Payroll taxes and youth labor market outcomes: 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 5% for young people below 28 compared to people above 28. 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.

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1. Introduction

One of the great challenges facing both developed and developing economies is the high and persistent youth unemployment rate (Egebark 2016). Difficulties in finding a job during the first years of working have long-term consequences on the probability of getting a formal job (Gregg and Tominey 2005; Nordstrom Skans 2011; Schmillen and Umkehrer 2017; Wachter 2020). Payroll taxes can worsen youth unemployment. Theoretically, we know that payroll taxes should particularly affect those who experience greater wage rigidities (Freeman and Gottschalk 1998; Bell 1997; Blinder and Choi 1990; Campbell and Kamlani 1997; Mondragón-Vélez et al. 2010). One factor affecting young people in the formal labor market is high minimum wage levels, particularly in emerging economies. Since many young workers earn close to the minimum wage, they are more vulnerable to changes in payroll taxes, which can impact their ability to find 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 et al. 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 hired formally. We analyze labor market outcomes for individuals younger and older than 28, both before and after the reform, using data from household surveys. Our goal is to estimate the impact of reduced payroll taxes on six outcome variables: wages in the formal and informal sectors, the likelihood of participating in the labor force, the chances of being a wage earner formal worker, a wage earner informal worker, and being self-employed. The identification strategy of this paper is based on the observation that the reform did not change the likelihood of hiring workers over 28 years old. It is important to highlight that what we have here is an intention-to-treat (ITT) since people younger than 28 were elegible for the treatment, but not necessarily in fact treated.

In competitive labor markets, when there is a link between payroll taxes and the benefits received by workers, changes in payroll taxes should primarily affect wages, with minimal impact on employment. However, if wages are rigid and cannot decrease due to a minimum wage requirement, they will not absorb the payroll taxes. This can lead to increased total labor costs, resulting in changes in employment levels or a shift of workers to the informal sector. (A. Kugler, M. Kugler,

and Prada 2017; Almeida and Carneiro 2012). Therefore, the introduction of payroll taxes could lead to a decline in wage-earner formal employment, particularly affecting groups with wages that are less flexible 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 wage-earner 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 et al. 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 (Freeman and Gottschalk 1998; A. D. Kugler, Jimeno, and Hernanz 2003; Saez, Schoefer, and Seim 2019). However, other authors find low or null effects for the case of Sweden (Egebark and Kaunitz 2018). 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[3](Maloney 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 not 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 for young people by exploiting differential degrees of exposure to wage rigidities. This contribution is relevant to understand when reducing payroll taxes can increase formal employment among youth. This article is related to two large literatures. On one hand, it focuses on active programs aimed at reducing youth unemployment, particularly employment subsidy initiatives like lowering payroll taxes for young workers (Kluve et al. 2019; Saez, Schoefer, and Seim 2019). This article contributes to this literature by showing that reducing payroll taxes increased the probability of finding formal employment as a wage-earner and participating in the labor market for young people who before the reform were facing a binding minimum wage but after the reform they were 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

[3]Colombian minimum wage is around 90% the median wage, which suggests a disproportionate minimum wage in relation to the other salaries in the economy, in other words, it means a very high minimum wage compared to the average productivity of workers (Arango et al. 2022)

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. If 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 would also be 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 the United States and Chile, Gruber and Krueger (1991), and Gruber (1997) find 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, Galiani, and Kidyba 2010; A. Kugler and M. Kugler 2009; A. Kugler, M. Kugler, and Prada 2017; Raquel Bernal 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. Reducing payroll taxes increased the probability of being a formal wage earner worker, given that the person is employed, by 16% and increased the probability of participating in the labor market by 5% for young people below 28 compared to people above 28. The pass through effect[4] is null which is consistent with a labor market with high wage rigidities (Becerra 2019).

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 and section 8 concludes.

2. Theoretical framework

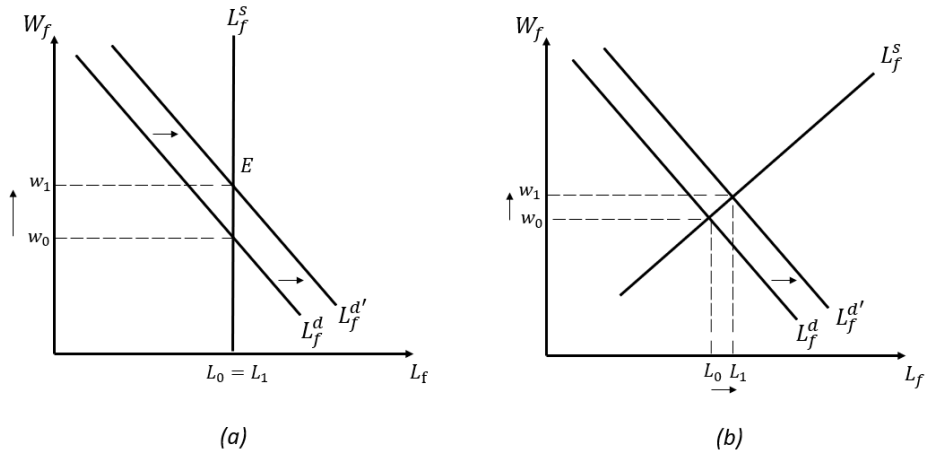
We incorporate an informal labor market into a basic model of the incidence of payroll taxes in a competitive formal labor market (Summers 1989; Lazear 1990; Gruber and Krueger 1991). Payroll taxes have different effects on formal and informal labor markets. Employers in formal labor

[4]The degree to which payroll taxes are passed on to wages depends on the elasticity of labor supply and the link between taxes and benefits, specifically how workers value the benefits they receive from payroll taxes.

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 it 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 workers who face labor markets below the minimum wage 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. As a result of a payroll tax cut, the group defined "near" stops facing a binding minimum wage after the reform, and therefore is 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 some 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. 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 shrinks.

Finally, figure 2 panel e, 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 absorbed in this group of people increasing wages while formal employment do not change.

