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Innovation and Employment: The Role of Labor Markets Regulations in Latin America

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Innovation and Employment: The Role of Labor Markets Regulations in Latin America*

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Abstract

The link between innovation and employment is at the center of the policy debate. This paper sheds light on how labor market regulations affect the relationship between different types of innovation and employment in Latin America. We estimate the model developed by Harrison *et al.* (2014) using Enterprise Surveys for 14 Latin American countries. We find that: (i) product innovations have a positive impact on employment growth; (ii) process innovations do not affect employment growth; (iii) more rigid labor market regulations (minimum wages and severance payments) reduce the effects of innovation.

JEL Classification: D2, J21, J38, L60, O31.
Keywords: Process Innovation, Product Innovation, Employment Growth, Labor Markets Regulations, Latin America.

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1 Introduction

Although there is growing empirical evidence that innovation creates jobs (see, for instance, Calvino & Virgillito, 2017), the fear that the development of new technology will generate unprecedented job destruction is more widespread than ever. Consequently, the relationship between innovation and employment is nowadays at the core of the policy debate.

Theoretically, the relationship between innovation and employment is not straightforward. Different schools of thought have conceptualized alternative channels that can counterbalance the initial effect of innovation on employment and leave the final effect undetermined (Calvino & Virgillito, 2017). Therefore, innovation can create or destroy jobs depending, for example, on the institutional setting, market structure, and the type of innovation the firm introduces (i.e. product or process innovation).

The introduction of a new product, if successful, can increase the demand and, consequently, increase employment. However, if after the innovation the innovator earns market power, it could be optimum to set higher prices and reduce the production, reducing the demand of labor. Therefore, the net effect of a product innovation could be a contraction in employment. A new product can also destroy jobs, if it is designed to reduce costs, or leave it unaltered, if it just replaces old products without changes in demand.

The development (or adoption) of a new production process usually leads to greater efficiency in production, saving labor and/or capital and, potentially, reducing prices. Therefore, at first it would probably create job destruction. However, if the demand grows due to increased quality or lower price, innovation could lead to higher employment.

Most empirical studies identify a positive link between product innovation and employment in businesses, especially when the products are not only new to the firm but also new to the entire market, while process innovation effects look more ambiguous (see, among the others, Herstad *et al.*, 2015; Crespi & Tacsir, 2011; Hall *et al.*, 2009; Benavente & Lauterbach, 2008).

The empirical literature that uses firm-level data followed different approaches to examine the link between innovation and employment. Several authors use proxies of the innovation effort, such as R&D intensity or patents, to evaluate their effect on employment (Stam & Wennberg, 2009; Bogliacino *et al.*, 2012; Coad & Rao, 2011). These studies find that, in general, innovation effort is correlated with employment growth at the firm level. Other authors focus on the differential effect of product and process innovations. The main reason to distinguish between types of innovation is that process innovation has a higher potential of destroying jobs. This line of research finds a positive link only between product innovation and employment, while their estimations on the effect of process innovation remain inconclusive (Smolny, 1998; Greenan & Guellec, 2000).

Other studies, pioneered by Harrison *et al.* (2014) (henceforth HJMP), use a more structural approach to study the differential effect of product and process innovation on employment. HJMP propose a model to explain the relationship between employment growth, product innovation and process innovation. Using data from France, Germany, Spain, and the United Kingdom, HJMP find that the increase in employment caused by product innovations is large enough to compensate for the displacement effect due to process innovations. Several studies estimate the HJMP model in different contexts with similar results; Benavente & Lauterbach (2007), Hall *et al.* (2008), Mairesse & Wu (2014), and De Elejalde *et al.* (2015)

estimate the model for Chile, Italy, China, and Argentina. Alvarez *et al.* (2011), Aboal *et al.* (2011) and Monge-González *et al.* (2011) estimate the model for Chile, Uruguay and Costa Rica, respectively. Finally, Dachs & Peters (2014) also estimate the model in 16 European countries.

As we mentioned before, the literature has documented several compensation mechanisms that can counterbalance the initial effect of innovation and render the final effect undetermined. Nevertheless, few studies had analyzed the role of labor market regulations in this context.

The economic literature on the effect of labor marker regulations on employment is long-standing and vast. Regarding minimum wages, neoclassical economic theories predict that as the price of labor increases, employers will demand less labor, reducing employment (Meer & West, 2015). Empirically, there is lack of consensus about the overall effects on low-wage employment of an increase in the minimum wage (Neumark *et al.*, 2014b). Nevertheless, several studies find a modest negative effect on employment (Lemos *et al.*, 2004; Maloney & Mendez, 2004; Arango-Arango & Pachón, 2004; Neumark *et al.*, 2006; Del Carpio *et al.*, 2012; Gindling & Terrell, 2007; Alaniz *et al.*, 2011), with more pronounced effects on young and low skilled workers (Montenegro & Pagés, 2007; Arango-Arango & Pachón, 2004; Neumark *et al.*, 2014a). Recent literature supports the idea that the minimum wage may not reduce the level of employment in a discrete manner, but rather affect the slope for employment growth —providing an explanation for the small effects found in literature—. Therefore, the minimum wage has a negative impact on employment, but it can only be seen in the long run (Meer & West, 2015).

Concerning firing restrictions, theoretical models predicts that, by imposing implicit and explicit costs on the firm's ability to adjust its labor demand to optimal levels, dismissal protection (such as severance payments) may inhibit efficient job terminations and, indirectly, reduce job creation. Hence, stricter employment protection implies a slower speed of adjustment of employment towards its equilibrium level (Blanchard & Wolfers, 2000). However, the net effect over the business cycle remains ambiguous (OECD, 2013). From an empirical point of view, the first generation of studies on the effects of employment protection legislation (EPL) on aggregate employment, found no significant effects (see, for instance, Boeri *et al.*, 2011). More recently, available empirical evidence suggests that, when targeting on a specific group of workers, EPL usually induces substitution across groups as regards hiring (see, for instance, Acemoglu & Angrist, 2001). Kaplan (2009) investigates the relationship between labor market regulations and employment for Latin American countries and comes to the conclusion that an increase in the flexibility of labor markets will likely increase aggregate employment for permanent employees.

