

# Payroll taxes, degree of wage gap and youth unemployment: Evidence from the Colombian labor market.

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## Abstract

This paper studies the effect on labor market outcomes of a payroll tax cut for new hires of young workers under the age of 28 in an economy with a high binding minimum wage. We use exposure to wage rigidities to identify the effect. We measure an individual's exposure to wage rigidities as the gap between the median salary, in the city in which the individual lives, and the minimum wage set at the national level. We use a difference-in-difference model. The effect of a payroll tax cut is asymmetric for youth who face labor markets with a binding minimum wage and those who do not. Reducing payroll taxes increased the probability of being formally employed given that the person is employed by 16% and increased the probability of participating in the labor market by 6% for young people who face labor markets without a binding minimum wage. In the same direction, the probability of being an informal worker given that the person is employed decrease in 5%. Pass through effect are null which is consistent with a labor market with high wage rigidities.

(JEL: H25, H32, J21, J31, J46).

**Keywords:** youth unemployment, payroll taxes, nominal rigidities.

## 1. Introduction

One of the great challenges facing both developed and developing economies is the high and persistent youth unemployment rate (Egebark and Kaunitz, 2014; OIT, 2018). We know that these difficulties during first years of working have long-term consequences on the probability of getting a formal job (Nordstrom, 2004; Gregg and Tominey, 2005; von Wachter, 2020). Payroll taxes can worsen youth unemployment. Theoretically, we know that payroll taxes should particularly affect those who experience greater wage rigidities (Houseman, 1998; Bell, 1997; Blinder and Choi, 1990; Campbell and Kamlani, 1997; Mondragón-Vélez, Peña and Wills, 2010). One wage rigidity who affect young people in the formal labor market is a high minimum wage, especially in emerging economies where young people tend to earn wages near the minimum wage and therefore we

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would expect to be more exposed to changes in payroll taxes when it comes to finding formal employment.

This paper studies how an active labor market program, in particular a payroll tax cut, affects labor market outcomes for young people exploiting differential degrees of exposure to wage rigidities. We measure an individual's wage rigidity as the gap between the median salary, by educational level, of people employed in the city where the individual lives and the minimum wage. We argue this is an exogenous measure of wage rigidity for a person. We adopt a strict definition of formal employment in which a worker is formal if they contribute to a pension fund at the time the survey is carried out (Bernal, 2009).

We exploit a reform in 2010 in Colombia that allowed firms who hired new formal workers under the age of 28 years old, to discount at the end of the year from the income tax an amount equivalent to 11 percentage points of the payroll taxes out of a total of 46 percentage points, this implies a 24% reduction in payroll taxes for new young workers. From the comparison of labor market outcomes between people younger and older than 28 before and after the reform, and using data from household surveys, we estimate the effect of the reduction of payroll taxes on six outcome variables: wage in the formal and informal sector separately, probability of being part of the labor force, probability of being a salaried formal worker, probability of being a salaried informal worker, and probability of being self-employed. The identification strategy of this paper relies on the fact the reform did not alter the selection hiring workers above 28 years old.

In competitive labor markets when there is a connection between the payroll tax and the benefit it brings to the worker, changes in payroll taxes should be reflected mainly in changes in wages, with little or no effect on employment. However, if wages rigid downwards due to a minimum wage requirement, they will not absorb payroll taxes causing changes in total labor costs and hence a variation in the employment or transfer of workers to the informal sector (Kugler et al., 2017; Almeida and Carneiro, 2012; Mondragón-Vélez, Peña and Wills, 2010, Santa María et al., 2009). Therefore, the introduction of payroll taxes could generate a drop in formal employment that would be concentrated in groups whose wages are more rigid downward. Since young people have lower levels of experience, they are more likely to face such rigidities. For this reason, they may be particularly exposed to job losses due to the introduction of payroll taxes, and to improvements in their employability in the formal sector when such taxes are reduced or eliminated.

Economic literature has shown that changes in payroll taxes have an effect on the level of employment in the economy. For European countries, some studies find a negative and significant effect on employment due to an increase in payroll taxes (Blanchard and Wolfers, 2000; Heckman and Pagés, 2004). Similarly, other authors find a positive effect on youth employment as a consequence of reductions in payroll taxes in United States, Spain, and Sweden (Katz, 1998; Kugler et al., 2002;

Saez, Schoefer y Seim, 2019). However, other authors find low or null effect for the case of Sweden (Egebark and Kaunitz, 2018; Skedinger, 2014). European countries have high productivity and a minimum wage less distant from the mass of wage distribution, so we would expect less effect of a payroll tax cut on employment than in an emerging economy such as the colombian case where the minimum wage is highly binding (Maloney and Nuñez, 2004). Additionally, the difference in results may lie in the fact that workers, depending on their level of education, are exposed to different degrees of wage rigidities. None of the studies mentioned in this paragraph use differential degrees of exposure to wage rigidities to see the effect on youth employment and wages of a reduction in payroll taxes. Furthermore, in these studies no worker is hired for less than the minimum wage, which may be the case in most developing countries who have large informal labor markets.

This article contributes to the literature on the incidence of payroll taxes on labor market variables in young people by exploiting differential degrees of exposure to wage rigidities. This contribution is relevant to understand when reducing payroll taxes can increase youth formal employment, which is more important now since formal employment has sharply decreased due to COVID-19, especially for the young. This article is related to two large literatures. On one hand, active programs to reduce youth unemployment, in particular employment subsidy programs, such as reducing payroll taxes for the youth (Kluve et al., 2016; Saez, Schoefer and Seim, 2019). This article contributes to this literature by showing that reducing payroll taxes increased the probability of getting formal employment and increased the probability of participating in the labor market for young people who before the reform were facing a binding minimum wage but after the reform they do not. On the other hand, it contributes to the literature on the role of wage rigidities in the incidence of payroll taxes on labor market outcomes, innovating in the way wage rigidities are measured. This article is the first to combine exposure to nominal wage rigidities and the incidence of payroll taxes on youth to better understand youth unemployment.

The degree to which payroll taxes affect formal employment and the wage of these workers depends on three factors, each one considered independently. First, whether or not the worker values the benefits of the payroll taxes. In the case the valuation of the payroll taxes for workers is high, changes in payroll taxes would be translated into changes in wages, known as the pass-through effect (Summers, 1989). A second factor is the flexibility of the wage. In the case wages are flexible, changes in payroll taxes will be also translated into changes in wages. And a third factor is whether or not workers have an inelastic formal labor supply, that is whether workers find it difficult to move from formal to informal employment. In the case formal labor supply is inelastic, changes in payroll taxes will also affect wages. Taking into account these factors, for the case of United States and Chile, Gruber (1994, 1997) finds a high pass-through effect and therefore an increase in workers' wages due to reductions in payroll taxes, which is supported by other authors (Cruces et al., 2010; Kugler and Kugler, 2009; Bernal et al., 2017; Kugler et al., 2017). Colombia has an ideal framework to test whether changes in payroll taxes may affect formal employment for the youth

because we have a context where the minimum wage is binding, we have an elastic formal labor supply and most of the payroll taxes paid in the formal economy are not fully valued by formal workers.

Based on a difference-in-differences estimator, we find that reducing payroll taxes is asymmetric for young people facing labor markets with different degrees of wage rigidities. On one hand, the reduction of payroll taxes by 11 percentage points increased the probability of being formally employed by 8.5% for young people who before the reform were facing a binding minimum wage but after the reform they do not. Similarly, labor force participation increased by 4% and the probability of being informal given that the person is employed did not change for this group of people. We do not find pass through effects in the formal market. On the other hand, the payroll tax cut did not affect neither wages nor employment for young people who did not face a binding minimum wage before the payroll tax cut. Finally, formal employment did not change for young people with a high binding minimum wage, while the probability of being an informal worker for these people increased.