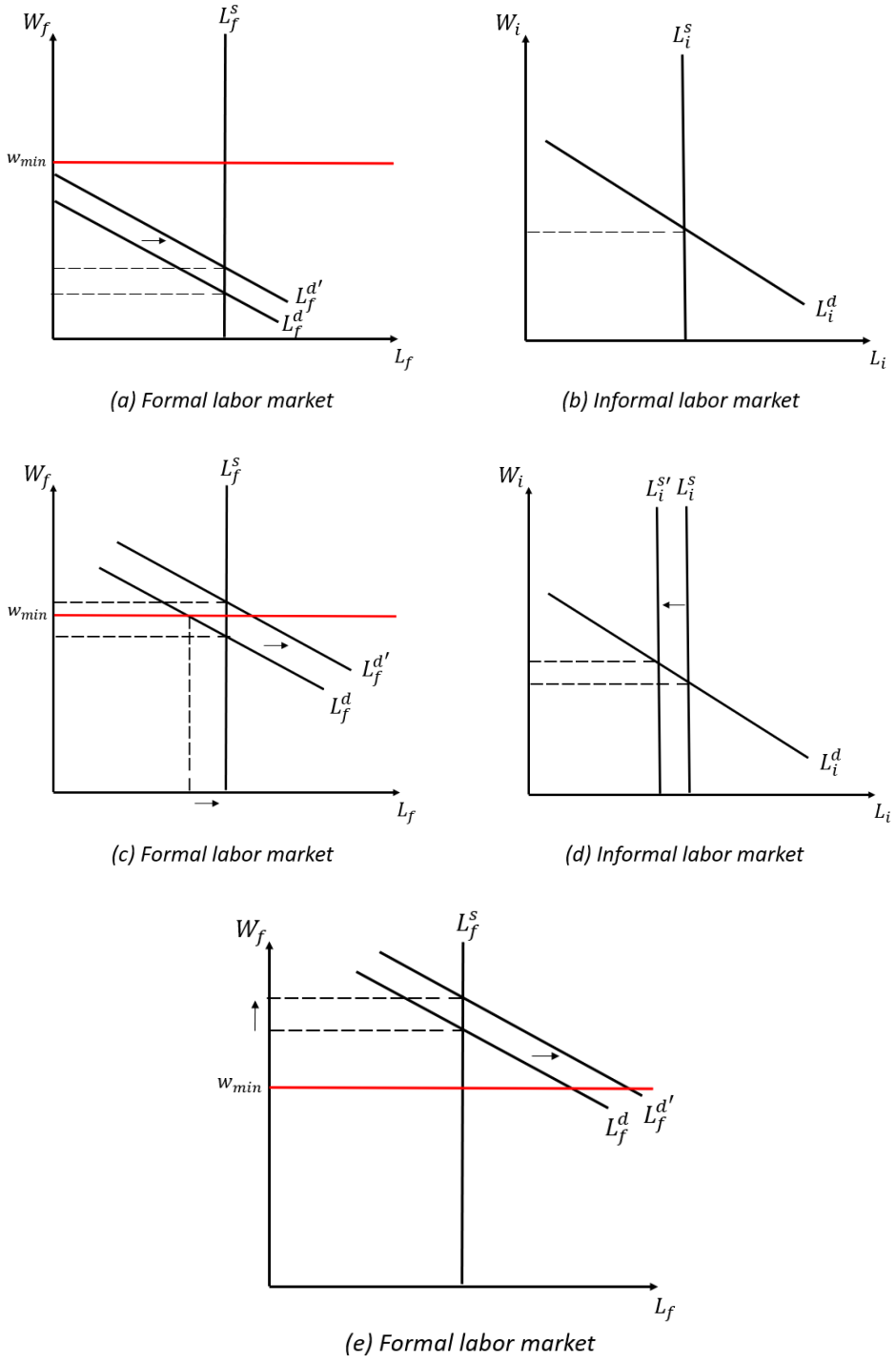
In summary, we have three propositions applicable to the case of an inelastic labor supply:

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 above the equilibrium wage before and after the reform.

Proposition 2. A payroll tax cut should increase formal employment, reduce informal employment and increase wages for young workers who face labor markets where the minimum wage was above the equilibrium wage before the reform but below 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 below the equilibrium wage before and after the reform if labor supply is inelastic. However, if labor supply is elastic we expect that both formal employment and wages increase as a result of a payroll tax cut (figure 1, panel b).

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



Source: Almeida y Carneiro (2012)

3. Institutional framework

Colombia is one of the Latin American countries with the highest payroll taxes (Lora and Fajardo-González 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 represented then 46 to 54 percent of worker's monthly wage, and was divided into three components: insurance, family benefits, and public goods. The insurance component was the largest part of the payroll tax rate (37 to 45 percentage points), and provided 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 went to finance the public health care system. The family benefits component (4 percentage points) went 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 was 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 wage-earner employment for workers facing difficulties to find a wage-earner formal job, and second increase the registration rate of small firms. This paper evaluates the first objective of the Law. 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 the public health system. 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 [5]. 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

[5]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

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 includes the period from January 2011 until December 2012. 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[6]. 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.

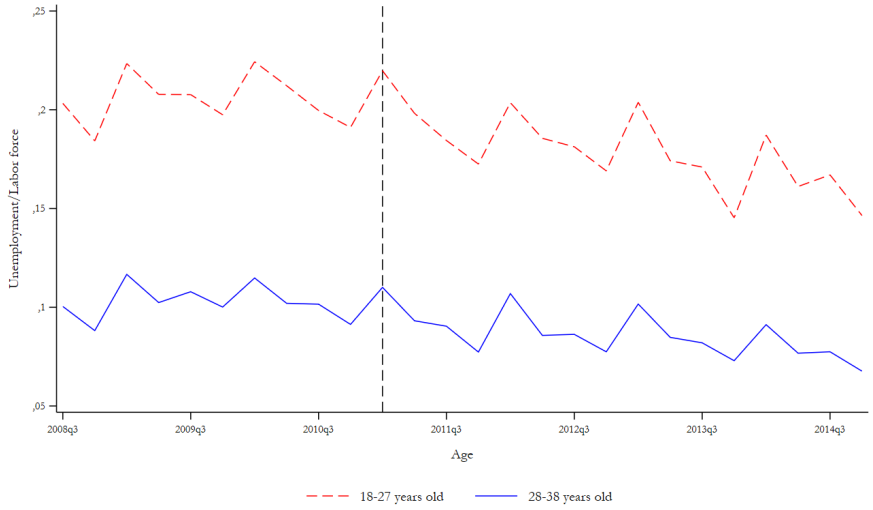
4. Data

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 I use data from 2009 to 2012. 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.

[6]Law 1607.