In summary, labor market regulations on minimum wages or severance payments may increase labor costs and therefore affect job creation per se, but also different regulations may be changing the compensation mechanisms triggered after an innovation, affecting the link between innovation and employment. However, there are just a few papers addressing this issue (none following our empirical strategy). Giuliodori & Stucchi (2012) find that innovation created permanent employment in Spain only after a change in the labor market legislation that reduced the difference in severance payments between permanent—regular open-ended contracts—and fixed-term contracts. Before the change, all the employment created was through fixed-term contracts. Andrews *et al.* (2014) use patent stock to measure the effect of innovation on employment and capital flows. They find evidence that well-functioning product, labor and capital markets, efficient judicial systems, and bankruptcy laws that do not overly penalize failure, can raise the returns to innovative activity.

The main contribution of our paper is to provide empirical evidence on the role of different labor market regulations on the link between innovation and employment for Latin America. We consider that our empirical strategy is novel, since we are not aware of other works that have applied the HJMP's model in this context, and the main advantage of this strategy is that it allows a meaningful interpretation of the estimated coefficients, which would be more difficult in a simple reduced form approach.[1] We estimate the HJMP's model using data from the World Bank Enterprise Surveys (WBES) for 14 Latin-American countries and we use the difference in terms of minimum wages and severance payments to address the effect of labor market regulation. This dataset has two important characteristics for our study. First, it provides us with data that is comparable across countries and therefore it allows us to use the cross country difference in labor market regulations to identify their effect on the link between innovation and employment. Second, the dataset collected in 2010 Latin America contains information on the proportion of sales that comes from new products, a key variable needed to estimate the HJMP model. As previous studies, our findings confirmed the positive relationship between innovation and employment. However, we find that these results heavily depend on the labor market regulations; when labor market regulations are rigid, innovation does not create employment.

The rest of this paper is organized as follows. Section 2 presents the empirical strategy. In section 3 we describe the data. Section 4 shows the results. Section 5 presents robustness checks and Section 6 concludes.

2 Empirical strategy

2.1 HJMP's model

To study the effect of innovation on employment we use the simple two-products two-periods model proposed by Harrison *et al.* (2014). In this model we observe a firm in two different years, $t = 1$ and $t = 2$. In the second period the firm can produce two types of products: old or only marginally modified products (old products, j=1) and new or significantly improved products (new products, j =2). Let Y_{jt} be the output produced by the firm. In the first period, all products are old, therefore the output is given by Y_{11}. In the second period the firm can produce the old product Y_{12} and the new product Y_{22}.

Assuming separability in the production of old and new products and constant returns to scale in capital K, labor L and intermediate inputs (M), the production function of firm i in the first period is $Y_{11i} = \theta_{11}F(L_{11i}, K_{11i}, M_{11i})e^{\eta_i}$. In the second period, it can be $Y_{12i} = \theta_{12}F(L_{12i}, K_{12i}, M_{12i})e^{\eta_i - u_i}$, if the firm produce the "old product", or $Y_{22i} = \theta_{22}F(L_{22i}, K_{22i}, M_{22i})e^{\eta_i - v_i}$, if the firm decides to produce the "new product".[2] The productivity of firm i is given by a Hicks-neutral technological productivity index, θ_{jt}, an idiosyncratic

[1] De Elejalde *et al.* (2015) illustrated how challenging it is to understand the mechanisms linking innovation and employment without imposing additional structure

[2] The minus sign on u_i and v_i is introduced for convenience.

advantage modeled as a firm fixed effect (η_i), and unanticipated productivity shocks to the production of old and new products in the second period, u_i and v_i.[3]

Assuming cost minimization and applying Shephard's lemma, the conditional labor demand function corresponding to the production of old products can be written as:

$$L_{11i} = c_{w_L}\left(w_{11i}\right)\frac{Y_{11i}}{\theta_{11}e^{\eta_i}},$$

$$L_{12i} = c_{w_L}\left(w_{12i}\right)\frac{Y_{12i}}{\theta_{12}e^{\eta_i - u_i}},$$

where $c_{w_L}(.)$ represents the derivative of $C(.)$ with respect to wage. Similarly, labor demand corresponding to production of the new products is:

$$L_{22i} = c_{w_L}\left(w_{22i}\right)\frac{Y_{22i}}{\theta_{22}e^{\eta_i - v_i}},$$

if $Y_{22i} > 0$ and $L_{22i} = 0$ otherwise.

Assuming $c_{w_L}\left(w_{11i}\right) = c_{w_L}\left(w_{12i}\right) = c_{w_L}\left(w_{22i}\right)$. Employment growth at the firm level can be approximated in the following way

$$\begin{aligned} \frac{\Delta L_i}{L_i} &= \frac{L_{12i} + L_{22i} - L_{11i}}{L_{11i}} + \frac{L_{12i} - L_{11i}}{L_{11i}} + \frac{L_{22i}}{L_{11i}} \cong ln\frac{L_{12i}}{L_{11i}} + \frac{L_{22i}}{L_{11i}} \\ &= -\left(ln\theta_{12} - ln\theta_{11}\right) + \left(lnY_{12} - lnY_{11}\right) + \frac{\theta_{11}Y_{22}}{\theta_{22}Y_{11}} + u_i. \end{aligned}$$

From the approximated equation above, we can write the observed labor growth (l) between the two periods $t = 1$ and $t = 2$ as follows:

$$l = \alpha_0 + \alpha_1 d + y_1 + \beta y_2 + u. \tag{1}$$

In this equation, labor growth is the sum of five elements: the average efficiency growth in the production of old products (α_0), the introduction of process innovations related to old products (d), change in output growth of old products (y_1), increase in output growth of new products (y_2), and the impact of unanticipated productivity shocks (u). Thus, the parameter α_1 picks up the effect of process innovation and β represents the relative efficiency of the production of old and new products $\left(\frac{\theta_{11}}{\theta_{22}}\right)$. If $\beta < 1$, new products are produced more efficiently than old ones, and employment grows at a smaller rate than the output of new products (y_2).