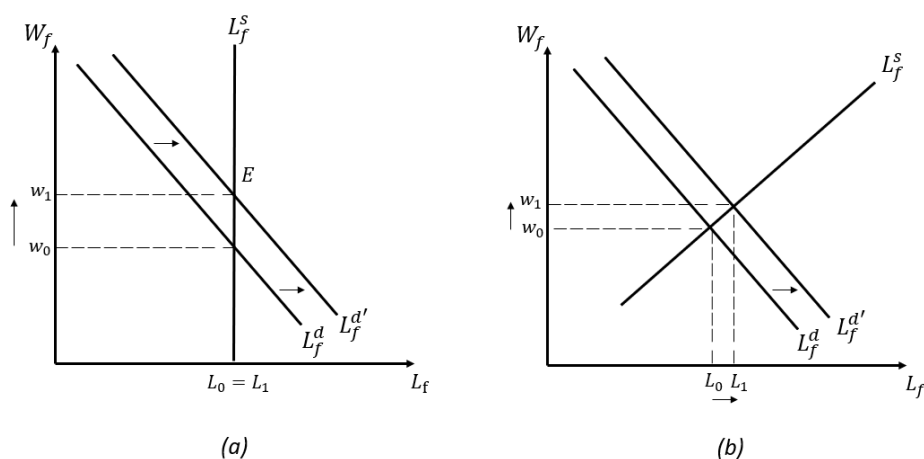
This paper is organized as follows. Section 2 presents the theoretical model on which we base our hypotheses on the relationship between payroll taxes and labor market variables. Section 3 describes the institutional framework. Section 4 describes the data we use. Section 5 presents the empirical strategy. Section 6 shows and discusses the results. Section 7 presents some extensions of the methodology. Section 8 makes a brief discussion of costs and benefits of FEL and section 9 concludes.

## **2. Theoretical framework**

We incorporate an informal labor market into a basic model of the incidence of payroll taxes in a competitive formal labor market (Summers, 1989; Lazear, 1990; Gruber and Krueger, 1991). Payroll taxes have different effects on formal and informal labor markets. Employers in formal labor markets pay payroll taxes while those in informal labor markets do not.

Assume initially an inelastic labor supply and flexible wages. A reduction in payroll taxes shifts labor demand to the right, and as a consequence wages increase but employment does not change, as is shown in figure 1, panel *a*.

Figure 1: Effect of payroll tax cut on wages and employment

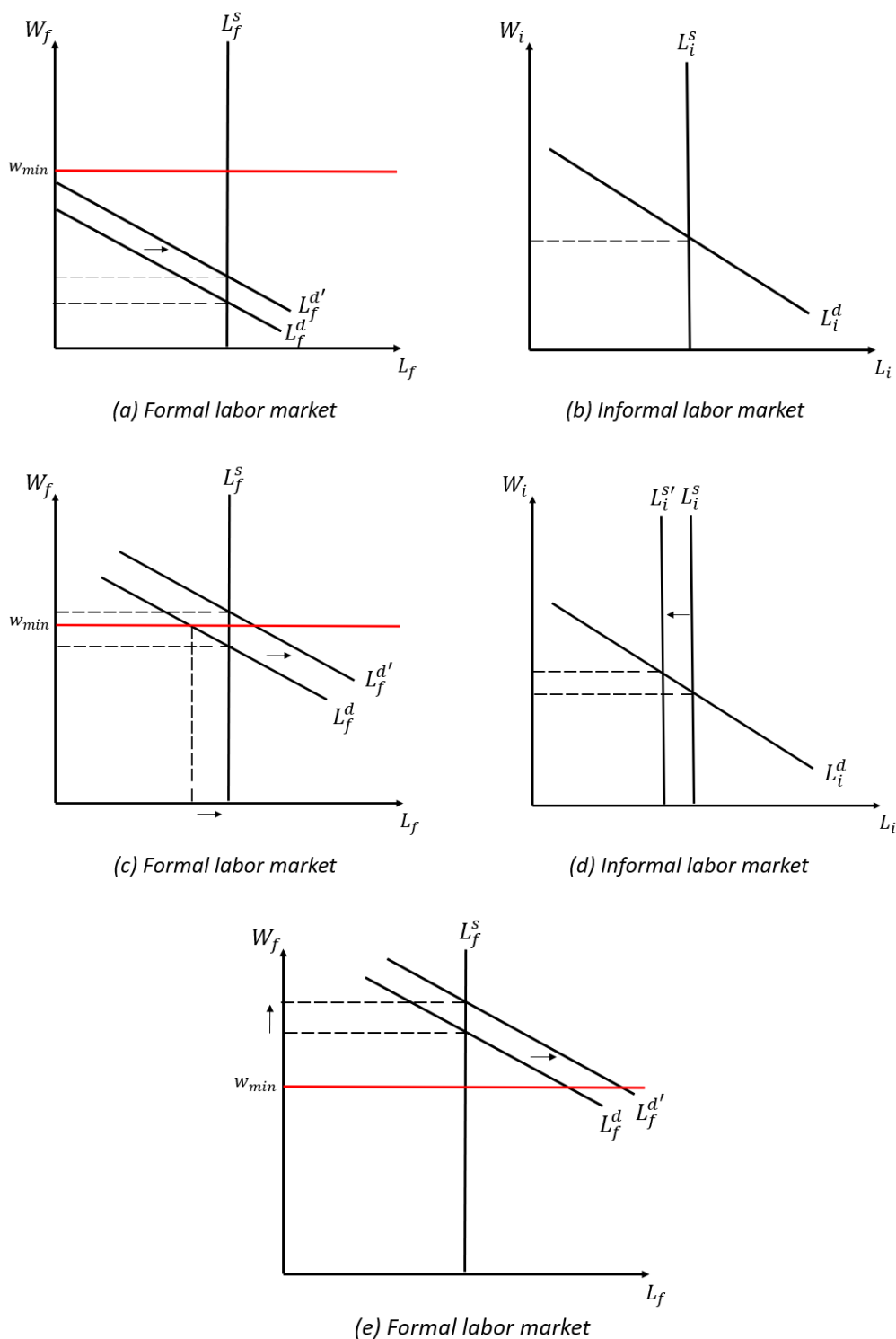


Source: Houseman (1998)

Suppose there is a minimum wage in the economy, constant labor supply and equal bargaining power between employers and employees. Assume also there are two different groups of people who face labor markets where the equilibrium wage is below and above the minimum wage respectively (e.g. skilled and unskilled workers). We assume that some individuals who face labor markets where the equilibrium wage is below the minimum wage work in the informal economy, while some individuals who face labor markets where the equilibrium wage is above the minimum wage work in the formal economy. Inside the first group there are some individuals which we called “near”, meaning that the minimum wage is binding before a payroll tax cut but not after it. When the minimum wage is above the competitive wage equilibrium, individuals cannot find a job in the formal sector, therefore they end up in the informal labor market. In this basic framework we assume that labor supply in the informal sector absorbs people who cannot find a job in the formal sector. A payroll tax cut make that the group defined “near” do not face a binding minimum wage after the reform and therefore being able to find a job in the formal economy.

Figure 2, panel *a*, shows the case where the equilibrium wage is below the minimum wage before and after the payroll tax cut. As a result all people work in the informal economy, panel *b*. A payroll tax cut should shift the labor demand schedule in the formal sector upwards, in an amount equivalent to the per-worker cost reduction implied by the reform, but the payroll tax cut is not enough to make the minimum wage not binding. Therefore, for this group of people the payroll tax cut do not reduce informal employment neither increase formal employment.

Figure 2: Effect of payroll tax cut on wages and employment with inelastic labor supply



Source: Almeida y Carneiro (2012)

Now, figure 2 panel *c* shows a case where the minimum wage was binding before the payroll tax cut but not after it. As a result, before the payroll tax cut there are people working in the informal

economy, panel *d*, a payroll tax cut should shift the labor demand schedule in the formal sector upwards, in an amount equivalent to the per-worker cost reduction implied by the reform making the minimum wage not binding, and therefore formal employment increase and as a result informal employment shrink.

Finally, figure 2 panel *d*, shows the case where the equilibrium wage is above the minimum wage. These workers do not face a binding minimum wage and therefore none of them work in the informal economy. A payroll tax cut should shift the labor demand schedule in the formal sector upwards, in an amount equivalent to the per-worker cost reduction implied by the reform, therefore the minimum wage continue being not binding. Since labor supply is inelastic, the payroll tax cut is absorb in this group of people increasing wages while formal employment do not change.

In summary, we have three propositions we need to test in a world with an inelastic labor supply:

***Proposition 1.*** A payroll tax cut should not change employment neither formal/informal, nor wages for young workers who face labor markets where the minimum wage was binding before and after the reform.

***Proposition 2.*** A payroll tax cut should increase formal employment, reduce informal employment and not change wages for young workers who face labor markets where the minimum wage was binding before the reform but not after it.

***Proposition 3.*** A payroll tax cut should not change formal employment but increase wages in the formal sector for young workers who face labor markets where the minimum wage was not binding before and after the reform.