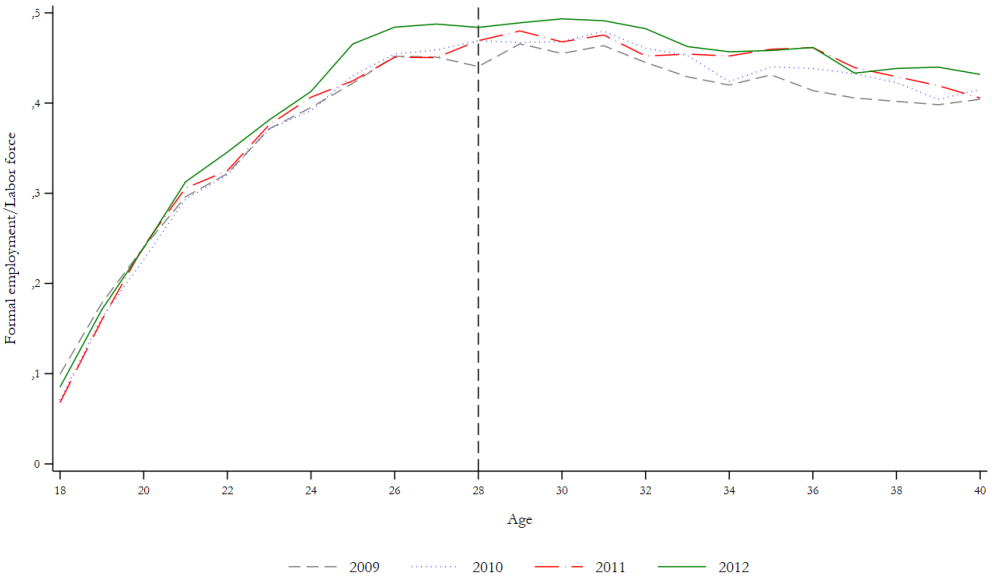
Figure 3. Youth unemployment rate



Source: Household survey LIHS.

To analyze the effect of FEL on formal youth employment, we first examine the wage-earner formal employment rate by age group two years before and after the reform. We adopt a strict definition of labor formality in which a wage-earner worker is formal if he or she contributes to a pension fund at the time the survey is carried out (Bernal, 2009). The wage-earner formal employment rate is defined as the percentage of formal wage-earner workers out of total wage-earner workers, defined for each age group. Figure 4 shows the wage-earner formal employment rate for different ages and time periods. First, at each year the 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 the wage-earner 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 estimation strategy explained in section 5.

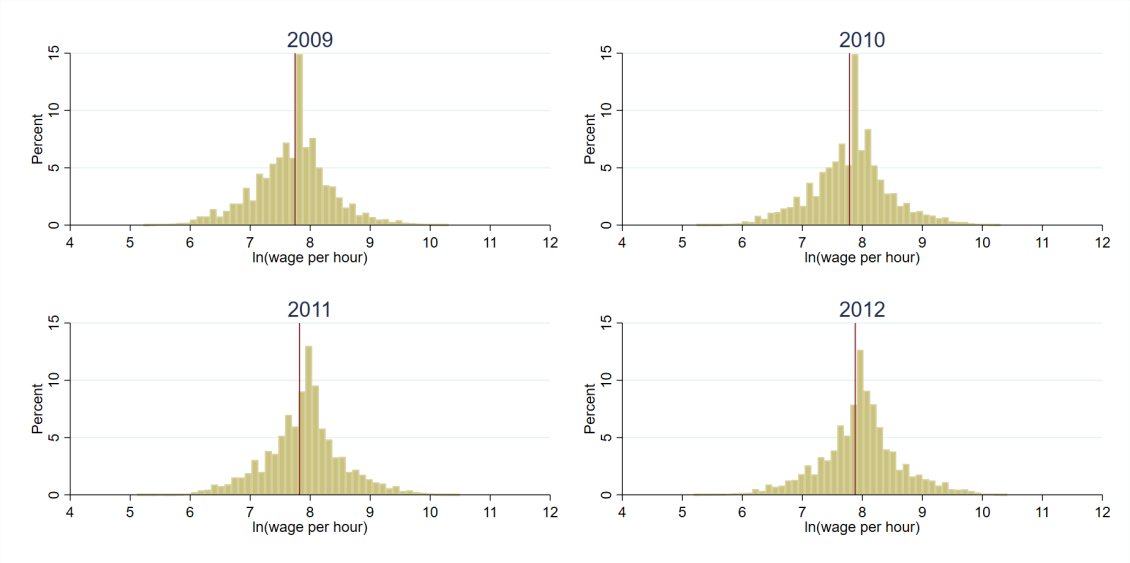
Figure 4. Formal employment rate



Source: Household survey LIHS.

On the other hand, Colombia provides an ideal framework to see the effect of a payroll tax cut on wage-earner formal employment because a large fraction of young people in Colombia earn wages near the minimum wage, some of them slightly below and other slightly above the minimum wage. Figure 5 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. Notice that there are workers who earn wages below the minimum wage which typically are workers in the informal sector while there are workers who earn above the minimum wage where we may have workers in the formal or informal sector depending on whether or not they contribute to a pension fund.

Figure 5. Distribution of ln(wage per hour) for young workers below 28 years old



Source: Household survey LIHS.

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. Wage-earner formal employment rate is the proportion of people who are contributing to a pension fund out of those working as wage-earners, and we define the informal employment rate as the complementary proportion of wage-earners working people not contributing to a pension fund (Bernal et al. 2009). To look for nonsalaried workers we define the self-employment rate as those who own and operate a business by themselves or as a partner and derive income by conducting profitable operations of that business, rather than receiving a salary as an employee, divided by working-age population. It is important to highlight that what we have here is an intention-to-treat (ITT) since people younger than 28 were elegible 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.

Table 1 presents the mean of the labor force participation rate, employment rate in the formal and informal sectors and self-employed workers for people below and above 28 years old before and after the reform. This table shows that after the payroll tax cut, wages increased by 6% for the people under 28 compared to those in the 28 and above group. In addition, the probability of participating in the labor market increased by 4.6% for people under 28 compared to people above 28 and particularly striking is the increase in the probability of being a wage-earner formal worker after the reform for people under 28, which increased in 16% compared to people above 28.