We do not observe the physical growth of outputs (y_1, y_2) but a proxy; the real growth of outputs that is obtained by deflating the nominal growth of sales of old and new products (g_1 and g_2, respectively). Replacing and rearranging terms we obtain the estimating equation:

$$l - g_1 = \alpha_0 + \alpha_1 d + \beta g_2 + \nu. \tag{2}$$

If π_1 is the price growth rate of old products and π_2 the price growth rate of new products ($g_1 = y_1 + \pi_1$ and $g_2 = y_2 + \pi_2$) the error term is now:

$$\nu = u - \pi_1 - \beta\pi_2. \tag{3}$$

[3] Correlation among these shocks does not create any problem in the HMJP model, but may be an issue in the empirical application.

2.2 Identification issues

If product and process innovation (g_2 and d) are not correlated with the error term u, the OLS estimate of the parameters α_0, α_1 and β in equation (3) is consistent. A possible concern that could create this correlation, and the corresponding endogeneity problem, is the presence of omitted variables correlated with both employment and innovation variables; for instance, the level of productivity. However, given that equation (3) is a growth equation, all time-invariant firm-specific characteristics are canceled out. Therefore if the productivity of firm i is given by a time-invariant firm-specific characteristic—for example, related to the entrepreneurs managerial ability—plus a random component, equation (3) can be estimated by OLS. However, if the the productivity shocks are not random—for instance, if innovation and productivity are correlated with the business cycle—then the OLS estimation is not consistent. To address this possible correlation, we include a set of industry dummies in equation (3). Industry dummies in a growth equation are analogue to the inclusion of the interaction of industry dummies with a year dummy in a level equation. Thus, these industry dummies capture the effect of an industry-specific business cycle.

The key assumption for innovation being uncorrelated with productivity is that innovations are the result of the success of "technological investments", mainly R&D, which have to be decided upon by firms in advance and depend on their individual productivity effects. However, if firms were, in fact, carrying out these investments within the period affected by the shocks, lagged values of the included variables would be uncorrelated with u. In a robustness check we add past productivity as an additional control (see Table 4).

In any case, if innovation is positively related to productivity shocks, it will be negatively correlated with the random error u.[4] Therefore, in that case, we should expect a downward bias in the coefficients on d and y_2, obtaining larger employment displacement effects for process innovation and smaller effects for product innovation. We will show that, after controlling for the measurement problems, our estimates seem free of such biases.

Another source of concern, already pointed out by Harrison *et al.* (2014), is that we observe nominal sales (g_1 and g_2) rather than real production (y_1 and y_2). With firm-level information about prices, this would not be an issue. However, given that do not have firm-level data on prices and we deflate nominal variables using the consumer price index, there is a measurement error problem that could create an endogeneity problem.

If there is a difference between the deflator we employ and firm-level prices, two problems arise. The measurement error in y_1 implies that we can only identify part of the effect of process innovation, causing an attenuation bias in the estimation of both α_1 and β. However, our imperfect measure of y_2 might also create an endogeneity problem when the sales growth rate from new products is correlated with the error term (ν_{it}).

To overcome this bias, we follow an instrumental variable strategy. In particular, we look for an instrument correlated with real growth in the production of new products (y_2), but uncorrelated with all that may be in the error after substituting g_2 for y_2 (u, ν, and difference in prices).

We use a dummy variable that takes value one if the firm received public support for innovation as our instrument. We can show that this instrument satisfies the relevance condition, i.e. it is significantly correlated with the instrumented variable y_2, by observing

[4] That is why HJMP added a minus sign to u for convenience.

the F-statistic in Table 2. Stock *et al.* (2002) recommend an F statistic greater than 10 to avoid a problem of weak instruments and our estimated F statistics are larger in all the specifications. It also satisfies the robust weak instruments pre-test threshold of Olea & Pflueger (2013).

The identification strategy also requires the instrument to be exogenous once we control for industry, location, and time-invariant productivity. Although this assumption cannot be tested, it would be invalidated only if firms that obtained public support for innovation are different from the rest and if that difference is correlated with the outcome of interest. This could be the case if, for example, more productive firms decide to participate in this type of programs and we do not control for this selection bias. However, by estimating a growth equation, we are controlling for any fixed characteristic of the firms, such as invariant productivity, size, and location, and it seems unlikely that firms would apply to support for innovation because of temporary productivity shocks.

3 Data and descriptive statistics

Our data on firms stem from the 2010 World Bank's *Enterprise Surveys*,[5] which is a representative firm-level survey of an economy's private sector. The *Enterprise Surveys* covers a large set of countries and a broad range of business environment topics. The surveys are stratified with random sampling,[6] where the strata are firm size, business sector, and geographic region within a country.[7] We focus on 14 Latin American countries (Argentina, Bolivia, Chile, Colombia, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, and Uruguay)[8] because for these countries in 2010 the *Enterprise Surveys* included, in addition to the standard set of questions, a detailed questionnaire on innovation activities; including a question on the percentage of sales that results from the introduction of new products, which is key to estimate g_2 in the HJMP's model. Given that firms were asked about their sales and permanent full-time employment both for the last fiscal year and three years before, we were able to construct a panel of firms for 2007-2009 and calculate employment and sales growth between those years.

We only consider firms in the manufacturing sector with complete data on total sales, total cost of intermediate inputs (energy costs, cost of raw materials and overhead and other expenses), labor inputs, and support for innovation. We cleaned the data from outliers dropping observations with more than 5,000 permanent employees, observations with labor cost or materials cost higher than sales, and observations with the natural logarithm of labor productivity[9] higher or lower than 3 standard deviations from its mean. To make sure that the final sample is not too different from the original sample, we exclude industries with fewer

[5] The dataset is available at http://www.enterprisesurveys.org.