### **3. Institutional framework**

Colombia is one of the Latin American countries with the highest payroll taxes (IADB, 2016). Table A1 presents a summary of payroll taxes in Colombia in 2010. It shows the tax rate, as a percentage of wage, paid by the employer and employee and whether the contribution is applied to the provision of benefits for workers. The total payroll tax rate represents between 46 to 54 percent of worker's monthly wage, and is divided into three components: insurance, family benefits, and public goods. The insurance component forms the largest part of the payroll tax rate (37 to 45 percentage points), and provides insurance for workers in the event of negative health shocks, old age, disability, and unemployment. Of the 12.5 percent deducted for health care insurance, 2 percentage points go to finance the public health care system. The family benefits component (4 percentage points) goes to Family Benefits funds, which are non-profit organizations responsible for providing benefits to workers, such as child allowance and access to recreation facilities. The

public goods component of the payroll tax (5 percentage points) funds a public institution that provides technical education and training programs (SENA), and a government agency responsible for providing child protection and family services (ICBF). Most of the payroll tax rate is paid by the employer (38 to 46 percentage points), 80 percent of the total payroll tax (Becerra, 2019).

In December 2010, the *First Employment Law* (FEL) was issued by the Colombian government with two objectives: first, increase formal employment for workers facing difficulties to find a formal job, and second increase the registration rate of small firms. FEL allowed firms that hired new workers under the age of 28 to discount from the corporate income tax an amount equivalent to 11 percentage points of the taxes paid on the payroll of these new workers. The payroll taxes that could be discounted correspond to taxes intended to finance some public goods such as National Learning Service (SENA in Spanish), Colombian Institute of Family Welfare (ICBF in Spanish) and public health system. Other payroll taxes were used to finance mandated benefits, which directly benefit the worker. Eligibility to be a beneficiary of the Law was based on the age of the worker at the beginning of the work contract, and the benefits granted by FEL could extend for a maximum of two years. Since the intention of the Law was to promote the creation of new jobs, the employer could benefit from the Law as long as its payroll was effectively increased at the end of the year, which was verified from the social security payment of its workers. The discount was applied at the time of settlement of the corporate income statement<sup>3</sup>. The payroll tax cut can be read as a positive shock in the demand for workers under the age of 28. FEL reduced total labor cost of eligible workers by 11 percentage points.

After the enactment of this Law, a series of Decrees and Resolutions were issued to regulate the benefits provided by FEL. In February 2011, Decree 545 described who could benefit from FEL. However, all of this occurred without significant dissemination of the benefits provided by the Law. It was not until December 2011 with the issuance of Decree 4910 that the number of companies benefiting from FEL started to increase more rapidly (MinTrabajo, 2012). Decree 4910 detailed the conditions for a company to be able to benefit from the deduction of payroll taxes and more solidly regulated the Law. This suggests two moments of implementation of FEL: a weak implementation that would be all 2011, and a strong implementation that starts in December 2011. The period of analysis in this paper runs until December 2012, because by that date, a new Law reduced payroll taxes for all workers who earned less than 10 minimum wages regardless of their age<sup>4</sup>. Almost all people below 28 years old in Colombia earn less than 10 minimum wages, so this new Law could have also affected labor markets outcomes for people below 28 years old.

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<sup>3</sup>FEL included other groups of eligible workers: women 40 and above without a formal job in the last 12 months; people with disabilities; refugees, and demobilized people from groups outside the law. In this paper, we restrict the analysis to workers under the age of 28

<sup>4</sup>Law 1607.

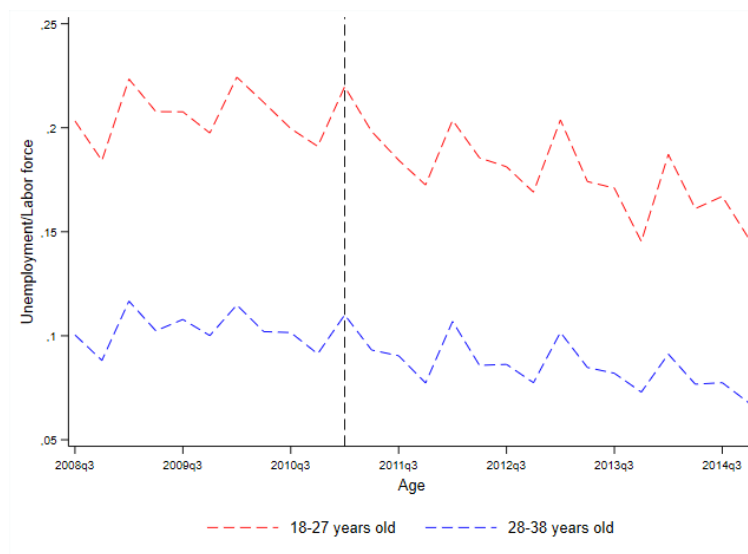


## 4. Data

We use monthly repeated cross-sections of the Colombian Household Survey (LIHS) for periods before and after the implementation of FEL. This survey is the basis of the indicators of the labor market in Colombia and is available from 2008 to 2021. This survey collects information on the employment conditions of individuals and general characteristics at the individual level such as sex, age, marital status and educational level.

As in many countries, one characteristic of the youth labor market in Colombia is the high and persistent youth unemployment rate. From figure 3, the unemployment rate for people between 18 and 27 years old before 2011 was double compared to people between 28 and 38 years old. The FEL was aimed at reducing youth unemployment in the group of young people under 28 years of age. Figure 3 effectively shows a decrease in the youth unemployment rate after the issuance of the First Employment Law, apparently greater than the decrease of unemployment in the group between 28 and 38 years old. The pattern is consistent with possible effectiveness of the mentioned Law.

Figure 3: Youth unemployment rate

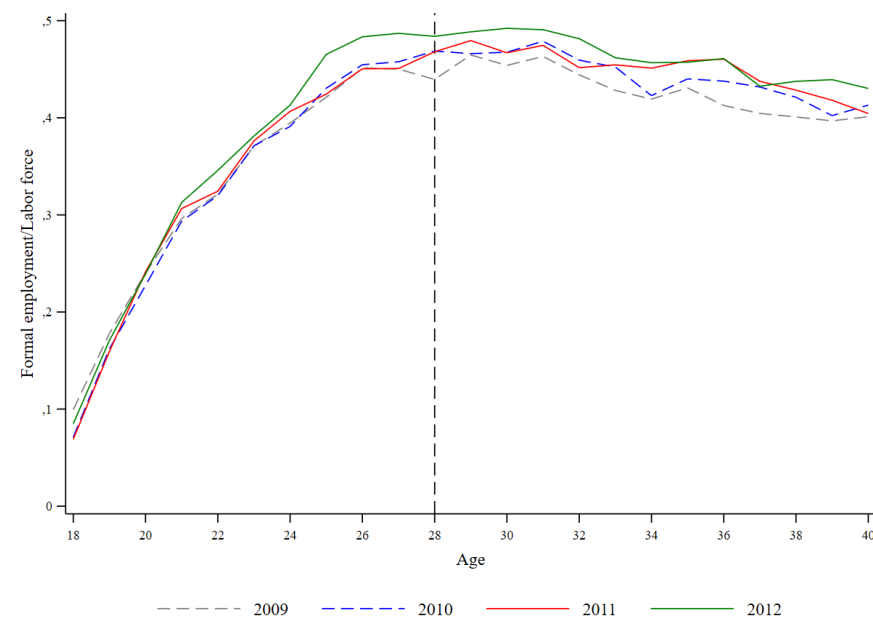


Source: Household survey LIHS.

To analyze the effect of FEL on formal youth employment, we first examine the formal employment rate by age group for two years before and two years after the reform. We adopt a strict definition of labor formality in which a worker is formal if he or she contributes to a pension fund at the time the survey is carried out (Bernal, 2009). The formal employment rate is defined as the percentage of formal workers out of total workers, defined for each age group. Figure 8 shows the formal employment rate for different ages and time periods. First, at each year formal employment rate is

an increasing function with age up to age 30, with their minimum being 8% at age 18, and peaking at 48% at age 30, thereafter the formal employment rate has a slight downward slope with respect to age. Second, it is not clear that formal employment rate has increased after 2011 for a certain age group. This is simply an observation of correlations, which neither dismisses nor demonstrates the effect that the reform has had. What it does point out is the importance of controlling for time effects in the identification strategy explained in section 5.

