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

Danilo E. Aristizábal G.[1], Eduard F. Martínez G.[2]

June 10, 2021

Abstract

This paper studies the effect on labor market outcomes of a payroll tax cut for new hires young workers under the age of 28 in Colombia. We use differential degrees of 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 have two different treatment groups and use a difference-in-difference model. The effect of reducing payroll taxes is asymmetric for youth who earn below, near and above the minimum wage. Reducing payroll taxes increased the probability of getting formal employment by 8.5% and increased the probability of participating in the labor market by 4% for young people who face labor markets where the median salary is near the minimum wage. However, informality did not decrease. 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 rates (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 job. (Nordstrom, 2004; Gregg and Tominey, 2005). Payroll taxes can worsen youth unemployment. Theoretically, we know that payroll taxes particularly affect those who experience greater wage rigidities (Houseman, 1998; Bell, 1997; Blinder and Choi, 1990; Campbell and Kamlani, 1997). However, we know very little about how prevalent wage rigidities are in young people, which would make them more or less exposed to changes in payroll taxes when it comes to finding employment.

---

[1]Universidad de los Andes. Email: de.aristizabal411@uniandes.edu.co

[2]Universidad de los Andes. Email: ef.martinezg@uniandes.edu.co

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 of a person.

We exploited a reform in Colombia that allows firms who hired new workers under the age of 28 years old and pay all payroll taxes, 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 42 percentage points. 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 a self-employed worker. We adopt a strict definition of labor formality in which a worker is formal if they contribute to a pension fund at the time the survey is carried out (Bernal, 2009).

When there is a connection between the payroll tax and the benefit it brings to the worker, changes in payroll taxes should be reflected, to a greater extent, in changes in wages, with little or no effect on employment. However, if wages are not flexible enough due to a minimum wage in the economy, 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). 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). 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 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 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 people under 28 years old. This article is related to two great 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 young people who face labor markets with high wage rigidity will gain the benefits of a payroll tax cut. 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. 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 will 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 labor supply, that is whether workers find it difficult to move from formal to informal employment. In teh case 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 have an ideal framework to test whether changes in payroll taxes may affect formal employment because we have a context where the minimum wage is binding, we have a very high informal labor market and most of the payroll taxes paid in the formal economy are not valued by formal workers. This article shows that a payroll tax cut increase formal employment for those workers with highest wage rigidities.

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 increased the probability of getting formal employment by 8.5% for young people who face labor markets where the median wage is near the minimum wage. Similarly, labor force participation increased by 4% and informality did not change 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 labor markets where the median wage by educational level is far above the minimum wage. Finally, formal employment did not change for young people who face labor markets where the median wage is far below the minimum wage, while the probability of being an informal worker 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 makes a description of 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

Summers (1989), Lazear (1990), and Gruber and Krueger (1991) developed a theoretical framework to explain the incidence of payroll taxes in the labor market. In this framework, the incidence of such taxes depends on the degree to which they can pass through wages. In addition, payroll taxes may have differential effects on labor market outcomes depending on whether we are talking about formal or informal labor markets, where employers in formal labor markets contribute to payroll taxes while in informal labor markets they do not.

Initially, assume we have an inelastic labor supply and flexible wages. In this case, as it is shown in figure 1, panel a, a reduction in payroll taxes shifts labor demand to the right, and as a consequence wages will increase but employment will not change. However if we would have an elastic labor supply, a payroll tax cut should increase both wages and employment as it is shown in panel b of figure 1.

Figure 1: Effect of payroll tax cut wages and employment
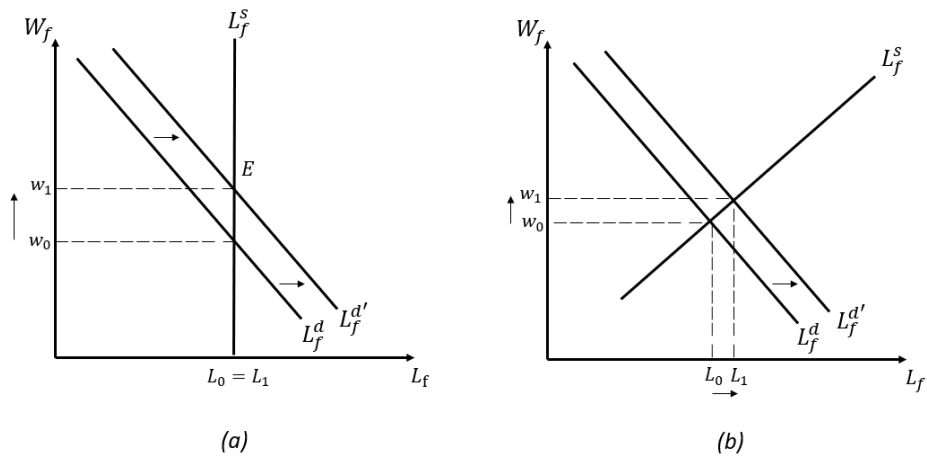
Now, suppose we have a minimum wage in the economy and three different groups of people who face labor markets where the median wage is below, near and above the minimum wage respectively. We assume that all people who face labor markets where the median wage is below the minimum wage work in the informal economy, so they do not pay payroll taxes, while people who face labor markets where the median wage is above the minimum wage work in the formal economy, which means paying all payroll taxes. Finally, people who face labor markets where the median wage is near the minimum wage, some of them work in the formal economy, while others do not. Labor supply who do not work in the formal economy, will go to the informal sector.

