to bring in the near future.

## CONCLUSIONS

ICTs and automation are becoming more pervasive around the world, and studies to date have shown a negative effect on employment, at least in the short term. This study further contributes to that literature, while also showing deficiencies in the generation of employment, arising from problems with infrastructure and bureaucracy, as well as from the ineffectiveness of the private sector. The region, without significant government intervention, is likely to suffer serious economic conditions. It needs to reduce bureaucratic hurdles, while aggressively investing in education, research and development, and providing incentives for the private sector to invest in training.

The region is still growing its population, which means that there will be additional pressure on the market for employment opportunities from a young population which, if disenfranchised, can cause serious economic and, consequently, political instability.

Governments in the region have some time to adjust, but they cannot wait long, as the effects of these technologies are already evident, and the trends are likely to continue.

## REFERENCES

- Agrawal, A., & Cockburn, I. (2003). The Anchor Tenant Hypothesis: Exploring the Role of Large, Local, R&D-Intensive Firms in Regional Innovation Systems. *International Journal of Industrial Organization*, 21(9), 1227-1253. doi: [http://dx.doi.org/10.1016/S0167-7187\(03\)00081-X](http://dx.doi.org/10.1016/S0167-7187(03)00081-X)
- Ahsan, A., & Pagés, C. (2009). Are all labor regulations equal?: evidence from Indian manufacturing. *Journal of Comparative Economics*, 37(1), 62-75. doi: 10.1016/j.jce.2008.09.001
- Anderson, J. M., & Harris, S. (1989). Communications and future employment trends. *Telematics and Informatics*, 6(2), 71-80. doi: 10.1016/S0736-5853(89)80035-8
- Arrow, K. J. (1962). The Economic Implications of Learning by Doing. *The Review of Economic Studies*, 29(3), 155-173.
- Bertola, G. (1990). Job security, employment and wages. *European Economic Review*, 34(4), 851-879. doi: 10.1016/0014-2921(90)90066-8
- Birch, D. L. (1981). Who creates jobs. *Public Interest*(65), 3-14.
- Botero, J. C., Djankov, S., La Porta, R., López de Silanes, F., & Shleifer, A. (2003). The regulation of labor. *NBER working paper*(w9756).
- Brown, C. (1990). *Employers large and small*: Harvard University Press.
- Charlot, O., & Malherbet. (2013). Education and employment protection. *Labour economics*, 20, 3-23. doi: 10.1016/j.labeco.2012.09.004
- Chorafas, D. N. (2011). *Education and Employment in the European Union : The Social Cost of Business*. Farnham: Ashgate Publishing Ltd.
- Davis, S. J., & Haltiwanger. (1996). Small Business and Job Creation: Dissecting the Myth and Reassessing the Facts. *Small business economics*, 8(4), 297.
- Feldman, M. P. (1994). *The geography of innovation* (Vol. 2; 2.). Dordrecht; Boston: Kluwer Academic.
- Foster, L., Haltiwanger, J., & Syverson, C. (2008). Reallocation, Firm Turnover, and Efficiency: Selection on Productivity or Profitability? *The American*

- Economic Review*, 98(1), 394-425. doi: <http://dx.doi.org/10.1257/aer.98.1.394>
- Gonzaga, G., Maloney, W. F., & Mizala, A. (2003). Labor Turnover and Labor Legislation in Brazil [with Comments]. *Economía*, 165-222.
- Güell, M., & Petrongolo, B. (2007). How binding are legal limits? Transitions from temporary to permanent work in Spain. *Labour economics*, 14(2), 153-183. doi: <http://dx.doi.org/10.1016/j.labeco.2005.09.001>
- Haltiwanger, J., Scarpetta, S., & Schweiger, H. (2008). Assessing job flows across countries: The role of industry, firm size and regulations: National Bureau of Economic Research.
- Heckman, J., Pagés-Serra, C., Edwards, A. C., & Guidotti, P. (2000). The Cost of Job Security Regulation: Evidence from Latin American Labor Markets [with Comments]. *Economía*, 1(1), 109-154. doi: 10.1353/eco.2000.0007
- Jaffe, A. B., & Trajtenberg, M. (2002). *Patents, citations, and innovations: A window on the knowledge economy*.
- Kaplan, D. S. (2009). Job Creation and Labor Reform in Latin America. *Journal of Comparative Economics*, 37(1), 91-105. doi: <http://dx.doi.org/10.1016/j.jce.2008.10.002>
- Ketelhöhn, N., & Ogliastri, E. (2013). Introduction: innovation in Latin America. *Academia Revista Latinoamericana de Administración*, 26(1), 12-32. doi: 10.1108/ARLA-05-2013-0037
- Kugler, A. (2004). The effect of job security regulations on labor market flexibility: Evidence from the Colombian labor market reform. In J. J. Heckman & C. e. Pages (Eds.), *Law and employment: Lessons from Latin America and the Caribbean* (pp. ix-ix): University of Chicago Press.
- McGuckin, R. H., Spiegelman, M., & Van Ark, B. (2005). The US advantage in retail and wholesale trade performance: how can Europe catch up? *Perspectives on a Global Economy*.
- Merino, M., & Vargas, M. (2004). Evaluación comparativa del potencial emprendedor de Latinoamérica: una perspectiva multinivel. *Academia Revista Latinoamericana de Administración*, 46(46), 38-54.
- Micco, A. (2006). The economic effects of employment protection: evidence from international industry-level data.
- Mincer, J. (1988). *Studies in Human Capital*. Vermont: Brookfield, VT: Edward Elgar Publishing Company.
- Mincer, J. (1991). Education and unemployment. *NBER Working Paper No. 3838*. from <http://www.nber.org/papers/w3838>

- O'Mahony, M., & Van Ark, B. (2003). *EU productivity and competitiveness: an industry perspective: can Europe resume the catching-up process?* : Office for Official Publications of the European Communities Luxembourg.
- Riddell, W. C., & Song, X. (2012). Does Education Reduce Unemployment? New Evidence on the Impact of Education on Unemployment and Re-employment. *Intereconomics*(1), 16-22.
- Romer, P. M. (1986). Increasing returns and long-run growth. *The journal of political economy*, 94(5), 1002-1037. doi: 10.1086/261420
- Saavedra, J., & Torero, M. (2004). Labor market reforms and their impact on formal labor demand and job market turnover: The case of Peru. In J. J. Heckman & C. e. Pages (Eds.), *Law and employment: Lessons from Latin America and the Caribbean* (pp. ix-ix): University of Chicago Press.
- Sicherman, N. (1990). Education and occupational mobility. *Economics of Education Review*, 9(2), 163-179.
- Stern, S., & Porter, M. (2001). Innovation: location matters. *Sloan management review*, 42(4), 28.