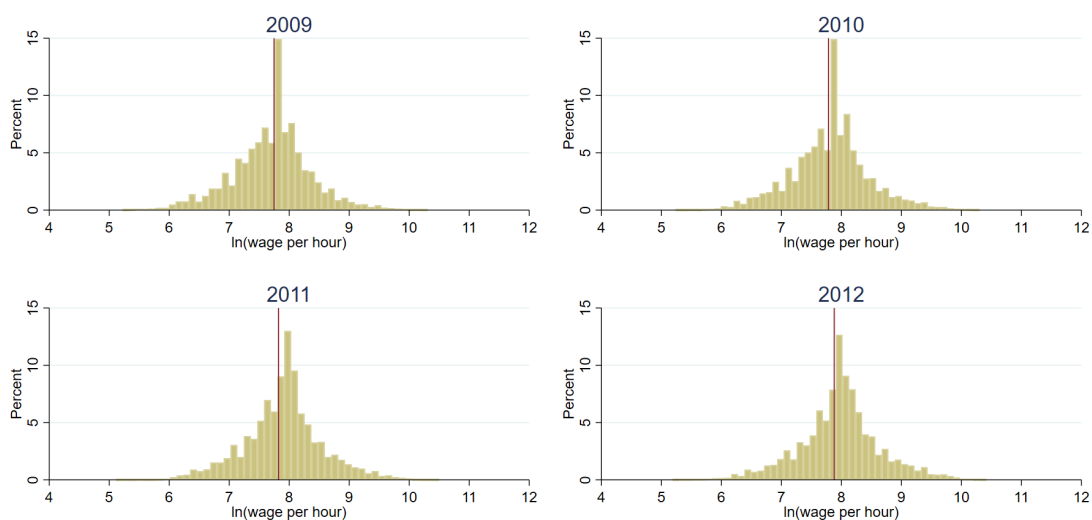
Figure 4: Formal employment rate



Source: Household survey LIHS.

On the other hand, Colombia results in an ideal framework to see the effect of a payroll tax cut on formal employment because a lot of young people in Colombia earn wages near the minimum wage, meaning that the minimum wage is highly binding among the young. Figure 6 shows the distribution of the log wage per hour for workers below 28 years old for 2009, 2010, 2011 and 2012, the red vertical line is the logarithm of the minimum wage per hour in each year. According to this graph, there is a high proportion of colombian young workers that earn wages near the minimum wage. In addition, Colombia also results in an ideal framework because many of the payroll taxes paid in the formal sector are not fully valued by the workers with the exception of the mandated benefits (Caja de compensación Familiar) and the pension contribution, which taking into account both represent 20 out of the 46 percentage points of the payroll taxes. This implies there is a 26 percentage points where the tax-benefit link is weak for the worker.

Figure 5: Distribution of  $\ln(\text{wage per hour})$  for young workers below 28 years old



Source: Household survey LIHS.

## 5. Identification

Within people below 28 years old we may have a lot of heterogeneity in terms of education and work experience. Young people who are near the 28 years old are more comparable in terms of observable and unobservable variables to people who have already passed the threshold of 28 years old. For that reason, from now on we are going to limit the sample observations to people who were between 24 and 32 years old at the time of the survey. Since people under 28 years old after January 2011 could be benefited by the Law, our treatment group will be people under 28 years old at december 2012, while people above 28 in december 2010 will be part of the control group. Therefore, the treatment group are people who had not reached the age of 28 until december 2012. These people were exposed to treatment in all the years of the sample for not exceeding that age in any of those years. It is important to highlight that what we have here is an intention-to-treat (ITT) since people younger than 28 were eligible for the treatment, but not necessarily in fact treated. It is also important to say that benefits granted by the Law could be extended for a maximum of two years once the new hired worker was under 28.

We define the labor force participation rate as the proportion of a country's working-age population (15 - 62 years old) that engages actively in the labor market, either by working or looking for a job. We define employment rate as the proportion of the working-age population who are actually working. Formal employment rate is the proportion of people who are working and contributing to a pension fund, and we define informal employment rate as the proportion of people who are working and not contributing to a pension fund. To look for nonsalary workers we define the self

employment rate as the people who owns and operates a business by themselves or as a partner and derives income by conducting profitable operations of that business, rather than receiving a salary as an employee, divided by working-age population. Table 1 presents the mean for the control and treatment group before and after the reform of the labor force participation rate, employment rate in the formal and informal sectors and self-employed workers. This table shows that after the payroll tax cut, wages increased by 6% for the treatment group compared to the control group. In addition, the probability of participating in the labor market increased by 6.4% in the treatment group compared to the control group and particularly striking is the increase in the probability of being a formal worker after the reform for the treatment group, which increased in 19%.

**Table 1**  
**Average of labor market outcomes before and after First Employment Law**

Variable	Control		Treated		Diff-Diff	Magnitude
	2009-2010	2011-2012	2009-2010	2011-2012		
Log hourly wage	7.99	8.14	7.85	8.06	0.06	6.0%
Labor force rate	0.841	0.867	0.752	0.826	0.048	6.4%
Formal employment rate	0.304	0.345	0.217	0.299	0.041	18.9%
Informal employment rate	0.401	0.410	0.371	0.385	0.005	1.3%
Self-employed rate	0.261	0.290	0.209	0.246	0.008	3.8%

Treated: People that at December 2012 were younger than 28 years old. This people were exposed to the treatment during 2011 and 2012.  
Control: People that at December 2010 were 28 years old or more. This people were not exposed to the treatment in any year between 2011 and 2012.

We first propose a basic empirical strategy of a differences-in-differences model that looks at the effect of the Law on labor market outcomes, without considering the effect of degree of wage rigidities. In the following specification we contrast our treated group against our control group.

$$Y_{im} = \alpha_m + \gamma_c + \beta_1 S_{im} + \beta_2 S_{im} Post_m + \beta_3 X_{im} + \varepsilon_{im} \quad (1)$$

Where:

- $Y_{im}$  = Labor outcome of person  $i$  in month  $m$ , listed below.
- $\alpha_m$ : Month fixed effects.
- $\gamma_c$ : City fixed effects.
- $S_{im} = 1$  if the age of the individual  $i$  is less than 28 years until December 2012 included; 0 otherwise.
- $Post_m = 1$  if  $m >$  December 2010; 0 otherwise. In section 6 we show that our results are consistent using the weak and strong implementation.

- $X_{im}$ : Controls vector: gender, having a partner, years of schooling. These helps to control for observable characteristics of the individuals that may increase the probability of finding a job in the formal labor market.

Five outcomes are considered for an individual  $i$  in month  $m$ : being part of the labor force for the working age population, and for the people who are employed we have four outcome variables: the logarithm of worker's wage per hour, being employed in the formal sector, being employed in the informal sector, and being self-employed. The last outcome variable help us to look only for nonsalary workers. The coefficient  $\beta_2$  in equation (1) tells us the average difference between the treated and the control group after the implementation of the FEL on each of the outcome variables.

To correct for pre-existing differences in the labor outcomes defined above for older and younger 28-year-old, we used a difference-in-difference model with repeated cross-section. If the entry of the reform does not affect the probability of obtaining employment of young people over 28, the result of the comparison of employment rates between those over 28 and under is an estimate of the effect of the payroll tax cut on the probability of getting a formal job for youth.

Subsequently, we expand this strategy to incorporate the effect of nominal wage rigidities. The wage rigidity variable denoted by  $gap_{cem}$ , is a measure of the exposure of individuals to wage rigidities in city  $c$ , with a level of education  $e$ , in month  $m$ :

$$gap_{cem} = \frac{MedianWage_{cem} - Wagemin_m(1 + t)}{Wagemin_m(1 + t)} \quad (2)$$

We define  $e$  as one of six levels of education: having no education, primary education dropout, primary education, high school dropout, high school, and higher education. And  $t$  is the total payroll tax, which was reduced by 11 percentage points after 2011.