A payroll tax cut should increase labor demand in the formal economy because now it is cheaper to hire new workers, especially for those who face labor markets where the minimum wage is binding. Additionally, the increase in the probability of getting formal employment make that informality decrease for people who face labor market where the median wage is near the minimum wage. However, a payroll tax cut may not give enough incentives to hire workers formally, especially those who earn below the minimum wage because of their low productivity, neither workers who earn above the minimum wage because the payroll tax cut may not compensate the high marginal cost of hiring these type of workers formally. First, suppose we have an inelastic labor supply as it is shown in figure 2. In this case, a payroll tax cut will shift labor demand to the right, but the consequences on wages and employment will vary depending whether the workers face labor markets where the minimum wage is binding or not.

Figure 2: Effect of payroll tax cut on wages and employment with inelastic labor supply
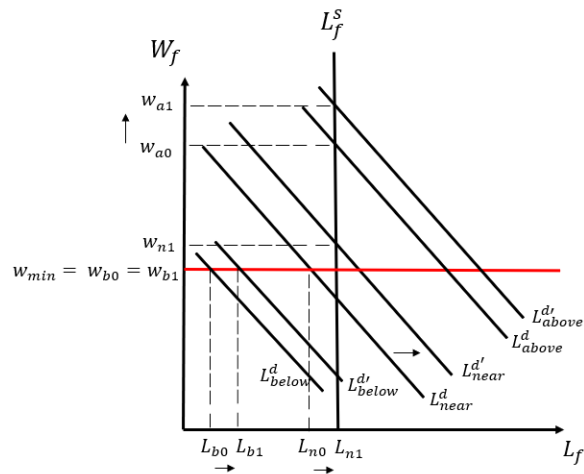
For those people who face labor markets where the median wage is below the minimum wage, the labor demand shift will not change wages in the formal economy for those workers, but probably formal employment may slightly increase for this type of workers. On the other hand, for people who earn above the minimum wage, the payroll tax cut will result in an increase on wages without changing formal employment. Finally for people who face labor markets with high wage rigidities, that is median wage near the minimum wage, the payroll tax cut will increase wages and formal employment.

Now suppose we have an elastic labor supply. In this case, as it shown in figure 3, not only labor demand will shift but also labor supply, so people who face labor markets where the median wage is near to the minimum wage will experience a more pronounced increase in formal employment and probably no change on wages, panel a, while informality for this type of workers should shrink and wages slightly increase. In summary, the effects of a payroll tax will be different depending on whether the minimum wage is binding or not. In particular, a payroll tax cut should increase formal employment, reduce informal employment, and no effect on wages for those workers who face labor markets where the median salary is near minimum wage and will have minor effects on wages and employment for the other two groups.

Figure 3: Effect of payroll tax cut on wages and employment
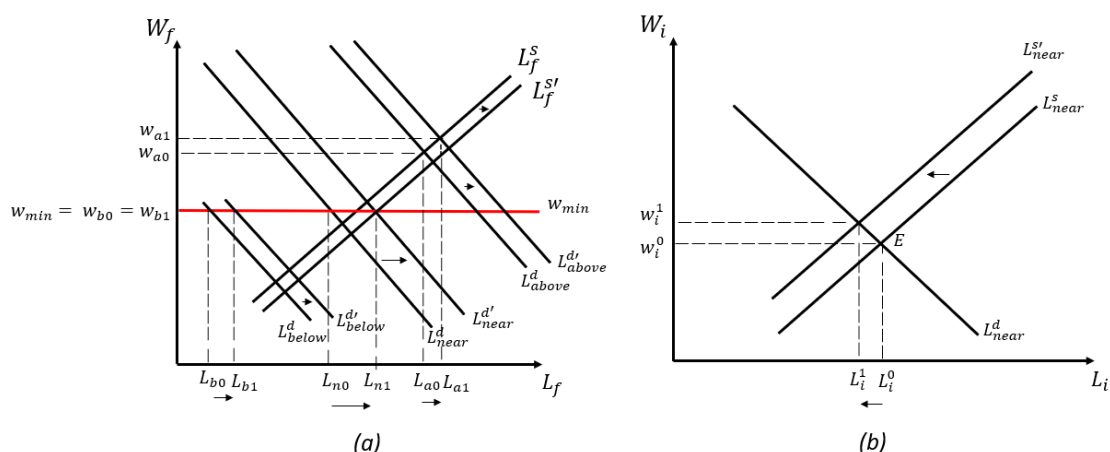
Source: Houseman (1998)

3. Institutional framework

In decemeber 2010, *First Employment Law* (FEL) was issued in Colombia. FEL allowed firms that hired new workers under the age of 28 to discount from the 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: National Learning Service (SENA in Spanish), Colombian Institute of Family Welfare (ICBF in spanish), public health system, and mandated benefits. 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 income statement.