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

	Above 28 years old		Under 28 years old			
Variable	**2009-2010**	**2011-2012**	**2009-2010**	**2011-2012**	**Diff-Diff**	**Magnitude**
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	0.039	4.6%
Formal employment rate	0.304	0.345	0.217	0.299	0.049	16.2%
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	3.0%

This table shows the descriptive statistics of labor market outcomes for people above and under 28 years old, before and after the payroll tax cut. We denote the treated group, people that at December 2012 were younger than 28 years old. This people were exposed to the treatment during 2011 and 2012. We denote the control group, 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.

5. Estimation Strategy

We first propose a basic empirical strategy of a differences-in-differences model that looks at the effect of FEL on labor market outcomes, without considering the effect of degree of wage rigidities. If the entry of the reform does not affect the probability of obtaining employment for people over 28, then comparing employment rates of those under 28 with those over 28 provides an estimate of the effect of the payroll tax cut on the probability of obtaining a formal wage-earner job for youth. In the following specification we contrast people under 28 (treated group) against people over 28 (control group).

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

Where:

- Y_{im} = Labor outcome of person i, living in city c in month m, listed below.
- α_m: Month fixed effects.
- γ_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[7].

[7]Weak implementation of FEL includes all the year 2011. Strong implementation includes all 2011 and 2012.

- 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, living in city c in month m: being part of the labor force; for the people who are employed we have four outcome variables: the logarithm of worker's wage per hour, being a formal wage earner worker, being an informal wage earner worker, and being self-employed defined as mutually exclusive. The last outcome variable help us to look only for nonsalaried workers. The coefficient β_2 in equation (1) tells us the average difference between people below 28 and above 28 after the implementation of the FEL on each of the outcome variables.

Within people below 28 years old we may have a lot of heterogeneity in terms of education and work experience. Young people right below 28 years old are comparable in terms of observable and unobservable variables to people right above 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 below 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.

The identifying assumption of our empirical strategy is that in the absence of the FEL, the average outcomes for both the treatment and the control group would have followed the same trajectory over time. We test for this assumption comparing pre-treatment trends of formal employment between people right above 28 and right below 28 and we do not find any statistical difference in the pre-treatment period of analysis. This suggests that parallel trends assumption seemed to be satisfied (see appendix figure A2).

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:

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

We define e as one of six levels of education: having no education, incomplete primary education, primary education, incomplete high school, complete high school, and higher education. And t is

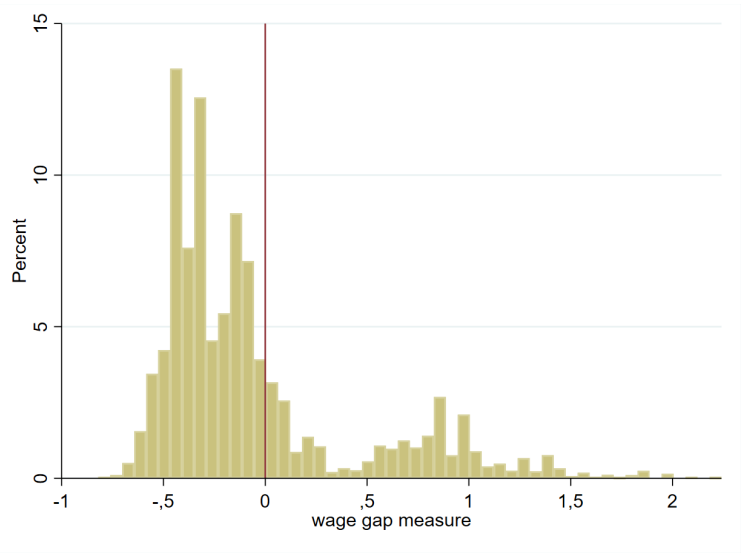
the total payroll tax, which was reduced by 11 percentage points after 2011.

We use the variable gap_{cem} to sort out people who face different nominal wage rigidity. Before the reform, for people whose gap_{cem} is negative we say they face a labor market where the median wage is below the minimum wage, and for those whose gap_{cem} is positive we say they face a labor market where the median wage is above the minimum wage. Among individuals in a labor market where the median wage falls below the minimum wage, some have transitioned to a labor market with wages above the minimum wage following the payroll tax cut. We refer to these individuals as "near".

Figure A5 in the appendix shows the variability in the wage gap variable defined above for 23 Colombian cities aggregated in three educational levels for years 2009, 2010, 2011 and 2012. In figure A5 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 labor markets where the median wage is below the minimum wage, while people with higher education in all cities of Colombia earn wages above the minimum wage, which means they face labor markets where the median wage is above the 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.

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 the 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 measures, we define two dummies that capture whether people were facing a labor market where the median wage was below the 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:

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

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

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

According to our theoretical framework, we expect changes in formal employment and wages for workers who faced a labor market where the equilibrium wage was below the 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 labor market where the equilibrium wage is below the minimum wage. In order to disentangle the effect of a payroll tax on those who faced a labor market where the equilibrium wage is below the minimum wage before the reform but not after it, we divide D_{1cem} into two groups in order to be able to test for the three propositions mentioned in the theoretical framework.

Figure A5 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 measures, 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 $D_{3cem} = I\{gap_{cem} \geq decile_8\}$. $gap_{cem} = 0$ falls in the decile 7th. 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 thrid 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:

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

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

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

From equation (5), β_6 tells us the marginal effect of reducing payroll taxes on the outcome variables after the reform for people under 28 who face a binding minimum wage all the time. The coefficient β_7 tells us the marginal effect of reducing payroll taxes on the outcome variables after the reform for people under 28 who face a binding minimum wage before but not after the reform. Finally, β_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 β_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 β_6 do not change for any outcome variable while β_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 estimation strategy section. Table 2 shows the results of the first specification restricting the sample from 2009 to 2012, that is, 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 a formal wage earner worker, 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 a formal wage earner after the payroll tax cut increased by 4.9 percentage points, which is equivalent to an increase of 16% in the probability of obtaining a formal wage earner job for people under 28 with respect to people above 28. Interestingly, wages did not change for workers under 28 compared to workers above 28 after the reform, which is consistent with null pass through effects in an economy with a minimum wage that is close to the median wage and where employers have high wage bargaining power (Amodio and De Roux 2024). Furthermore, the probability of being an informal wage earner worker did not decrease which suggest that informality is not only the result of lack of formal employment but also a decision made by the worker, which is consistent with what other studies have found (Ulyssea 2020). The results go in the same direction but in a lower magnitude when we only use the weak implementation of FEL (see table A2 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 has 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 they could have decided to participate in the labor market. Second, informal employment only exist because people cannot find a job in the 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 be 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
$S * Post$	0.0134	0.0390***	0.0495***	0.0020	0.0136
	(0.0208)	(0.0030)	(0.0067)	(0.0031)	(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: This table shows the results of the differences and differences empirical strategy for specification (1) using strong implementation period, 2009-2012. Controls include gender, marital status and years of education. All regressions include time fixed effects and area fixed effects. *** Significant at 1%, ** significant at 5% and * significant at 10%. Standard errors clustered at the city level.