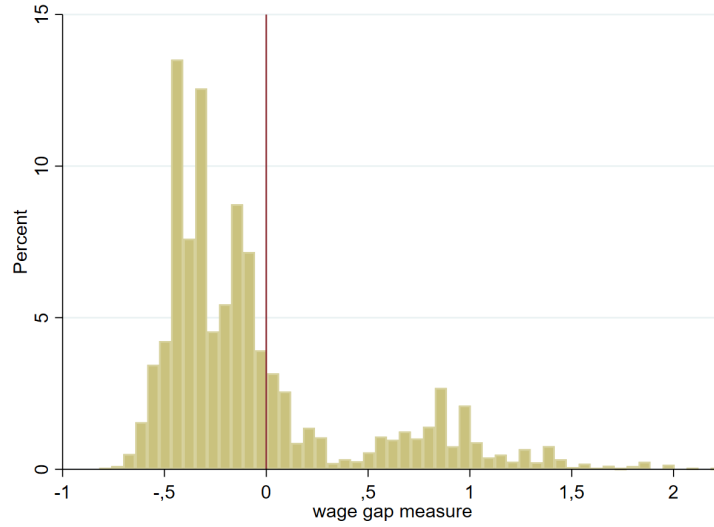
We use the variable  $gap_{cem}$  to sort out people who face a binding minimum wage. For people whose  $gap_{cem}$  is negative we say they face a binding minimum wage, and for those whose  $gap_{cem}$  is positive we say they do not face a binding minimum wage. Within people who face a binding minimum wage, after the payroll tax cut some individuals became not binding by the minimum wage, these are the individuals we call "near".

Figure 12 in the appendix shows the variability in the wage gap variable defined before for 23 Colombian cities aggregated in three educational levels for years 2009, 2010, 2011 and 2012. In this graph high school drop out includes workers between 24 and 32 years old without finishing high school. As would be expected, people with at most high school education face a binding

minimum wage, while people with higher education in all cities of Colombia earn wages above the minimum wage, which means they do not face a binding minimum wage. This variability is what we want to exploit to identify the effect that nominal rigidities can have on the incidence of payroll taxes on labor market outcomes.

Now, figure 6 shows the distribution of the wage gap variable for people between 24 and 32 years old and using in the sample only the pre-reform period given that wage gap may have changed after the introduction of FEL. Since the effect of payroll taxes on labor market variables may be different for individuals with different wage gap measure, we define two dummies that capture whether people are facing a binding minimum wage or not:  $D_{1cem} = I_{\{gap_{cem} \leq 0\}}$  and  $D_{2cem} = I_{\{gap_{cem} > 0\}}$ .

Figure 6: Distribution of wage gap measure before FEL for people between 24 and 32 years old



Source: Household survey LIHS.

In order to see the effect of the payroll tax cut on wages and employment for these two groups we make the following exercise taking into account the wage rigidity measure:

$$Y_{im} = \alpha_m + \gamma_c + \beta_1 D_{2cem} + \sum_{l=1}^2 \beta_{l+1} S_{im} D_{lcem} + \sum_{l=1}^2 \beta_{l+3} S_{im} Post_m D_{lcem} + \beta_6 X_{im} + \epsilon_{im} \quad (3)$$

Where  $\gamma_c$  are city fixed effects. In this case the difference-in-difference estimator will be equal to

$$\beta^{DiD} = \begin{cases} \beta_4, & \text{if } gap \leq 0; \\ \beta_5, & \text{if } gap > 0; \end{cases} \quad (4)$$

According to our theoretical framework, we expect changes in formal employment for workers who experienced a binding minimum wage before the payroll tax cut but not after it. This is not completely captured by equation (3) since inside  $D_{1cem}$  is all people who experience a binding minimum wage. In order to disentangle the effect of a payroll tax on those who experience a binding minimum wage before the reform but not after it we divide the first group into two groups in order to be able to test for the three propositions mentioned in the theoretical framework.

Figure 13 in the appendix shows the distribution of the wage gap variable and the cutoffs for the different deciles for people between 24 and 32 years old. Since the effect of payroll taxes on labor market variables may be different for individuals with different wage gap measure, we define three different dummies that want to capture three different groups of wage gap:  $D_{1cem} = I_{\{gap_{cem} \leq decile_5\}}$ ,  $D_{2cem} = I_{\{decile_6 \leq gap_{cem} \leq decile_7\}}$ , and  $D_{3cem} = I_{\{gap_{cem} \geq decile_8\}}$ . The first group is the people described in *proposition 1*, that is people who face a binding minimum wage before and after the payroll tax cut. The second group is the people described in *proposition 2*, that is people who face a binding minimum wage before the reform but not after it. Finally, the third group describes the people who do not face a binding minimum wage neither before nor after the payroll tax cut, that is people in *proposition 3*.

Thus, the main equation to be estimated is an expanded version of the previous equation, which includes the three groups described above as follows:

$$Y_{im} = \alpha_m + \gamma_c + \sum_{l=1}^2 \beta_l D_{lcem} + \sum_{l=1}^3 \beta_{l+2} S_{im} D_{lcem} + \sum_{l=1}^3 \beta_{l+5} S_{im} Post_m D_{lcem} + \beta_9 X_{im} + \epsilon_{im} \quad (5)$$

In this case the difference-in-difference estimator will be equal to

$$\beta^{DiD} = \begin{cases} \beta_6, & \text{if } gap \leq decile_5; \\ \beta_7, & \text{if } decile_6 \leq gap \leq decile_7; \\ \beta_8, & \text{if } gap \geq decile_8; \end{cases} \quad (6)$$

From equation (5),  $\beta_6$  tells us the marginal effect of reducing payroll taxes on the outcome variables after the reform for the treated who face a binding minimum wage all the time. The coefficient  $\beta_7$  tells us the marginal effect of reducing payroll taxes on the outcome variables after the reform for the treated who face a binding minimum wage before but not after the reform. Finally,  $\beta_8$  captures the effect of a payroll tax cut on outcome variables for those who do not face a binding minimum wage in any time. We expect  $\beta_7$  to be positive when the outcome variable is formal employment and negative when the outcome variable is informal employment, absorbing almost all the effect on labor market outcomes as a result of the payroll tax cut introduced by FEL. Furthermore, we expect  $\beta_6$  do not change for any outcome variable while  $\beta_8$  only change when the outcome variable

is log hourly wage.

## 6. Results

In this section we present the results of specification (1), (3) and (5) proposed in the identification strategy. Table 2 shows the results of the first specification restricting the sample from 2009 to 2012, that is to say taking into account the strong implementation of FEL. According to table 2, the payroll tax cut had a positive and significant effect on the probability to participate in the labor market and the probability of being formal employed, but did not change wages. In particular, the payroll tax cut increased the probability of participating in the labor market by 3.9 percentage points, which is equivalent to an increase of 4.6% in the probability to participate in the labor market. Similarly, the probability of being formally employed after the payroll tax cut increased by 4.9 percentage points, which is equivalent to an increase of 16% in the probability of obtaining formal employment for the treated with respect to control group. In the same direction. Interestingly, wages did not change for the treated compared to the control group after the reform, which is consistent with null pass through effects in an economy a binding minimum wage. Furthermore, the probability of being informally employed did not decrease which seems counterintuitive. The results go in the same direction but in a lower magnitude when we only use the weak implementation of FEL (see table A1 in the appendix).

According to these results, two assumptions of our theoretical framework seem not plausible. First, we assumed constant labor supply, but in our results the probability to participate in the labor market have increased. A possible explanation could be that some young people that were out of the labor force before the payroll tax cut, could have seen the payroll tax cut as a good signal to find formal employment so could have decided to participate in the labor market. Second, informal employment only exist because people cannot find a job in teh formal economy, however after the payroll tax cut informal employment did not change at all. It suggests informality is not only the result of lack of formal employment but also a decision made by the worker. In this context, our results suggest that the increase in the probability of being formally employed may have driven by an increase in labor force participation rather than from a reduction in informality.



**Table 2**  
**Effect of payroll tax cut on wage and employment for treated vs control - Strong implementation**

Variables	Ln wage	Labor force	Formal Emp	Informal Emp	Self-employed
<i>S * Post</i>	0.0134 (0.0208)	0.0390*** (0.0030)	0.0495*** (0.0067)	0.0020 (0.0031)	0.0136 (0.0088)
Observations	109,035	174,612	174,612	174,612	174,612
R-squared	0.3174	0.0903	0.1642	0.0850	0.0333
Controls	Yes	Yes	Yes	Yes	Yes
FE Month	Yes	Yes	Yes	Yes	Yes
FE Area	Yes	Yes	Yes	Yes	Yes
Mean of the control group	7.9903	0.8411	0.3047	0.4018	0.2617

Note: \*\*\* Significant at 1%, \*\* significant at 5% and \* significant at 10%. Standard errors clustered at the city level.