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 goes 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[3]. 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 is available from 2008 to 2021. This survey requests information on the employment conditions of people who make up each household, and general characteristics of the population 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 rates. From figure 4, 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 4 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 a possible effectiveness of the mentioned Law.

Figure 4: Youth unemployment rate
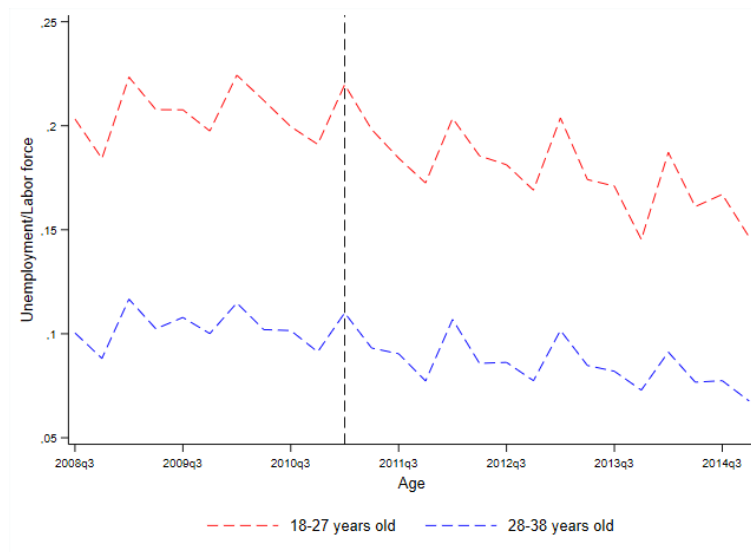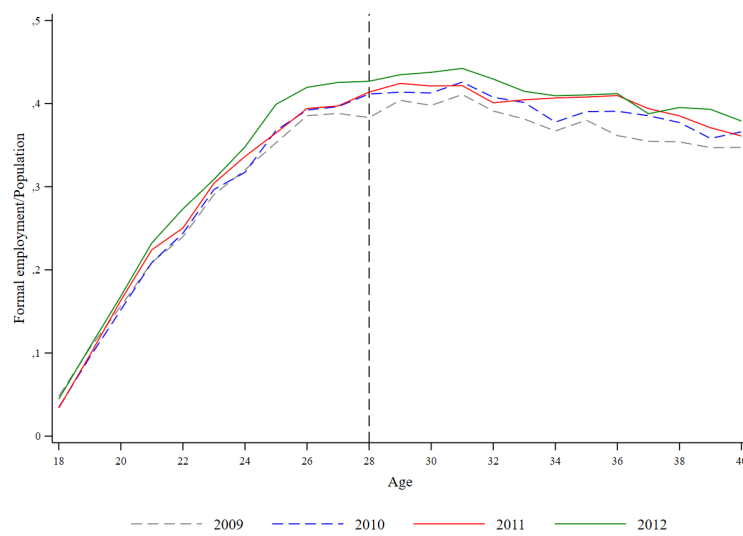

Source: Household survey LIHS.

To analyze the effect of FEL on formal youth employment, we first examined the formal employment rate by age group for two years before and two years after the reform. We adopt a strict

---

[3]Law 1607.

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 in the economy, defined for each age group. Figure 5 shows the occupancy rate of the formal sector for different ages and time periods. First, formal employment rates are an increasing function with age up to age 31, with their minimum being 4% at age 18, and peaking at 38% at age 31, thereafter the formal employment rate has a slight downward slope with respect to age. Second, it is not clear that growth in the formal employment rate is more marked 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.

Figure 5: Employment rate - Formal sector

Source: Household survey LIHS.

On the other hand, in Colombia the minimum wage is highly binding among the young. Figure 6 shows the distribution of log wage per hour for workers between 24 and 32 years old for 2009, 2010, 2011 and 2012. According to this graph, there is a high proportion of colombian young workers that near or less than the minimum wage which makes this country an ideal framework to see the effect of payroll tax cut on formal employment.