[6] In a stratified random sample, all population units are grouped within homogeneous groups and simple random samples are selected within each group.

[7] Firm size levels are: small (5-19 employees), medium(20-99), and large (100 or more). Sector levels are, usually: manufacturing, retail, and other services. Geographic regions are selected based on their importance in terms of economic activity.

[8] Enterprise Surveys in Latin America are jointly funded with the Wold Bank and the Inter-American Development Bank (IDB).

[9] We measured labor productivity as the ratio between sales and permanent full-time employment.

than 5 observations or where the number of usable observations is less than half the number of original observations. Finally, we exclude all surveys with fewer than 40 observations and with less than 40% of the original observations. From the initial 9,216 observations, only 3,148 are left after cleansing. Although the number of firms shrunk considerable, there is a clear gain in the quality of the data remaining.

The indicators of innovation are based on a framework provided by the Organization for Economic Co-operation and Development's (OECD) Oslo Manual, where product innovation is defined as the "introduction of a new or significantly improved product", and process innovation as "a) methods of manufacturing goods or offering services; b) logistics, delivery, or distribution methods for inputs, products, or services; and c) supporting activities such as maintenance systems or operations for purchasing accounting or computing". We have information on whether the establishment introduced a product or process innovation in the last three years.[10] This lets us categorize firms according to four groups: No innovation, Only product innovation, Only process innovation, and Product and process innovation. Furthermore, the survey contains detailed information about the composition of sales, namely sales of 2010 and the percentage of sales corresponding to new products in 2010. With the first two variables, we can construct the nominal growth rate in sales (g) which can be decomposed into the nominal growth in sales of old products (g_1) and the nominal growth in sales of new products (g_2). The *Enterprise Surveys* also provides us with our instrumental variable, i.e., support for innovation, as it includes the question: "In the last 3 years: did this establishment use any services to support innovation?".

To study the presence of heterogeneous effects for firms with different labor market regulations, we use the following labor market indicators: Redundancy Cost ("Weeks of severance pay for redundancy dismissal after 20 years of continuous employment"), and Minimum Wage Effectiveness. Doing Business provides us with information on the first indicator,[11] and we construct the latter using ILO Global Wage Database and households surveys. Following Lee (1999), we define the effectiveness of the minimum wage as the distance between the minimum wage in a country and some measure of centrality of wages within the country: we consider that a country has high (low) effectiveness of the minimum wage when the minimum wage/mean wages ratio is above (below) the median (0.59).[12,13]

We divide countries according to the two labor market indicators into two categories each: high or low redundancy cost and high or low effectiveness of the minimum wage. We consider that a country has high (low) redundancy cost when the period of severance pay is above (below) the region median (62 weeks).[14] In Figure 1 we divide countries depending on their

[10] For the case of product innovations, the establishment is being asked the following question: "During the last three years, did this establishment introduce onto the market any new or significantly improved products?". Hence, we know if the firm introduced a product innovation between 2007 and 2009. An analogue question is asked for process innovations.

[11] We use Doing Business 2008 data (which refers to 2007) on labor market regulations.

[12] We get the minimum wage from ILO Global Wage Database and mean wages from national household surveys.

[13] Lee (1999) uses the median wage as an indicator of location and uses the ratio of the minimum wage over the median wage as the "effective" minimum wage. In robustness checks we show that variations in the measure of centrality do not affect the results.

[14] For the case of Bolivia, there is no period given for the question on redundancy costs, because it is prohibited to dismiss someone after 20 years of continuous employment. Hence, we assign these observations

minimum wage effectiveness and their severance pay for redundancy dismissal after 20 years. The vertical dashed line represents the median of the minimum wage effectiveness (0.59) and the horizontal dashed line, the median of severance payments (65 weeks of salary due when terminating a redundant worker). If we analyze each indicator separately, Paraguay, Peru, Argentina, Honduras, Colombia, Guatemala and El Salvador exhibit more rigid labor markets in terms of minimum wage effectiveness than Ecuador, Nicaragua, Bolivia, Chile, Uruguay, and Mexico. While Bolivia, Ecuador, Guatemala, Argentina, Paraguay, El Salvador and Honduras present more rigid labor markets in terms of severance payments than Colombia, Peru, Chile, Mexico, Uruguay and Nicaragua. Nevertheless, if we study the indicators jointly, Paraguay, Argentina, Guatemala, El Salvador and Honduras have the most rigid labor market regulations.

Figure 1: Distribution of countries by minimum wage effectiveness and severance payment

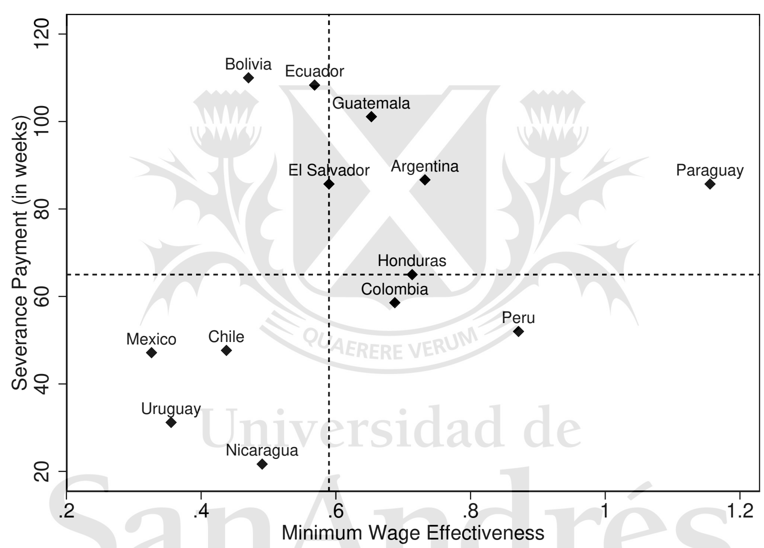

Table 1 shows the descriptive statistics for the distribution of firms and employment growth. Column (1) includes all firms; in columns (2)-(5), firms are divided into different categories according to their labor market characteristics.