Now, table 3 shows the results from specification (3), it shows whether there is a differential effect in labor market outcomes between people who face a binding minimum wage,  $D_1$ , and people who do not,  $D_2$ . The probability to participate in the labor force and the probability to be formally employed increase for both groups. However, the effect from the payroll tax cut is stronger for people who do not experience a binding minimum wage which is the opposite of what we expected. We do not find any effect on wages for none of the groups analyzed, which is again consistent with null pass through effects.

**Table 3**  
**Effect of payroll tax cut on wage and employment for binding and not binding**  
**minimum wage groups. Strong implementation**

Variables	Ln wage	Labor force	Formal Emp	Informal Emp	Self-employed
$S * Post * D_1$	0.0079 (0.0201)	0.0101** (0.0040)	0.0150** (0.0061)	-0.0014 (0.0069)	0.0140 (0.0129)
$S * Post * D_2$	0.0041 (0.0173)	0.0541*** (0.0103)	0.0750*** (0.0060)	-0.0139 (0.0082)	-0.0171*** (0.0059)
Observations	97,778	152,122	152,122	152,122	152,122
R-squared	0.3372	0.0963	0.2106	0.1038	0.0330
Controls	Yes	Yes	Yes	Yes	Yes
FE Month	Yes	Yes	Yes	Yes	Yes
FE Area	Yes	Yes	Yes	Yes	Yes
Mean of the control group	7.9903	0.8411	0.3047	0.4018	0.2617

Note: \*\*\* Significant at 1%, \*\* significant at 5% and \* significant at 10%. Standard errors clustered at the city level.

Finally, table 4 shows the results from specification (5) in which we include three groups:  $D_1$ , people who face a binding minimum wage before and after the reform;  $D_2$ , people who face a binding minimum wage before the payroll tax cut but not after it; and  $D_3$ , people who do not face a binding minimum wage neither before nor after the payroll tax cut. According to these results, *proposition 1* seems to be true, however *propositios 2* and *3* are not. In one hand, we expected that people who were facing a binding minimum wage before the payroll tax cut increase the probability to be formally employed after the payroll tax cut which is the case but the coefficient is not precise. On the other hand, people who were not facing a binding minimum wage neither before not after the payroll tax cut, should not change formal employment and increase wages in a world with an inelastic labor supply. We are finding the opposite, this suggests that formal labor supply for this group of people is elastic for two reasons. First, the payroll tax cut is reflected in this group in an increase in the probability of being formally employed. Second, the probability of being an informal worker decrease by 2 percentage points via a reduction in the probability of being self employed. This results suggests two things: labor supply for workers who do not face a binding minimum wage is elastic and within workers who do not face a binding minimum wage there are workers who are in the informal economy that are attracted to formality as a result of the payroll tax cut. Figure 12 in the appendix show these same results separating wages in formal and informal labor markets, we do not find pass-through effects in none of them. Figure 13 in the appendix shows the graph for the coefficients on labor force participation, formal employment, informal employment and self-employed for the three groups described in table 4.

**Table 4**  
**Effect of payroll tax cut on wage and employment for different degrees of wage gap.**  
**Strong implementation**

Variables	Ln wage	Labor force	Formal Emp	Informal Emp	Self-employed
<i>S * Post * D<sub>1</sub></i>	0.0075 (0.0238)	0.0049 (0.0040)	0.0052 (0.0045)	0.0049 (0.0086)	0.0193 (0.0157)
<i>S * Post * D<sub>2</sub></i>	0.0015 (0.0085)	0.0307** (0.0120)	0.0183 (0.0173)	0.0020 (0.0075)	0.0035 (0.0106)
<i>S * Post * D<sub>3</sub></i>	0.0054 (0.0179)	0.0550*** (0.0106)	0.0842*** (0.0061)	-0.0207** (0.0079)	-0.0203*** (0.0059)
Observations	97,778	152,122	152,122	152,122	152,122
R-squared	0.3380	0.0986	0.3040	0.1562	0.0487
Controls	Yes	Yes	Yes	Yes	Yes
FE Month	Yes	Yes	Yes	Yes	Yes
FE Area	Yes	Yes	Yes	Yes	Yes
Mean of the control group	7.9903	0.8411	0.3047	0.4018	0.2617

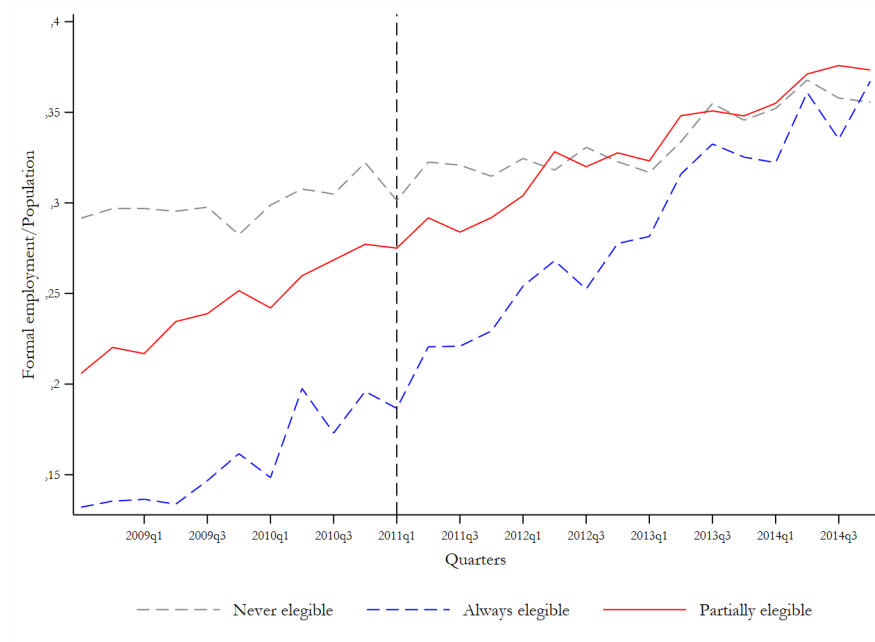
Note: \*\*\* Significant at 1%, \*\* significant at 5% and \* significant at 10%. Standard errors clustered at the city level.

## 7. Extensions and robustness checks

In order to see whether there is a differential effect on young people who were always exposed to treatment and young people who were exposed to only part of the period analyzed, we sort out young people eligible by the FEL into two different groups of treatment: always eligible and partially eligible. Partially eligible group are young people who during 2011 to 2012 became 28 years old, which means that they were eligible only for part of the period under consideration, it means in any new contract signed after reaching the 28 they were not sheltered by the benefits. Again, it is important to note that once hired, regardless of the age of the worker, as long as the new worker was under 28 years old, the benefits for the employer could be extended for a maximum of two years.

Figure 4 shows the employment rate in the formal sector before and after the reduction of payroll taxes for young people who are partially eligible and those who are always eligible. For young people who are always eligible formal employment rate experiences a high growth rate after FEL, until it reached a level similar to the employment rate of slightly older youth. This would be consistent with people between the ages of 24 and 26 being more attractive to businesses as a result of the reform.

Figure 7: Employment rate - Formal sector



Source: Household survey LIHS.

To capture the effect of FEL on employment for always eligible,  $S_{im}$ , and partially eligible,  $P_{im}$ , we use the following specification in our differences-in-differences model:

$$Y_{im} = \alpha_m + \gamma_c + \beta_1 S_{im} + \beta_2 P_{im} + \beta_3 S_{im} Post_m + \beta_4 P_{im} Post_m + \beta_5 X_{im} + \epsilon_{im} \quad (7)$$

We present the results of this specification in table 5. Always eligible have a greater probability of being formally employed, after the reform with respect to the control group than partially eligible group, which is consistent with what we expected. Always eligible were exposed to the treatment for a greater time period than partially eligible. In particular, for always eligible formal employment increased by 3.98 percentage points while for partially eligible it increased by 1.40 percentage points, which is equivalent to an increase in the probability of being formally employed of 12% and 4.5% respectively. Labor force participation also increased for both groups of people, but it increased more for always eligible. Again we do not find any effect neither in wages nor in informal employment for none of these two groups.