9

Figure 6: Distribution of wages per hour for young workers between 24 and 32 years old
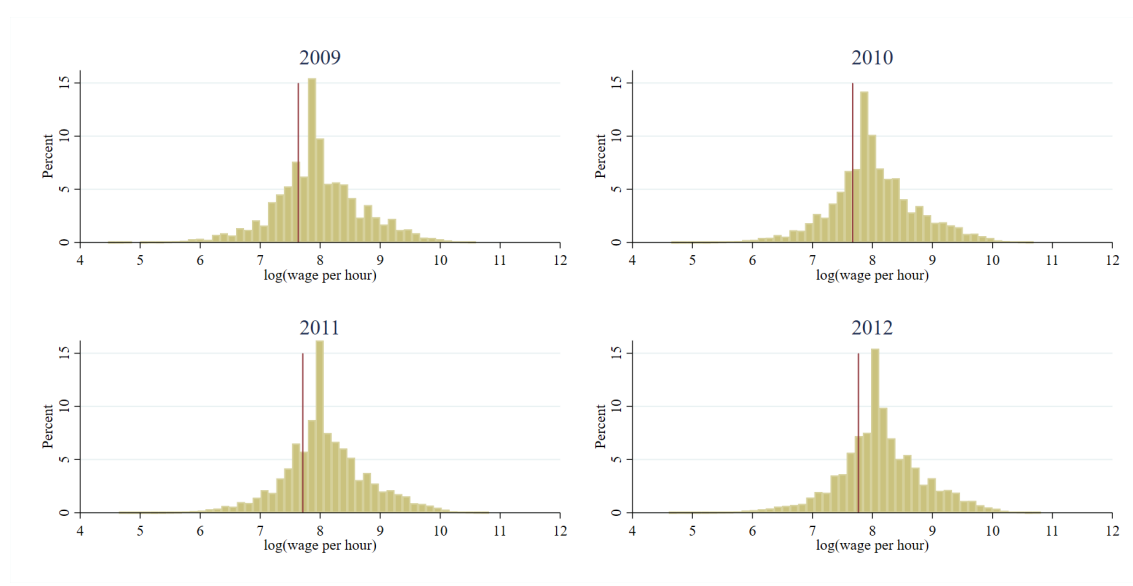
Source: Household survey LIHS.

5. Identification

For all the analyses 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 in order to have comparable groups. 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 over 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 elegible for the treatment, but not 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 control and treatment group before and after the reform for the participation rate in the labor market, employment rate in the formal and informal sectors and self-employed workers. To calculate these rates, we are using working age population instead of the labor force, because labor force is an outcome variable, in other words it is an endogenous variable. Particularly striking is the increase in the formal employment rate after the reform for the treatment group.

Table 1

Average of labor market outcomes before and after First Employment Law

	Control			Treated		
Variable	**2009-2010**	**2011-2012**	**p-value**	**2009-2010**	**2011-2012**	**p-value**
Log hourly wage	8.00	8.14	0.000	7.90	8.05	0.000
Labor force	0.853	0.870	0.000	0.781	0.817	0.000
Formal employment	0.312	0.341	0.000	0.239	0.290	0.000
Informal employment	0.419	0.419	0.414	0.385	0.384	0.699
Self-employed	0.282	0.300	0.000	0.228	0.242	0.000

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 outcomes, without considering the effect of degree of wage rigidities. In the following specification we contrast our treated group against our control group.

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

Where:

- $Y_{im} = $ Work outcome of person i in month m

- 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.

- X_{im}: Controls vector: gender, having a partner, years of schooling.

Five outcomes are considered for an individual i in month m: the logarithm of worker's wage per hour, being part of the labor force, being employed in the formal sector, being employed in the informal sector, and being self-employed. We pull apart self-employed workers to see whether there are differential effects over salaried and non-salaried workers. The coefficient β_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 older and younger 28-year-olds, 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 expanded this strategy to incorporate the effect of nominal wage rigidities. The variable of wage rigidity denoted by gap_{cem} is a measure of the exposure of individuals of city c, with a level of education e, in month m, to wage rigidities and we measure it as the gap in the city in which the individual lives, from the median wage by educational level with respect to the minimum wage in the month m, divided by the minimum wage, in order to see that gap as a percentage of the minimum wage. We use 6 levels of education: having no education, primary education dropout, primary education, high school dropout, high school, and higher education. For clarity, the variable gap_{cem} will be equal to:

$$gap_{cem} = \frac{MedianWage_{cem} - Wagemin_m}{Wagemin_m} \qquad (2)$$

For people who face labor markets where the gap measure is large and negative, a payroll tax cut should not affect them because in those markets the median wage is far below the minimum wage, meaning that we are talking about informal labor markets and therefore almost nobody complies with the payroll taxes. On the other hand, people who face labor markets where the gap measure is small, positive or negative, meaning there is a high wage rigidity, a payroll tax cut should increase labor demand in the formal economy because now the minimum labor cost has been reduced, so the marginal productivity of this type of workers make them compatible with a higher level of formal employment. In addition, labor supply should also increase because now people that before were reluctant to look for a formal job because they found it difficult, now they could interpret the payroll tax cut as an easier way to find a job in the formal economy. Finally, for people who face labor markets were the gap measure is positive and large we expect that the reduction of payroll taxes should almost not affect their labor market outcomes or if it does it should do it in the same direction as the previous group but in a lower magnitude.