Most firms in the sample (72%) introduced some sort of innovation, and of these firms, more than half (54%) are both process and product innovators. Innovators tend to have higher employment growth than non-innovators, with the exception of process only innovators, that have the lowest average yearly employment growth. This is in line with the standard view that process innovation destroys employment. The higher rates of employment growth showed by product innovators (both "product only" and "product and process") are also reflected in higher rates of real sales growth and of labor productivity growth.

the maximum value (110 weeks). Given that we use the value only to classify countries, the value we imputed is not relevant; it is only important to assign a value above the median so that Bolivian firms are in the right category when we run our regressions.

In columns (2) and (3), we compare firms in countries where the minimum wage effectiveness is above/below median. It is interesting to note that firms that operate in countries with higher minimum wage effectiveness show slightly better employment growth.[15] Countries with severance payments below and above the median (columns (4)-(5)) do not exhibit significant differences in employment growth.

Table 1: Descriptive Statistics

	All firms	**High MWE**	**Low MWE**	**High SP**	**Low SP**
Distribution of firms (%)					
Non-innovators	0.28	0.22	0.35	0.23	0.30
Process only innovators	0.12	0.13	0.11	0.11	0.13
Product only innovators	0.20	0.22	0.19	0.24	0.19
Process & product innovators	0.39	0.44	0.34	0.42	0.38
Age	26	24	28	29	25
	(18)	(17)	(19)	(18)	(18)
# Full-time employees in t=0 (mean)	31	30	33	34	31
	(132)	(142)	(119)	(178)	(111)
Full-time employment growth (%)					
All firms	0.03	0.04	0.02	0.02	0.03
	(0.16)	(0.18)	(0.13)	(0.13)	(0.17)
Non-innovators	0.02	0.02	0.01	0.01	0.02
	(0.14)	(0.15)	(0.14)	(0.18)	(0.13)
Process only innovators	0.01	0.01	0.01	0.00	0.01
	(0.13)	(0.15)	(0.11)	(0.10)	(0.14)
Product only innovators	0.03	0.05	0.01	0.02	0.04
	(0.21)	(0.25)	(0.13)	(0.11)	(0.24)
Process & product innovators	0.04	0.05	0.02	0.04	0.04
	(0.15)	(0.16)	(0.12)	(0.12)	(0.15)
Real sales growth, yearly (%)					
All firms	0.03	0.07	-0.03	0.03	0.02
	(0.50)	(0.62)	(0.29)	(0.52)	(0.49)
Non-innovators	-0.01	0.03	-0.04	0.01	-0.02
	(0.31)	(0.36)	(0.26)	(0.36)	(0.29)
Process only innovators	0.00	0.02	-0.02	0.01	0.00
	(0.29)	(0.28)	(0.29)	(0.36)	(0.26)
Product only innovators	0.03	0.06	-0.02	-0.01	0.04
	(0.55)	(0.62)	(0.44)	(0.29)	(0.63)
Process & product innovators	0.06	0.11	-0.01	0.08	0.06
	(0.62)	(0.78)	(0.19)	(0.70)	(0.58)
Labor productivity growth, yearly (%)					
All firms	0.01	0.05	-0.03	0.02	0.01
	(0.51)	(0.63)	(0.30)	(0.49)	(0.51)
Non-innovators	-0.02	0.02	-0.05	0.02	-0.03
	(0.30)	(0.35)	(0.26)	(0.34)	(0.29)
Process only innovators	0.00	0.02	-0.03	0.01	0.00
	(0.26)	(0.27)	(0.25)	(0.32)	(0.24)
Product only innovators	0.01	0.03	-0.02	-0.02	0.03
	(0.58)	(0.63)	(0.49)	(0.29)	(0.66)
Process & product innovators	0.03	0.08	-0.03	0.04	0.03
	(0.63)	(0.80)	(0.19)	(0.67)	(0.61)
Number of observations	3,148	1,685	1,463	812	2,336

Notes: Standard deviation presented in parenthesis.

[15] Employment growth in countries where the minimum wage is more effective is significantly higher at 5% for the full sample, for only-product innovators and process and product innovators.

4 Empirical Results

Table 2 presents the results of estimating equation (3) by OLS (Panel A) and IV (Panel B). In all regressions, we control for age, age squared, initial size, foreign ownership, industry and country dummies. Column (1) shows results in the full sample, namely for all 3,148 firms; columns (2)-(5) depict the estimated coefficients in subsamples characterized by different labor market regulations.

Table 2: Results

	(1) All	(2) High MWE	(3) Low MWE	(4) High SP	(5) Low SP
			(A) OLS		
g_2	0.4106**	0.2230	0.7242***	0.6395**	0.2738
	(0.188)	(0.289)	(0.184)	(0.253)	(0.247)
d	-0.0365*	-0.0420	-0.0275	-0.0153	-0.0462*
	(0.021)	(0.032)	(0.025)	(0.038)	(0.027)
Constant	0.1038**	0.1651**	0.0010	0.0559	-0.0050
	(0.042)	(0.069)	(0.056)	(0.045)	(0.035)
R^2	0.043	0.027	0.152	0.104	0.030
	(B) Instrumental Variables (Instrument: Innovation Support)				
g_2	0.8419*	0.2287	1.3050***	0.6420	0.9303*
	(0.435)	(0.873)	(0.324)	(0.771)	(0.523)
d	0.0029	-0.0414	0.0160	-0.0150	0.0125
	(0.048)	(0.101)	(0.035)	(0.095)	(0.056)
Constant	0.0521	0.1643	-0.0648	0.0556	0.1198
	(0.066)	(0.137)	(0.069)	(0.129)	(0.097)
F stat	43.78	13.79	37.74	10.42	34.56
H0: $\beta = 1$ (p-value)	0.716	0.377	0.347	0.642	0.894
Observations	3,148	1,685	1,463	812	2,336
Sector & Country FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes

SE clustered by country-sector in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Controls: Age, Age^2, ln(employment beginning) & Foreign.