**Table 5**  
**Effect of payroll tax cut on wage and employment for always and partially eligible**

Variables	Ln wage	Labor force	Formal Emp	Informal Emp	Self-employed
<i>S * Post</i>	0.0037 (0.0158)	0.0286*** (0.0034)	0.0398*** (0.0082)	-0.0040 (0.0042)	0.0004 (0.0052)
<i>P * Post</i>	0.0066 (0.0062)	0.0135*** (0.0034)	0.0140*** (0.0047)	0.0149 (0.0089)	0.0140** (0.0065)
Observations	205,991	315,345	315,345	315,345	315,345
R-squared	0.3271	0.0964	0.1734	0.0900	0.0325
Controls	Si	Si	Si	Si	Si
FE Month	Si	Si	Si	Si	Si
FE Area	Si	Si	Si	Si	Si
Mean of the control group	8.0056	0.8532	0.3127	0.419	0.2826

Note: \*\*\* Significant at 1%, \*\* significant at 5% y \* significant at 10%. Standard errors clustered at the city level.

Finally, table 5 presents the possibility of placebo effects or false experiments by estimating the impact of the reform in 2010 when there was no reform. The sample was restricted to the year in which the reform was activated and the previous years. The lack of effects on the placebo exercises on formal employment in table 5 reinforces the soundness of the identification strategy for capturing the effect of FEL on formal employment and for always eligible and partially eligible.

**Table 6**  
**Effect of payroll tax cut on wage and employment for always and partially eligible  
assuming FEL started in 2009**

Variables	Ln wage	Labor force	Formal Emp	Informal Emp	Self-employed
<i>S * Post</i>	-0.0020 (0.0215)	0.0170** (0.0072)	0.0030 (0.0153)	0.0325 (0.0252)	0.0231 (0.0160)
<i>P * Post</i>	0.0135	0.0116***	0.0084	0.0103	0.0114
Observations	108,721	169,929	169,929	169,929	169,929
R-squared	0.3253	0.0962	0.1717	0.0916	0.0344
Controls	Si	Si	Si	Si	Si
FE Month	Si	Si	Si	Si	Si
FE Area	Si	Si	Si	Si	Si
Mean of the control group	7.9689	0.7173	0.2263	0.4156	0.3067

Note: \*\*\* Significant at 1%, \*\* significant at 5% y \* significant at 10%. Standard errors clustered at the city level.

## **8. Cost and benefits**

By March 31<sup>st</sup> of 2012, 6,311 firms were covered by the benefits of FEL related with hiring new workers younger than 28, that is 3% of new firms created in 2011. In terms of the fiscal cost, according to the National Income Tax Institution in Colombia (DIAN) these firms discount from their annual income tax an amount equivalent to USD 175 million for all the benefits contemplated in FEL (2012, DIAN).

## **9. Conclusions**

In this article we evaluate the effect of a payroll tax cut on labor market outcomes for people under 28 years old in an economy with a high binding minimum wage. Taking into account differential degrees of exposure to wage rigidities and using a difference-in-differences estimator, we estimate that the effect of the payroll tax cut is asymmetric for young people who face labor markets with binding minimum wage and those who do not. In one hand, the reduction of payroll taxes increased the probability of getting formal employment by 16% for young people who do not face a binding minimum wage. Similarly, the probability of being in the labor force participation increased by 6% and the probability of being an informal worker was reduced in 5% for this group of people. We do not find pass through effects. On the other hand, the payroll tax cut did not affect neither wages nor employment for young people who face a binding minimum wage.

In conclusion, according to our results, the payroll tax cut for new hires of young workers increased the probability to participate in the labor market for people younger than 28, increase the probability of being formally employed and reduce the probability of being an informal worker for people who do not face a binding minimum wage.

It is important to highlight three limitations of our theoretical framework which is based on a competitive labor market. First, we may have an elastic labor supply instead of an inelastic labor supply, which in fact seem to be the case at least for workers who do not face a binding minimum wage. Second, labor force participation may not be constant along time. Payroll tax cut can be seen by people out of the labor force as a good opportunity to participate in the labor market and get a formal job. Third, informality is not only the result of lack of formal employment but also a decision made by the worker. We need to consider the limitations of a competitive labor market when trying to interpret our results.

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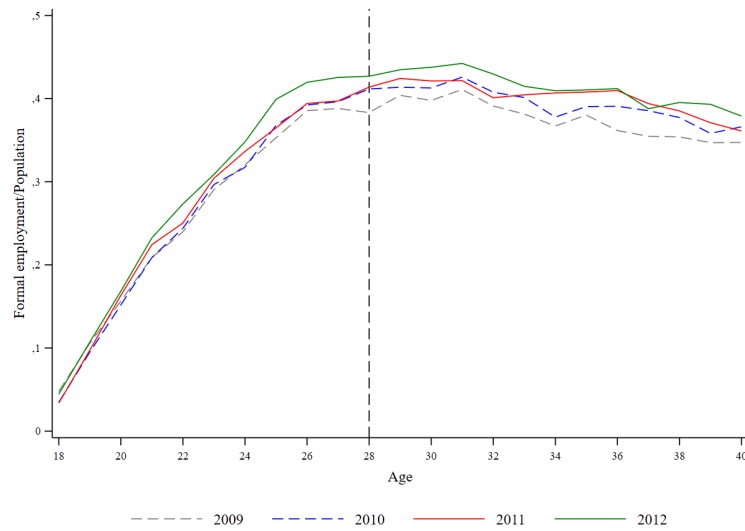
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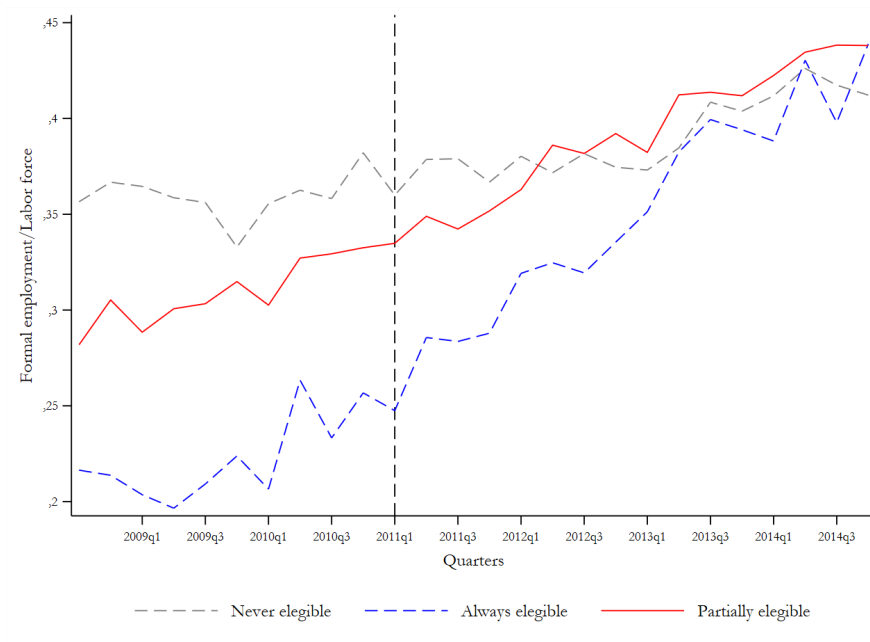
# Appendix