Figure 13 in the appendix shows the variability we have in the measure of the wage gap variable defined before for the Colombian municipal heads aggregated in three educational levels for years 2009, 2010, 2011 and 2012. In this graph high school drop out includes all workers without finishing high school. As would be expected, workers with less education experiences few nominal wage rigidities because they earn well below the minimum wage, which suggests they work in the informal sector of the economy. Similarly, those people with higher education in all the main cities of Colombia earn well above the minimum wage, and they also experience low nominal rigidities. Finally, people with only high school education are those who tend to experience greater nominal

wage rigidities as they are the group of the population who face labor markets where the median salary is closest to 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.

Now, figure 7 shows the distribution of the wage gap variable and the cuttoffs for the different deciles for people between 24 and 32 years old and using in the sample only the pre-reform period, since wage gap may have changed after the introduction of FEL. Half of the people employed in the economy faces labor markets where the median wage is below the minimum wage. 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: $D_{1cem} = I_{\{gap_{cem} < decile_4\}}$, $D_{2cem} = I_{\{decile_4 \leq gap_{cem} \leq decile_8\}}$, and $D_{3cem} = I_{\{gap_{cem} > decile_8\}}$. The first group is the people who face labor markets where the median wage is far below the minimum wage, the second group represents the people that face labor markets where the median is near the minimum wage, and the third group is the people who face labor markets where the median wage is far above the minimum wage.

Figure 7: Distribution of wage gap measure before FEL for people between 24 and 32 years old
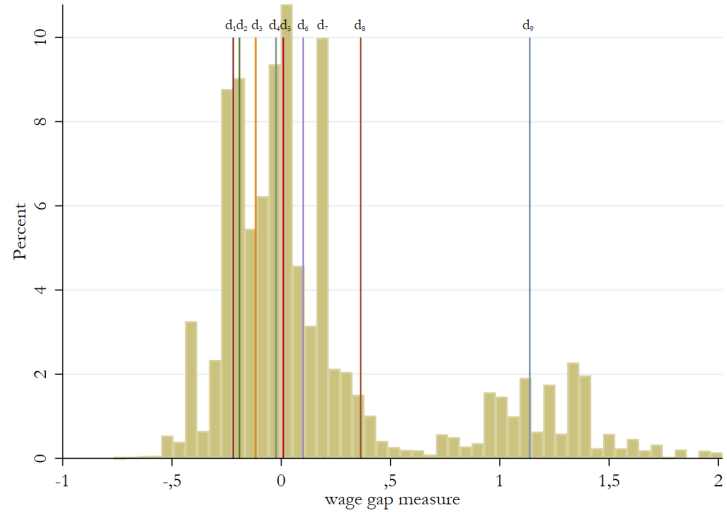
Source: Household survey LIHS.

Thus, the main equation to be estimated is an expanded version of the previous equation, which includes an interaction of the treatment with the dummy variables D_{cem} as follows:

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

$$(3)$$

13

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

$$\beta^{DiD} = \begin{cases} \beta_6, & if \ \ gap < decile_4; \\ \beta_7, & if \ \ decile_4 \leq gap \leq decile_8; \\ \beta_8, & if \ \ gap > decile_8; \end{cases} \tag{4}$$

From equation (3), β_6 tells us the marginal effect of reducing payroll taxes on the outcome variables after the reform for the treated who face labor markets where the median wage is far below the minimum wage. The coefficient β_7 tells us the marginal effect of reducing payroll taxes on the outcome variables after the reform for the treated who face labor markets where the median wage is near the minimum wage. Finally, β_8 captures the effect of a payroll tax cut on outcome variables for those who face labor markets where the median wage is far above the minimum wage. We expect β_7 is positive and statistically significant for labor force participation and formal 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 and β_8 do not change much for the outcome variables since groups far below and far above the minimum wage should not be affected by the payroll tax cut.

6. Results

In this section we present the results of specification (1) and (3) 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 reduction of payroll taxes had a positive and significant effect on formal employment but did not change wages. In particular, the reduction in payroll taxes increased the probability of obtaining formal employment by 3.8 percentage points, which is equivalent to an increase of 12% in the probability of obtaining formal employment for the treated with respect to control group. In the same direction, labor force participation increase by 2.78 percentage points, that is an increase of 3% in the probability of participating in the labor market. Interestingly, wages did not change for the treated compared to the control group after the reform, which is consistent with small or null pass through effects. However, informal employment did not decrease. The results go in the same direction but in a lower magnitude when we use the weak implementation of FEL (see table A1 in the appendix). Putting this pieces together, the increase in formal employment may have driven by an increase in labor force participation rather than from a reduction in informality.

14

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
$S * Post$	0.0017	0.0278***	0.0380***	-0.0034	0.0005
	(0.0155)	(0.0036)	(0.0082)	(0.0043)	(0.0053)
Observations	168,373	258,321	258,321	258,321	258,321
R-squared	0.3225	0.0958	0.1734	0.0900	0.0328
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: *** Significant at 1%, ** significant at 5% and * significant at 10%. Standard errors clustered at the city level.