According to OLS estimates, product innovation (g_2) has a positive and significant effect on employment growth in the full sample, and process innovations (d) a small but negative and significant impact. Once we instrument for product innovation (g_2), we find that product innovation has an even stronger effect on employment growth, while process innovations lose significance. This shows that the instrumental variable approach is working and helps us to mitigate the downward bias of the OLS estimates.

In columns (2) and (3), we analyze how the minimum wage influence the effect of innovations on employment growth. In countries where the effectiveness of the minimum wage is below the median (i.e. the minimum wage is further from mean wages), the effect of product innovation is reinforced. On the contrary, when labor markets are more rigid in terms of minimum wages being closer to mean wages, the effect of innovation is cancelled out. This result holds once we instrument for product innovation. It is also important to note that the instrument corrects the downward bias of the OLS estimation.

Similarly, columns (4)-(5) show the effect of severance payment regulations. In this case, the need to instrument is even more important. In fact, the OLS estimation shows that the effect of innovation on employment growth could be positive in rigid—in terms of severance payments—labor markets. However, the IV estimates that corrects for measurement errors, shows that it is only in more flexible labor markets where innovation creates permanent employment. The IV results are more intuitive because in rigid labor markets employers internalize the higher dismissal cost and decide to hire fewer employees.

Concerning the effect of process innovation on employment growth, according to the OLS specification we observe a small but negative and significant effect in the full sample. Nevertheless, once we instrument with support for innovation, this impact disappears. However, when we distinguish countries by labor market legislation in our IV estimation, the estimated coefficients of process innovation remain negative only in more rigid countries, but not significantly different from zero.

Finally, the magnitude of the coefficient β expresses the relative efficiency of the production of new versus old products. In IV estimates, whenever β is found to be significantly different from zero, it is always close to 1. In Table 2, we present tests of the null hypothesis H0: $\beta = 1$, which is never rejected. That is, there is no evidence that new products are produced with higher efficiency than old products, i.e. we do not find productivity gains and employment-displacements associated with product innovation.

5 Robustness checks

In this section, we run some robustness checks to assess the sensitivity of the results to alternative modeling assumptions. First, our empirical strategy above controls for unobserved factors that vary by sectors and countries. Given that there are factors that might change by industry within each country—for example, prices and productivity—our first robustness check controls for those factors by including country-sector fixed effects. Table 3 shows that the results are similar to the basic model.

Table 3: Robustness Check: With Country-Sector Fixed Effects

	(1) All	(2) High MWE	(3) Low MWE	(4) High SP	(5) Low SP
			(A) OLS		
g_2	0.4106**	0.2230	0.7242***	0.6395**	0.2738
	(0.204)	(0.313)	(0.179)	(0.254)	(0.276)
d	-0.0365*	-0.0420	-0.0275	-0.0153	-0.0462*
	(0.020)	(0.030)	(0.024)	(0.036)	(0.026)
Constant	0.1038**	0.1651**	0.0010	0.0559	-0.0050
	(0.041)	(0.066)	(0.042)	(0.050)	(0.038)
		(B) Instrumental Variables (Instrument: Innovation Support)			
g_2	0.8518*	0.2784	1.3322***	0.7091	0.9229*
	(0.446)	(0.903)	(0.337)	(0.802)	(0.540)
d	0.0042	-0.0327	0.0178	-0.0109	0.0120
	(0.049)	(0.105)	(0.036)	(0.097)	(0.058)
Constant	0.0280	0.1466	-0.1158	0.0555	0.1143
	(0.089)	(0.165)	(0.094)	(0.144)	(0.171)
F stat	41.49	12.82	35.01	9.562	32.37
H0: $\beta = 1$ (p-value)	0.74	0.424	0.324	0.717	0.886
Observations	3,148	1,685	1,463	812	2,336
Sector & Country FE	Yes	Yes	Yes	Yes	Yes
Country-Sector FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes

SE clustered by country-sector in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Controls: Age, Age^2, ln(employment beginning) & Foreign.

Second, our identification strategy assumes that productivity is an individual fixed characteristic of firms plus a random component whose effect can be removed by estimating a first difference equation. To assess the robustness of our results to the omitted productivity, we include labor productivity three years before as an additional control. Table 4 shows that although productivity is statistically significant, it is quantitatively not relevant—the coefficient is zero. The main results in terms of the effect of innovation on employment are similar to the basic model.

Table 4: Robustness Check: With Lag of Labor Productivity

	(1) All	(2) High MWE	(3) Low MWE	(4) High SP	(5) Low SP
		(A) OLS			
g_2	0.4154**	0.2306	0.7317***	0.6566***	0.2801
	(0.186)	(0.286)	(0.181)	(0.244)	(0.245)
d	-0.0339	-0.0373	-0.0250	-0.0131	-0.0433
	(0.021)	(0.032)	(0.024)	(0.038)	(0.027)
$ln\left(LaborProductivity_{t-3}\right)$	0.0000***	0.0000***	0.0000**	0.0001***	0.0000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	0.0983**	0.1536**	0.0065	-0.0304	-0.0219
	(0.042)	(0.066)	(0.057)	(0.054)	(0.033)
		(B) Instrumental Variables (Instrument: Innovation Support)			
g_2	0.7791*	0.1201	1.1716***	0.3683	0.8566*
	(0.428)	(0.859)	(0.310)	(0.744)	(0.512)
d	-0.0006	-0.0488	0.0081	-0.0410	0.0083
	(0.047)	(0.100)	(0.034)	(0.092)	(0.055)
$ln\left(LaborProductivity_{t-3}\right)$	0.0000***	0.0000***	0.0000***	0.0001***	0.0000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	0.0546	0.1689	0.0909	0.0112	0.1211
	(0.065)	(0.135)	(0.059)	(0.131)	(0.095)
F stat	43.92	13.87	39.01	11	34.68
H0: $\beta = 1$ (p-value)	0.606	0.306	0.580	0.396	0.779
Observations	3,148	1,685	1,463	812	2,336
Sector & Country FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes

SE clustered by country-sector in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Controls: Age, Age^2, ln(employment beginning) & Foreign.