Figure 8: Employment rate - Formal sector



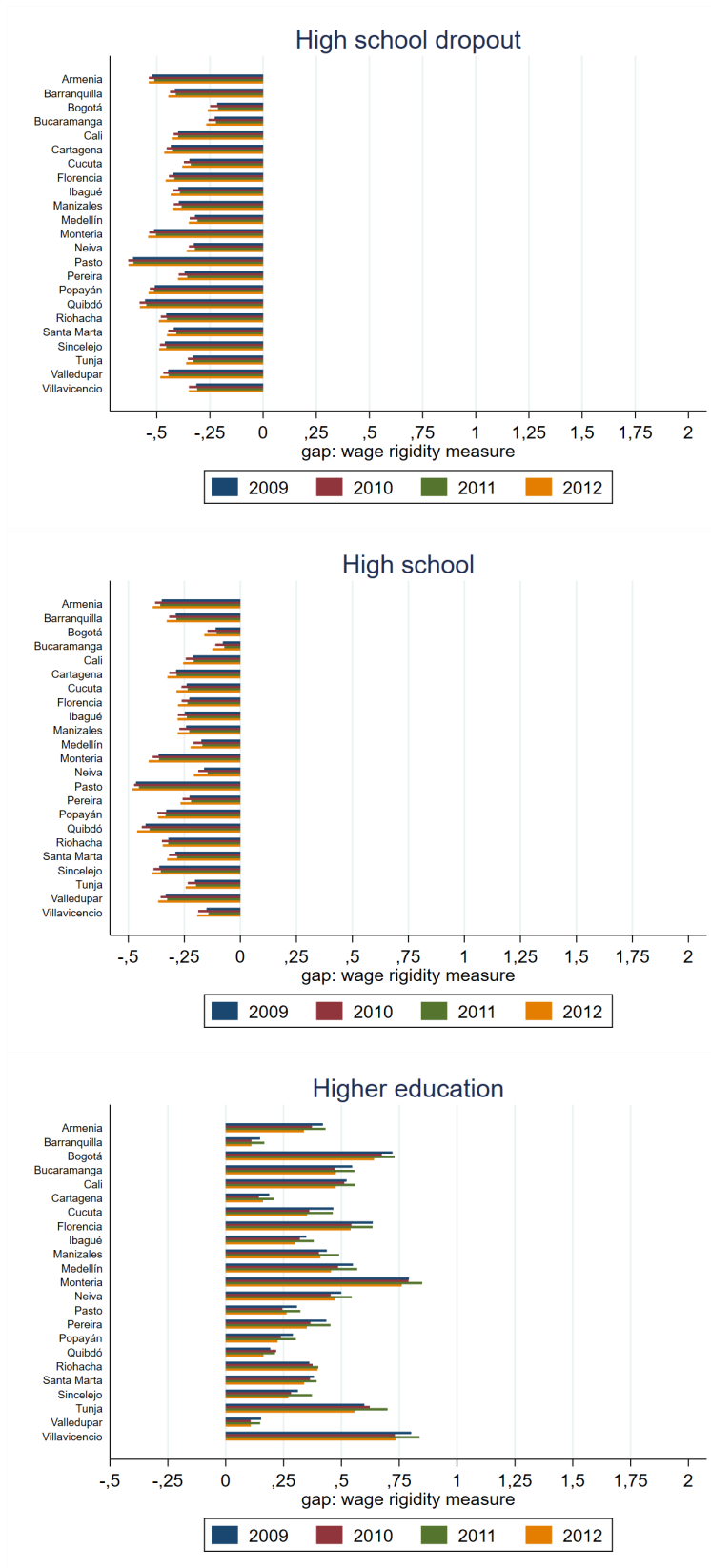
Source: Household survey LIHS.

Figure 9: Formal employment rate



Source: Household survey LIHS.

Figure 10: Measure of wage rigidity for different levels of education in different Colombian cities



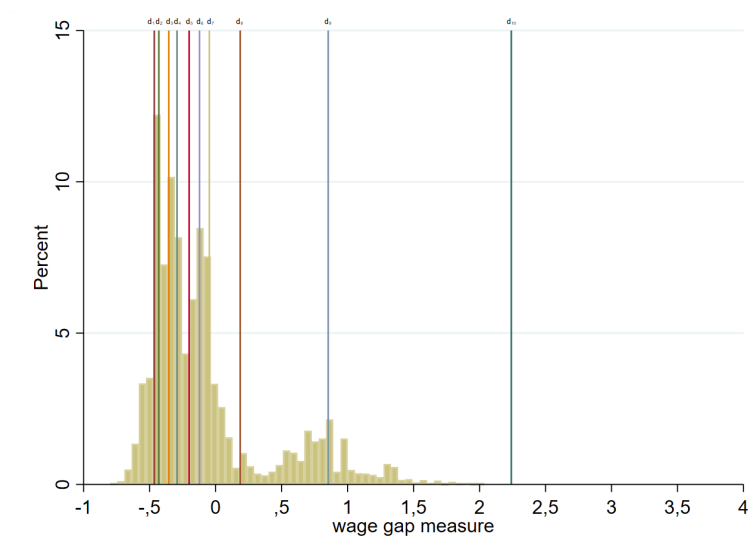
Source: Household survey LIHS.

**Table A1**  
**Payroll taxes in Colombia, 2010**

% of monthly wage	Total	Employer tax rate	Employee tax rate	Benefits for	
				Worker	Other
<b>A. Insurance</b>					
Health care	12.5	8.5	4.0	10.5	2.0
Workplace safety	0.4-8.7	0.4-8.7	-	0.4-8.7	-
Pension benefits	16.0	12.0	4.0	16.0	-
Severance savings	8.1	8.1	-	8.1	-
<b>B. Family funds</b>					
Family benefits	4.0	4.0	-	4.0	-
<b>C. Public goods</b>					
SENA/ICBF	5.0	5.0	-	-	5.0
<b>Total</b>	<b>46.0-54.3</b>	<b>38.0-46.3</b>	<b>8.0</b>	<b>39.0-47.3</b>	<b>7.0</b>

*Notes:* Here we show the employer and employee payroll tax rates, and the distribution of the rate between services provided to the worker and the financing of public goods. SENA is a public institution that provides technical education and training programs, ICBF is a government agency responsible for providing child protection and family services, and Family funds are non-profit organizations who provide benefits to workers and their families, such as child allowances, access to recreation facilities, and subsidies for housing (Becerra, 2019).

Figure 11: Distribution of wage gap measure before FEL for people between 24 and 32 years old for different deciles



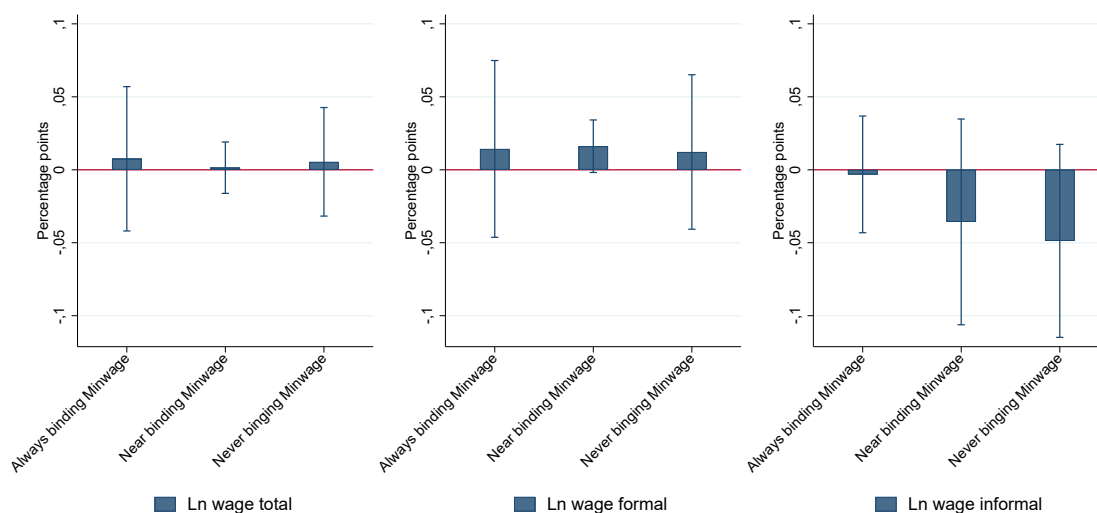
Source: Household survey LIHS.

**Table A2**  
**Effect of payroll tax cut on wage and employment for treated vs control - Weak implementation**

Variables	Ln wage	Labor force	Formal Emp	Informal Emp	Self-employed
<i>S * Post</i>	-0.0061 (0.0088)	0.0262*** (0.0074)	0.0255*** (0.0072)	0.0055 (0.0073)	0.0157 (0.0130)
Observations	55,442	88,049	88,049	88,049	88,049
R-squared	0.3124	0.0909	0.1643	0.0856	0.0315
Controls	Yes	Yes	Yes	Yes	Yes
FE Month	Yes	Yes	Yes	Yes	Yes
FE Area	Yes	Yes	Yes	Yes	Yes
Mean of the control group	7.99	0.8411	0.3047	0.4018	0.2617

Note: \*\*\* Significant at 1%, \*\* significant at 5% and \* significant at 10%. Standard errors clustered at the city level.

Figure 12: Marginal effects of payroll tax cut on labor market variables for young workers with different degree of wage rigidities, 24 months before and after FEL implementation



Note: Always binding Minwage are cities where the difference between the median wage by level of education in month  $m$  and the minimum wage after the payroll tax is below the 5th decile. Near binding Minwage are cities where the difference between the median wage by level of education in month  $m$  and the minimum wage is between the 6th and the 7th decile. Never binding Minwage are cities where the difference between the median wage by level of education in month  $m$  and the minimum wage is in decile 8th or above.

Figure 13: Marginal effects of payroll tax cut on labor market variables for young workers with different degree of wage rigidities, 24 months before and after FEL implementation