Now, Table 3 presents the results when we take into account the different degrees of wage gap descibed in specification (3). In this case the coefficients of interest are: β_6, β_7, and β_8. As expected, formal employment increase by 2.63 percentage points for people who epxerience labor markets with high wage rigidities, meaning an increase of 8.5% of getting a formal employment for the treated compared to the control group after the implementation of FEL. Similarly, labor force participation increase by 3.63 percentage points for the same group, which means an increase of 4% in the probability of participating in the labor market for the treated compared to the control group after the reform for people who face labor markets where the median wage was near the minimum wage. We do not find any effect on wages for none of the groups analyzed, which is consistent with null pass through effects.

Table 3

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
$S * Post * D_1$	-0.0358*	-0.0048	-0.0105	0.0342**	0.0167**
	(0.0207)	(0.0133)	(0.0067)	(0.0136)	(0.0061)
$S * Post * D_2$	0.0009	0.0363***	0.0263***	0.0062	0.0078
	(0.0180)	(0.0041)	(0.0055)	(0.0052)	(0.0114)
$S * Post * D_3$	-0.0004	-0.0060	-0.0114	-0.0005	-0.0173*
	(0.0220)	(0.0039)	(0.0074)	(0.0050)	(0.0089)
Observations	154,052	234,104	234,104	234,104	234,104
R-squared	0.3635	0.1269	0.5466	0.2188	0.0578
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: *** Significant at 1%, ** significant at 5% and * significant at 10%. Standard errors clustered at the city level.

Figure 8 shows the changes on wages after the implementation of FEL separating formal and informal labor markets, in none of them seem to be a change after FEL. Finally, figure 9 shows the differences in differences estimators for the composition of employment for the three different groups presented in table 3. From this graph we observe that the effect on wages, labor force, formal and informal occupation is asymmetric. It is young people who faces labor markets where the median wage is near the minimum wage that have positive effects on labor force participation and formal occupation as a result of a payroll tax cut. On the other hand, the probability of getting a formal job do not change for young people who face labor markets where the median wage is far below and far above the the minimum wage, which is consistent with our theoretical framework. However, informality did not change for none of the groups except the people who face labor markets where the median wage is far below the minimum wage, which is reflected in the increase in self-employed workers. In Colombia, most of self-employed workers are not affiliated to a pension fund which may explain the increase in informality for this group of people.

Figure 8: Marginal effects of payroll tax cut on labor market variables for workers earning below, near and above the minimum wage, 24 months before and after FEL implementation
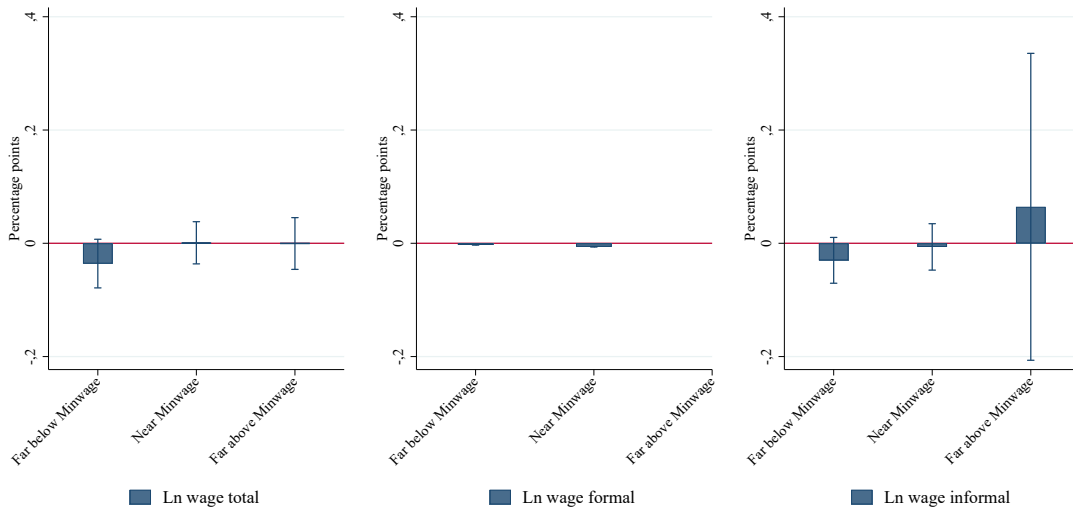
Note: Far below the minimum wage are cities where the distance of the median wage by level of education in month m and the minimum wage is below the 4th decile. Near the minimum wage are cities where the distance of the median wage by level of education in month m and the minimum wage is between the 4th decile and the 8th decile. Far above the minimum wage are cities where the distance of the median wage by level of education in month m and the minimum wage is in decile 8th or more.