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 labor market where the median wage is below the minimum wage, D_1, and people who face a labor market where the median wage is above the minimum wage, D_2. The probability of participating in the labor force and the probability of being formally employed as a wage earner, increase for both groups. However, the effect from the payroll tax cut is stronger for people who face a labor market where the median wage is above the minimum wage which is the opposite of what we expected. A possible explanation for these results is that labor supply is much more elastic for workers who face labor markets where the median wage is above the minimum wage. We do not find any effect on wages for none of the groups analyzed, which again is 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	0.0101**	0.0150**	-0.0014	0.0140
	(0.0201)	(0.0040)	(0.0061)	(0.0069)	(0.0129)
$S * Post * D_2$	0.0041	0.0541***	0.0750***	-0.0139	-0.0171***
	(0.0173)	(0.0103)	(0.0060)	(0.0082)	(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: This table shows the results of the differences and differences empirical strategy for specification (3). Controls include gender, marital status and years of education. All regressions include time fixed effects and area fixed effects. *** 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* and *proposition 3* seem to be true, while *proposition 2* seems to be partially true. 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 as a wage earner 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. However, if the labor supply is elastic, the payroll tax cut should increase the probability of being a formal wage earner. In addition, the probability of being an informal worker decreases 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 A6 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 A7 in the appendix shows the graph for the coefficients on labor force participation, formal wage earner workers employment, informal wage earners 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
$S * Post * D_1$	0.0075	0.0049	0.0052	0.0049	0.0193
	(0.0238)	(0.0040)	(0.0045)	(0.0086)	(0.0157)
$S * Post * D_2$	0.0015	0.0307**	0.0183	0.0020	0.0035
	(0.0085)	(0.0120)	(0.0173)	(0.0075)	(0.0106)
$S * Post * D_3$	0.0054	0.0550***	0.0842***	-0.0207**	-0.0203***
	(0.0179)	(0.0106)	(0.0061)	(0.0079)	(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

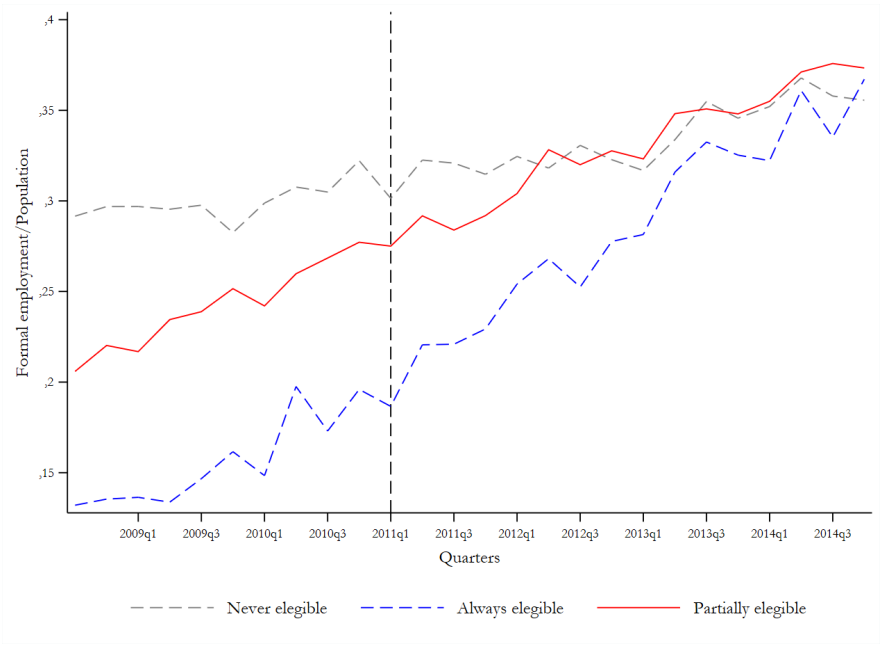
Note: This table shows the results of the differences and differences empirical strategy for specification (5). Controls include gender, marital status and years of education. All regressions include time fixed effects and area fixed effects. *** Significant at 1%, ** significant at 5% and * significant 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 that in any new contract signed after reaching the 28 they were not covered 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 wage earners employment rate experiences a high growth rate after FEL, until it reached a level similar to the wage earners 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 a formal wage earner worker, after the reform with respect to the control group than partially eligible group, which is consistent with what we expected. Always eligible where exposed to the treatment for a longer time period than partially eligible. In particular, for always eligible formal wage earner employment increase by 3.98 percentage points while for partially eligible it increases by 1.40 percentage points, which is equivalent to an increase in the probability of being a formal wage earner worker 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 elegible

Variables	Ln wage	Labor force	Formal Emp	Informal Emp	Self-employed
$S * Post$	0.0037	0.0286***	0.0398***	-0.0040	0.0004
	(0.0158)	(0.0034)	(0.0082)	(0.0042)	(0.0052)
$P * Post$	0.0066	0.0135***	0.0140***	0.0149	0.0140**
	(0.0062)	(0.0034)	(0.0047)	(0.0089)	(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	Yes	Yes	Yes	Yes	Yes
FE Month	Yes	Yes	Yes	Yes	Yes
FE Area	Yes	Yes	Yes	Yes	Yes
Mean of the control group	8.0056	0.8532	0.3127	0.419	0.2826

Note: This table shows the results of the differences and differences empirical strategy for specification (7). Controls include gender, marital status and years of education. All regressions include time fixed effects and area fixed effects. *** Significant al 1%, ** significant al 5% y * significant al 10%. Standard errors clustered at the city level.