Third, following Lee (1999) we define the effectiveness of the minimum wage using the median wage instead of average wage. This variable is less affected by outliers. We remove Guatemala survey from our sample because we did not have information on its median wage. Table A1 in Appendix A shows the new classification of countries according to this indicator in comparison with the original one. The countries that change classification are El Salvador, Honduras, Chile, and Ecuador. El Salvador and Honduras are now classified as low effectiveness minimum wage countries, while Chile and Ecuador as high. Table 5 shows that the our results are robust to a comparison of wages that are less affected by outliers.

Table 5: Robustness Check: Minimum Wage Effectiveness Based on Median Wages

	(1) MWE High	(2) MWE Low
	(A) OLS	
g_2	0.2889	0.5918***
	(0.276)	(0.205)
d	-0.0372	-0.0409
	(0.028)	(0.035)
Constant	0.1455**	0.0068
	(0.058)	(0.060)
(B) Instrumental Variables (Instrument: Innovation Support)		
g_2	0.4416	1.3362**
	(0.746)	(0.527)
d	-0.0223	0.0198
	(0.083)	(0.056)
Constant	0.1240	-0.0652
	(0.119)	(0.090)
F stat	17.82	17.80
H0 : $\beta = 1$ (p-value)	0.454	0.524
Observations	1,950	1,042
Controls	Yes	Yes
Sector & Country FE	Yes	Yes

SE clustered by country-sector in parentheses;
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Controls: Age, Age^2, ln(employment beginning) & Foreign.

Finally, using Figure 1 we divide countries in three categories of rigidity of labor market regulations depending on their minimum wage effectiveness and their severance payment classification: (1) High-High; (2) High-Low or Low-High; (3) Low-Low. Table 6 (B) presents the IV estimates for each group and shows that more rigid labor market regulations in terms of both (Column 1) or either (Column 2) minimum wages and severance payments reduce the effects of innovation.

Table 6: Robustness Check: Absolute Labor Market Rigidity Measure

	(1) MWE & SP High	(2) MWE or SP High	(3) MWE & SP Low
	(A) OLS		
g_2	0.6063**	-0.0807	0.6976***
	(0.280)	(0.435)	(0.195)
d	-0.0218	-0.0675	-0.0292
	(0.042)	(0.049)	(0.027)
Constant	0.0519	0.2255*	0.0888***
	(0.046)	(0.114)	(0.026)
	(B) Instrumental Variables (Instrument: Innovation Support)		
g_2	0.8292	-0.1116	1.4637***
	(0.976)	(1.115)	(0.372)
d	-0.0006	-0.0710	0.0255
	(0.113)	(0.138)	(0.037)
Constant	0.0185	0.2300	-0.1211**
	(0.167)	(0.211)	(0.055)
F stat	6.907	10.72	31.05
H0 : $\beta = 1$ (p-value)	0.861	0.319	0.212
Observations	723	1,051	1,374
Controls	Yes	Yes	Yes
Sector & Country FE	Yes	Yes	Yes

SE clustered by country-sector in parentheses;
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Controls: Age, Age^2, ln(employment beginning) & Foreign.

6 Conclusion

This paper presents evidence on the effect of labor market regulations on the relationship between product and process innovation and employment in Latin America. We estimated the model proposed in HJMP using data from *Enterprise Surveys* for 14 Latin American countries.

Our results show that product innovation has a positive effect on permanent employment growth. However, we find that those gains are lost in settings characterized by high minimum wages or high severance payments that make the labor market more rigid, i.e. labor market regulations seem to offset the benefits of product innovation on employment growth. We find no evidence of efficiency gains in the production of new products compared to old products. In terms of process innovation, our results show that process innovation do not affect employment. However, it is interesting to note that, although they are not statistically significant, the estimated coefficients are negative when the labor market legislation is more rigid.

Our data does not allow us to explore the effects of innovation on other types of employment that are relevant in some of Latin American countries like temporary or informal employment. Further research in that direction would provide a natural extension to our work.

References

Aboal, D., Garda, P., Lanzilotta, B., & Perera, M. (2011). *Innovation, firm size, technology intensity, and employment generation in Uruguay: The microeconometric evidence.* Technical report, Inter-American Development Bank.

Acemoglu, D. & Angrist, J. D. (2001). Consequences of employment protection? the case of the americans with disabilities act. *Journal of Political Economy*, 109(5), 915–957.

Alaniz, E., Gindling, T. H., & Terrell, K. (2011). The impact of minimum wages on wages, work and poverty in nicaragua. *Labour Economics*, 18, S45–S59.

Alvarez, R., Benavente, J. M., Campusano, R., & Cuevas, C. (2011). *Employment generation, firm size, and innovation in chile.* Technical report, Inter-American Development Bank.

Andrews, D., Criscuolo, C., & Menon, C. (2014). Do resources flow to patenting firms? cross-country evidence from firm level data. *OECD Economic Department Working Papers*, (1127), 0_1.

Arango-Arango, C. A. & Pachón, A. (2004). Minimum wages in colombia: holding the middle with a bite on the poor. *Banco de la República Documentos de Trabajo.*

Benavente, J. M. & Lauterbach, R. (2007). The effect of innovation on employment, evidence from chilean firms.

Benavente, J. M. & Lauterbach, R. (2008). Technological innovation and employment: complements or substitutes? *The European Journal of Development Research*, 20(2), 318–329.

Blanchard, O. & Wolfers, J. (2000). The role of shocks and institutions in the rise of european unemployment: the aggregate evidence. *The Economic Journal*, 110(462), 1–33.