Figure 9: Marginal effects of payroll tax cut on labor market variables for workers earning below, near and above the minimum wage, 24 months before and after FEL implementation

17
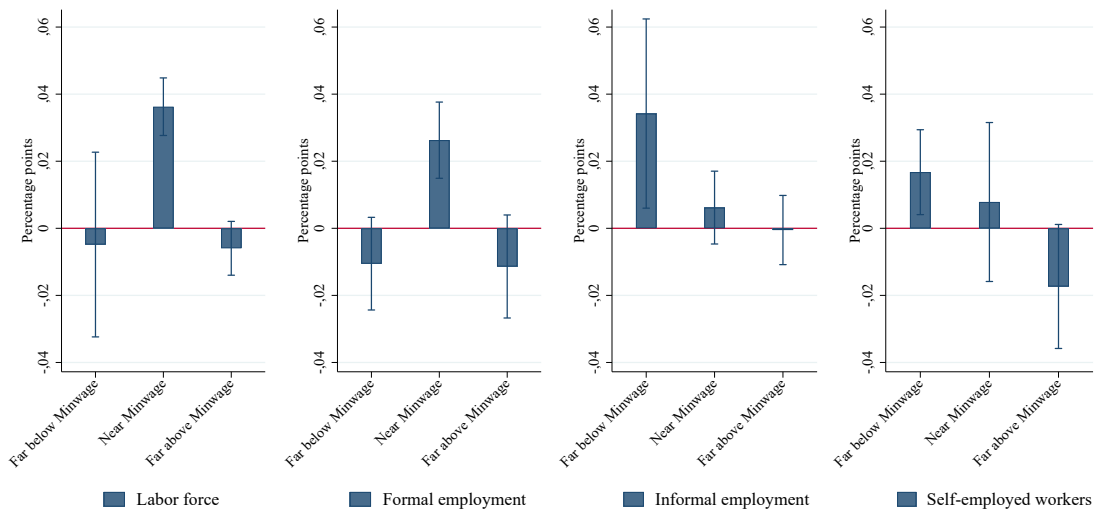
7. Extensions and placebo test

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 will classify young people eligible by the FEL into two different groups of treatment: always eligible and partially eligible. In the group of partially eligible we have 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, due to in any new contract signed after reaching that age 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 he was under 28 years of age, the benefits for the employer could be extended for a maximum of two years.

Figure 10: Employment rate - Formal sector
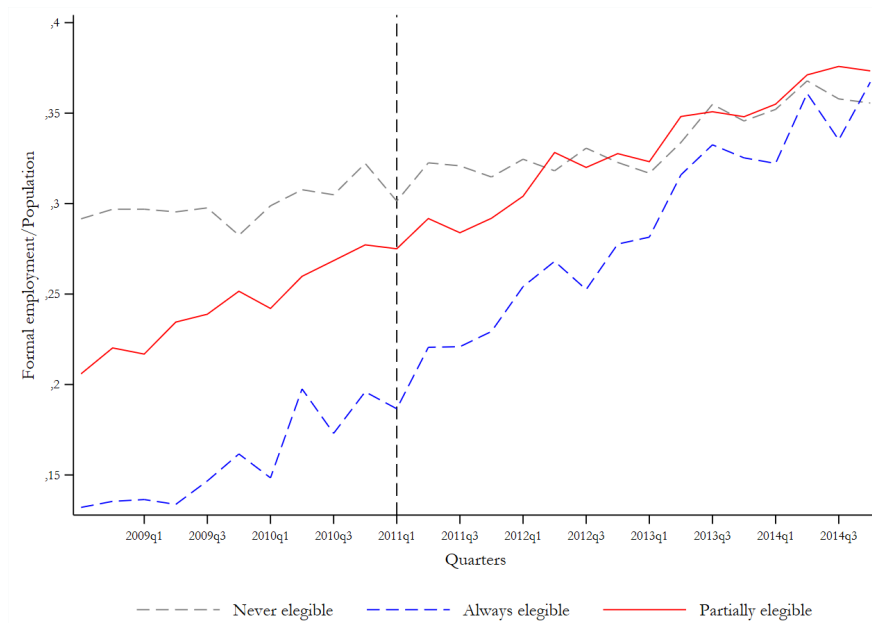
Source: Household survey LIHS.

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.

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:

$$Y_{im} = \alpha_m + \gamma_c + \beta_1 S_{im} + \beta_2 P_{im} + \beta_3 S_{im} Post_m + \beta_4 P_{im} Post_m + \beta_5 X_{im} + \epsilon_{im} \qquad (5)$$

We present the results of this specification in table 4. Always eligible have a greater probability of being formally employed than partially eligible after the reform, which is consistent with what we expected. Always eligible where exposed to the treatment for a greater time period than partially eligible. 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 4
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	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 al 1%, ** significant al 5% y * significant al 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 2009 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 in table 5 reinforces the soundness of the identification strategy for capturing the effect of FEL on formal employment and labor force participation for always eligible and partially eligible.

Table 5

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
$S*Post$	0.0021	0.0109	-0.0045	0.0296	0.0184
	(0.0276)	(0.0101)	(0.0178)	(0.0258)	(0.0168)
$P*Post$	0.0003	0.0083*	-0.0069	0.0204	0.0264
	(0.0100)	(0.0043)	(0.0115)	(0.0186)	(0.0195)
Observations	80,726	123,235	123,235	123,235	123,235
R-squared	0.3331	0.1006	0.1823	0.0947	0.0334
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 al 1%, ** significant al 5% y * significant al 10%. Standard errors clustered at the city level.