Finally, table 6 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. There seems to be an increased in the labor force participation after 2009 for people under 28 which suggest that labor force was increasing in 2010 (see appendix figure A3). However, the lack of effects on the placebo exercises on formal wage earner employment in table 6 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 elegible assuming FEL started in 2009

Variables	Ln wage	Labor force	Formal Emp	Informal Emp	Self-employed
$S * Post$	-0.0020	0.0170**	0.0030	0.0325	0.0231
	(0.0215)	(0.0072)	(0.0153)	(0.0252)	(0.0160)
$P * Post$	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	Yes	Yes	Yes	Yes	Yes
FE Month	Yes	Yes	Yes	Yes	Yes
FE Area	Yes	Yes	Yes	Yes	Yes
Mean of the control group	7.9689	0.7173	0.2263	0.4156	0.3067

Note: This table shows the results of the placebo test, using 2009 as the year of the payroll tax cut. Controls include gender, marital status and years of education. All regressions include time fixed effects and area fixed effects. *** Significant al 1%, ** significant al 5% y * significant al 10%. Standard errors clustered at the city level.

8. 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. 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 a formal wage earner worker after the payroll tax cut increased by 4.9 percentage points, which is equivalent to an increase of 16% in the probability of obtaining a formal wage earner job for people under 28 with respect to people above 28. Interestingly, wages did not change for workers under 28 compared to workers over 28 after the reform, which is consistent with null pass through effects in an economy with a minimum wage that is close to the median wage and where employers have high wage bargaining power.

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 where the median wage is above and below the minimun wage. On the one hand, the reduction of payroll taxes increased the probability of participating in the labor market by 5 percentage points for young people who did not face a binding minimum wage, which suggests that labor supply is highly elastic for this group of people. In addition, formal wage earners employment also increased for these workers, which suggest that firms could have seen the tax reform as an opportunity to formalize workers, which is also reflected in the reduction of informal-

ity rate. On the other hand, young people below 28 who face labor markets where the median wage is far below the minimum wage did not change neither labor force participation nor formal wage earner employment rate compared to young people above 28. We did not find pass through effects.

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. The payroll tax cut can be seen by people outside 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 wage earner jobs, 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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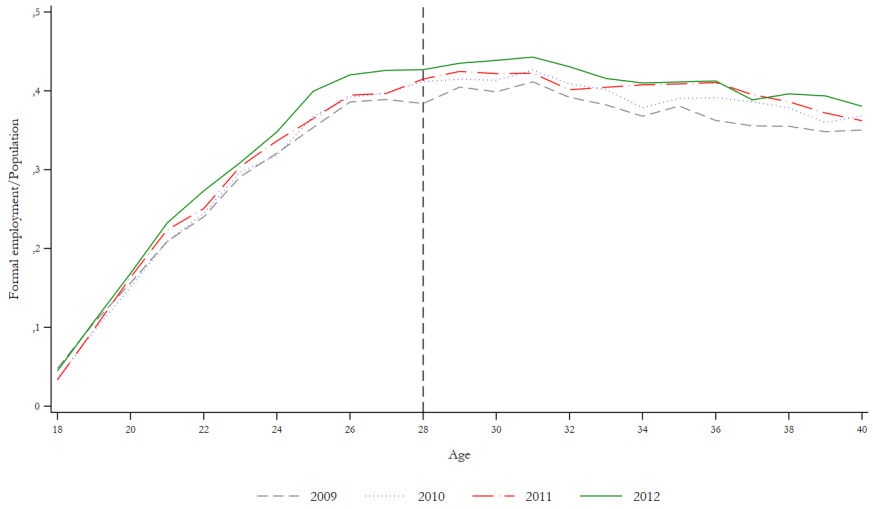
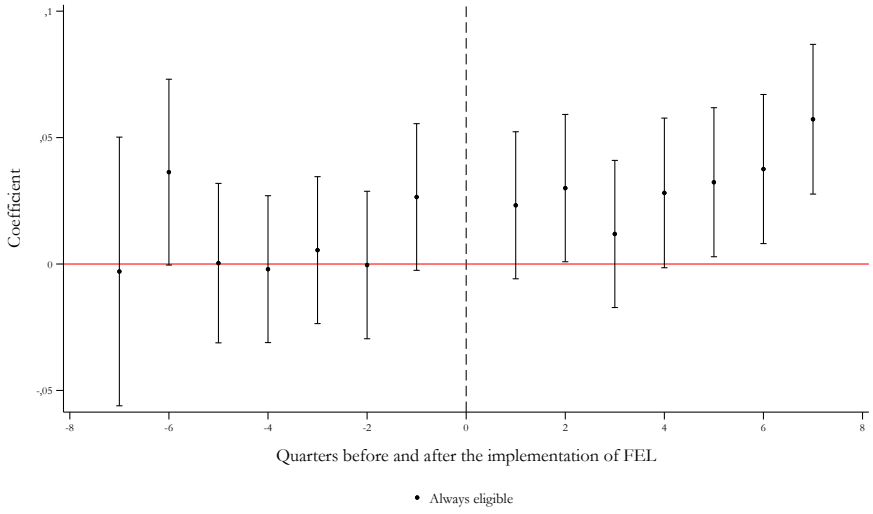
Appendix

Figure A1. Employment rate - Formal sector



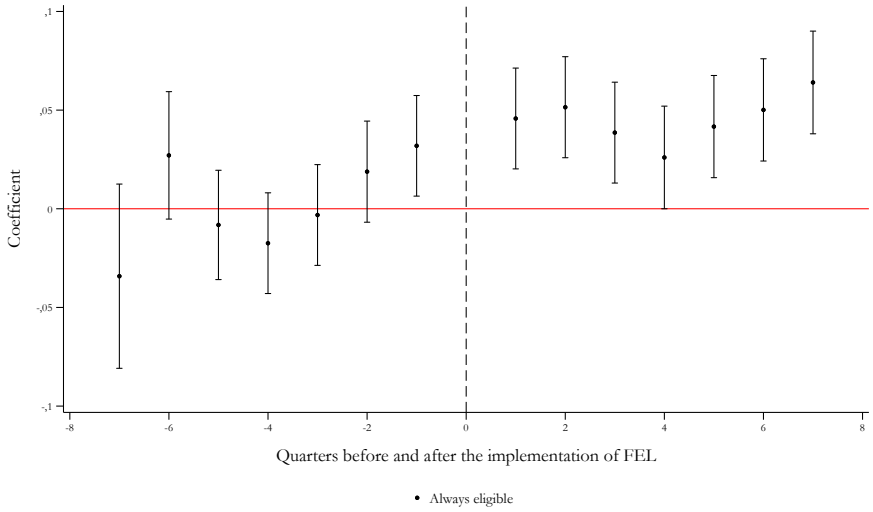
Source: Household survey LIHS.