Boeri, T. *et al.* (2011). Institutional reforms and dualism in european labor markets. *Handbook of labor economics*, 4(Part B), 1173–1236.

Bogliacino, F., Piva, M., & Vivarelli, M. (2012). R&d and employment: An application of the lsdvc estimator using european microdata. *Economics Letters*, 116(1), 56–59.

Calvino, F. & Virgillito, M. E. (2017). The innovation-employment nexus: A critical survey of theory and empirics. *Journal of Economic Surveys.*

Coad, A. & Rao, R. (2011). The firm-level employment effects of innovations in high-tech us manufacturing industries. *Journal of Evolutionary Economics*, 21(2), 255–283.

Crespi, G. & Tacsir, E. (2011). Effects of innovation on employment in latin america. In *Science and Innovation Policy, 2011 Atlanta Conference on* (pp. 1–11).: IEEE.

Dachs, B. & Peters, B. (2014). Innovation, employment growth, and foreign ownership of firms: A european perspective. *Research Policy*, 43(1), 214–232.

De Elejalde, R., Giuliodori, D., & Stucchi, R. (2015). Employment and innovation: Firm-level evidence from argentina. *Emerging Markets Finance and Trade*, 51(1), 27–47.

Del Carpio, X., Nguyen, H., Wang, L. C., *et al.* (2012). *Does the minimum wage affect employment? evidence from the manufacturing sector in Indonesia*. Technical report, The World Bank.

Gindling, T. H. & Terrell, K. (2007). The effects of multiple minimum wages throughout the labor market: the case of costa rica. *Labour Economics*, 14(3), 485–511.

Giuliodori, D. & Stucchi, R. (2012). Innovation and job creation in a dual labor market: evidence from spain. *Economics of Innovation and New Technology*, 21(8), 801–813.

Greenan, N. & Guellec, D. (2000). Technological innovation and employment reallocation. *Labour*, 14(4), 547–590.

Hall, B. H., Lotti, F., & Mairesse, J. (2008). Employment, innovation, and productivity: evidence from italian microdata. *Industrial and Corporate Change*, 17(4), 813–839.

Hall, B. H., Lotti, F., & Mairesse, J. (2009). Innovation and productivity in smes: empirical evidence for italy. *Small Business Economics*, 33(1), 13–33.

Harrison, R., Jaumandreu, J., Mairesse, J., & Peters, B. (2014). Does innovation stimulate employment? a firm-level analysis using comparable micro-data from four european countries. *International Journal of Industrial Organization*, 35, 29–43.

Herstad, S. J., Sandven, T., *et al.* (2015). *Innovation and corporate employment growth revisited*. Technical report, Lund University, CIRCLE-Center for Innovation, Research and Competences in the Learning Economy.

Kaplan, D. S. (2009). Job creation and labor reform in latin america. *Journal of Comparative Economics*, 37(1), 91–105.

Lee, D. S. (1999). Wage inequality in the united states during the 1980s: Rising dispersion or falling minimum wage? *The Quarterly Journal of Economics*, 114(3), 977–1023.

Lemos, S. *et al.* (2004). *The Effects of the Minimum Wage in the Formal and Informal Sectors in Brazil*. Technical report, Institute for the Study of Labor (IZA).

Mairesse, J. & Wu, Y. (2014). *An assessment of the firm-level impacts of innovation, exports, catch-up and wage on employment growth in Chinese manufacturing*. Technical report, mimeo, CREST.

Maloney, W. & Mendez, J. (2004). Measuring the impact of minimum wages. evidence from latin america. In *Law and employment: lessons from Latin America and the Caribbean* (pp. 109–130). University of Chicago Press.

Meer, J. & West, J. (2015). Effects of the minimum wage on employment dynamics. *Journal of Human Resources*.

Monge-González, R., Rodríguez-Álvarez, J. A., Hewitt, J., Orozco, J., & Ruiz, K. (2011). *Innovation and employment growth in Costa Rica: a firm-level analysis*. Technical report, Inter-American Development Bank.

Montenegro, C. E. & Pagés, C. (2007). Who benefits from labor market regulations? *Law and Employment: Lessons from Latin America and the Caribbean*, (pp. 401).

Neumark, D., Cunningham, W., & Siga, L. (2006). The effects of the minimum wage in brazil on the distribution of family incomes: 1996–2001. *Journal of Development Economics*, 80(1), 136–159.

Neumark, D., Salas, J. I., & Wascher, W. (2014a). More on recent evidence on the effects of minimum wages in the united states. *IZA Journal of Labor policy*, 3(1), 24.

Neumark, D., Salas, J. I., & Wascher, W. (2014b). Revisiting the minimum wageâĂŤemployment debate: Throwing out the baby with the bathwater? *ILR Review*, 67(3_suppl), 608–648.

OECD (2013). Protecting jobs, enhancing flexibility: A new look at employment protection legislation. In *OECD Employment Outlook 2013, OECD Publishing*.

Olea, J. L. M. & Pflueger, C. (2013). A robust test for weak instruments. *Journal of Business & Economic Statistics*, 31(3), 358–369.

Smolny, W. (1998). Innovations, prices and employment: A theoretical model and an empirical application for west german manufacturing firms. *The Journal of Industrial Economics*, 46(3), 359–381.

Stam, E. & Wennberg, K. (2009). The roles of r&d in new firm growth. *Small Business Economics*, 33(1), 77–89.

Stock, J. H., Wright, J. H., & Yogo, M. (2002). A survey of weak instruments and weak identification in generalized method of moments. *Journal of Business & Economic Statistics*, 20(4), 518–529.

A Additional Tables

Table A1: Minimum Wage Effectiveness Classifications

Country	MWE (mean)	MWE (median)
Argentina	High	High
Bolivia	Low	Low
Chile	Low	High
Colombia	High	High
Ecuador	Low	High
Guatemala	High	
Honduras	High	Low
Mexico	Low	Low
Nicaragua	Low	Low
Peru	High	High
Paraguay	High	High
El Salvador	High	Low
Uruguay	Low	Low