Figure A2. Formal employment rate



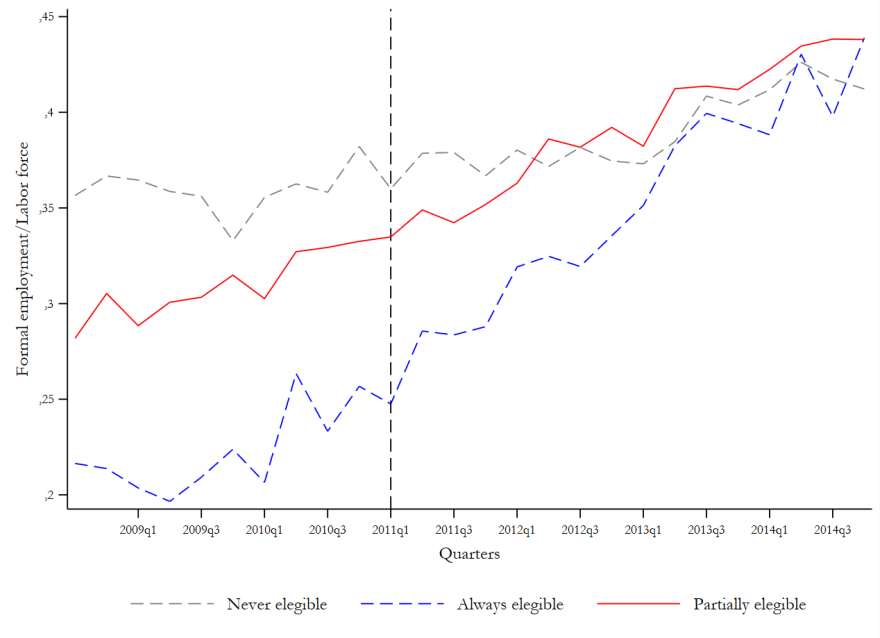
Source: Household survey LHIS.

Figure A3. Labor force participation



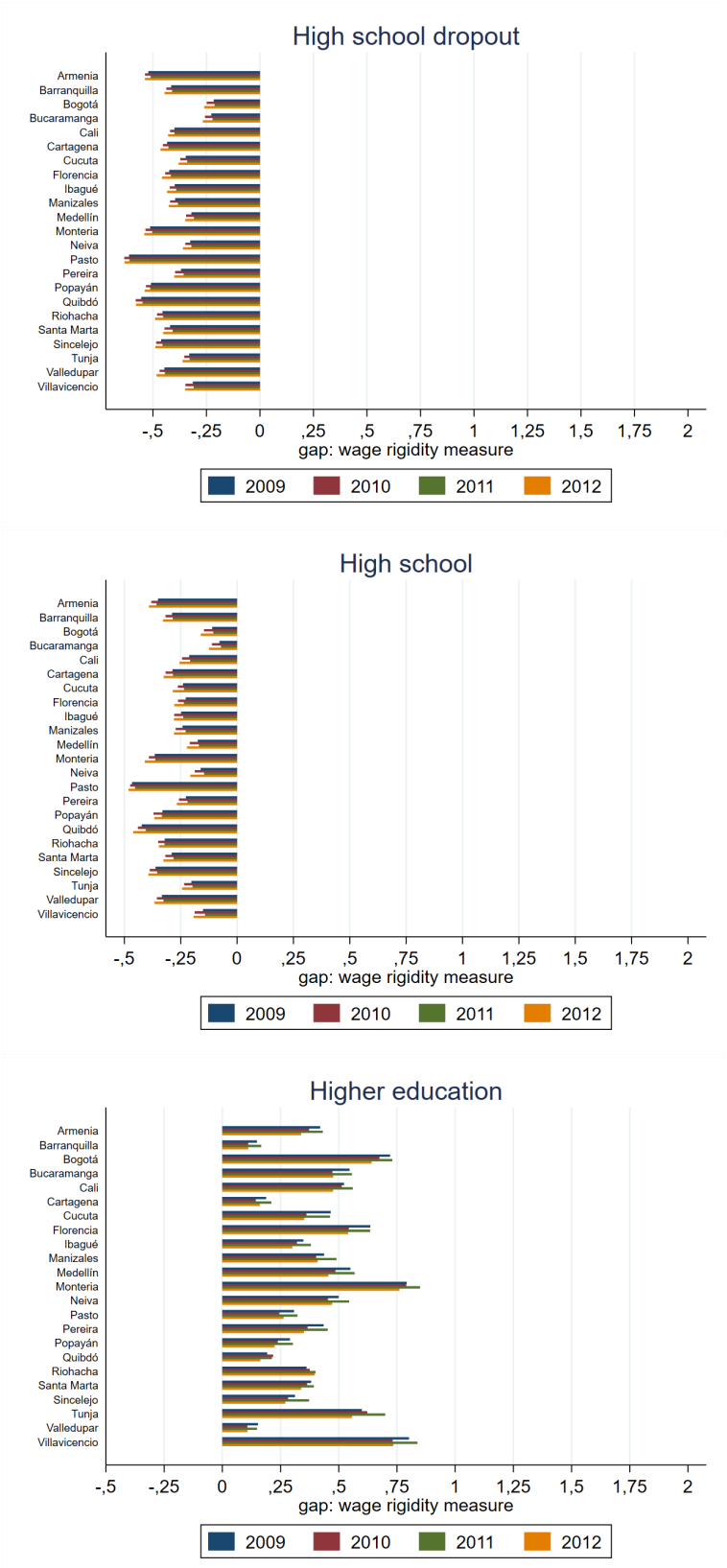
Source: Household survey LHIS.

Figure A4. Formal employment rate



Source: Household survey LHIS.

Figure A5. Measure of wage rigidity for different levels of education in different Colombian cities



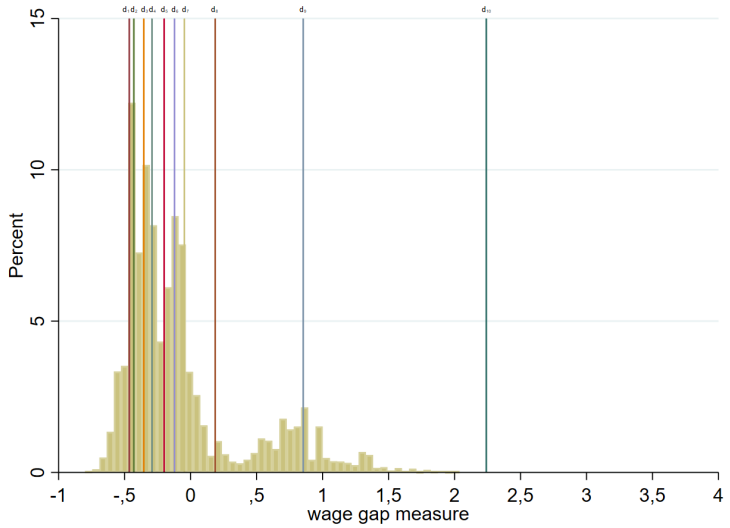
Source: Household survey LIHS.

Table A1. Payroll taxes in Colombia, 2010

	Total% of monthly wage	Employer tax rate	Employee tax rate	Benefits for Worker	Benefits for Other
A. Insurance					
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. Family funds					
Family benefits	4.0	4.0	-	4.0	-
C. Public goods					
SENA/ICBF	5.0	5.0	-	-	5.0
Total	46.0-54.3	38.0-46.3	8.0	39.0-47.3	7.0

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 A6. Distribution of wage gap measure before FEL for people between 24 and 32 years old for different deciles



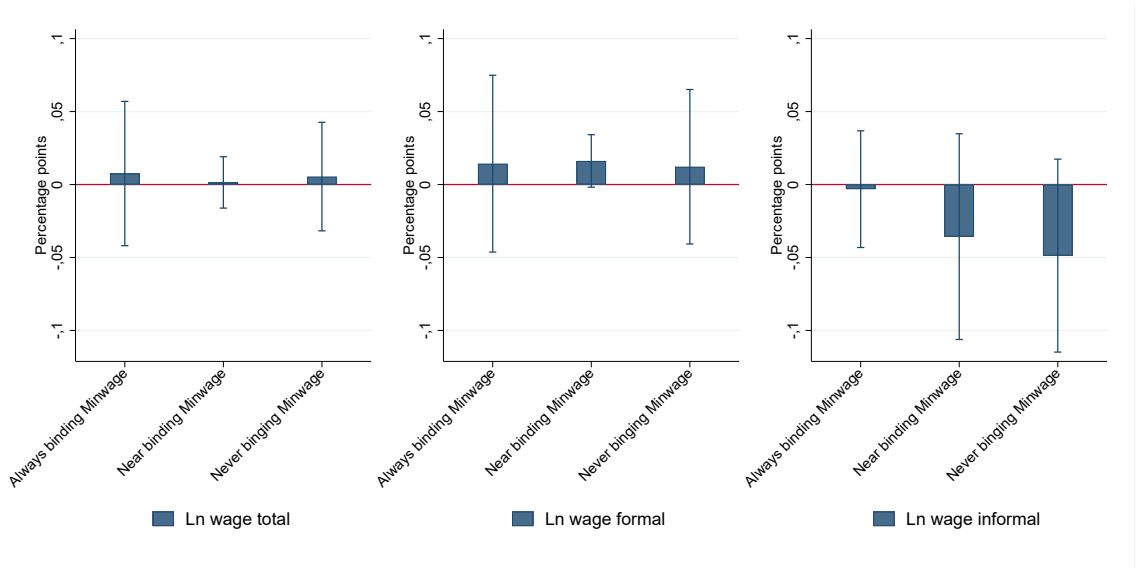
Source: Household survey LIHS.

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
$S * Post$	-0.0061	0.0262***	0.0255***	0.0055	0.0157
	(0.0088)	(0.0074)	(0.0072)	(0.0073)	(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

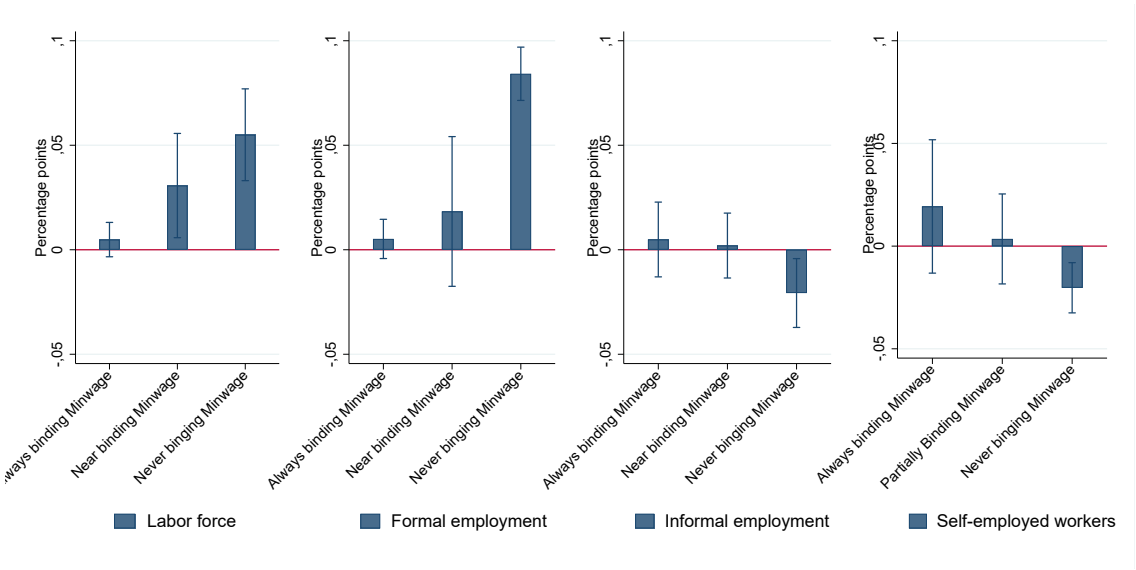
Note: This table shows the results of the differences and differences empirical strategy for specification (1) using only weak implementation period, 2009-2011. Controls include gender, marital status and years of education. All regressions include time fixed effects and area fixed effects. *** Significant at 1%, ** significant at 5% and * significant at 10%. Standard errors clustered at the city level.

Figure A7. 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 A8. 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.