8. Cost and benefits

By March 31st 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, since we do not have access to the administrative data yet, according to the National Income Tax Institution (DIAN) these firms discount from their annual income tax an amount equivalent to USD 175 milion for all the benefits comtemplated in FEL (2012, DIAN).

9. Conclusions

In this article we evaluate the effect of payroll tax cut on labor market outcomes for people under 28 years old. 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 far below, near, and far above the minimum wage. On one hand, the reduction of payroll taxes increased the probability of getting formal employment by 8.5% for young people who face labor markets where the median wage is near the minimum wage. Similarly, labor force participation increased by 4% and informality did not change 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 labor markets where the median wage by educational level is far above the minimum wage. Finally, formal employment did not change for young people who face labor markets where the median wage is far below the minimum wage, while the probability of being an informal worker increased.

In conclusion, rather than reducing informality, the reduction of payroll taxes increased formal employment via an increase in youth labor participation for people who face labor markets where the minimum wage is highly binding.

References

Almeida, R. and Carneiro, P. (2012). Enforcement of Labor Regulation and Informality. *American Economic Journal: Applied Economics*, 4(3): 64-89.

Bell, L. (1997). The impact of minimum wages in Mexico and Colombia. *Journal of Labor Economics*, 15(3): 102135.

Bernal, R. (2009). The Informal Labor Market in Colombia: Identification and Characterization. *Desarrollo y Sociedad*, 145-208.

Bernal, R., Eslava, M., Melndez, M. and Pinzn A. (2017). Switching from Payroll Taxes to Corporate Income Taxes: Firms Employment and Wages after the 2012 Colombian Tax Reform. *Economia: Journal of the Latin American and Caribbean Economic Association*, 18(1): 41-74.

Blanchard, O. and Wolfers, J. (2001). The Role of Shocks and Institutions in the Rise of European Unemployment: the Aggregate Evidence. *The Economic Journal*, 110(462): 1-33.

Blinder, A., and Choi, D. (1990). A Shred of Evidence on Theories of Wage Stickiness. *Quarterly Journal of Economics*, 105(4): 100315.

Campbell, C. and Kamlani, K. (1997). The Reasons for Wage Rigidity: Evidence from a Survey of Firms.*Quarterly Journal of Economics*, 112(3): 759-789.

Cruces, G. Galiani, S. and Kidyba, S. (2010). Payroll taxes, wages and employment: Identification through policy changes. *Labour Economics*, 17(4):743 749.

DIAN, Coordinacin de Estudios Econmicos (2012). Primer informe sobre la aplicacin de la Ley 1429 de 2010, Cifras y estimacin del Costo fiscal ao gravable 2011.

Egebark, J., and Kaunitz, N. (2014). Do Payroll Tax Cuts Raise Youth Employment? Institute for Evaluation of Labour Market and Education Policy Working Paper 2013:27.

Egebark, J., and Kaunitz, N. (2018). Payroll Taxes and Youth Labor Demand. *Labour Economics* 55: 16377.

Gregg, P. and Tominey, E. (2005). The wage scar from male youth unemployment. *Labour Economics*, 12(4): 487-509.

Gruber, J. (1997). The Incidence of Payroll Taxation: Evidence from Chile. *Journal of Labor Economics*, 15(3): 73-100.

Gruber, J. (2000). Payroll taxation, employer mandates, and the labor market. *Employee benefits and labor markets in Canada and the United States*. Pags. 183-233.

Gruber, J. and Krueger, A. (1991). The Incidence of Mandated Employer-Provided Insurance: Lessons from Workers' Compensation Insurance. *Tax Policy and the Economy*, pp. 111-144.

Heckman, J. and Pags, C. (2004). Introduction. In: Heckman J, Pags C (ed) Law and Employment: Lessons from Latin America and the Caribbean. University of Chicago Press, Chicago.

Houseman, S. (1998). The Effects of Employer Mandates. In Generating Jobs: How to Increase Demand for Less-Skilled Workers, edited by Richard B. Freeman, and Peter Gottschalk. New York: Russell Sage Foundation, pp. 154-191.

Katz, L. (1998). Wage Subsidies for the Disadvantaged. In: Freeman RB, Gottschalk P Generating Jobs. New York: Russell Sage Foundation. pp. 21-53.

Kluve, J. et al. (2016). Do Youth Employment Programs Improve Labor Market Outcomes? A Systematic Review. IZA Discussion Paper No. 10263.

Kugler, A., Jimeno, J. and Hernanz, V. (2002). Employment Consequences of Restrictive Permanent Contracts: Evidence from Spanish Labor Market Reforms. IZA Discussion Paper No. 657.

Kugler, A., Kugler, M. (2009). Labor Markets Effects of Payroll Taxes in Developing Countries: Evidence from Colombia. *Economic Development and Cultural Change*, 57(2): 335-358.

Kugler, A., Kugler, M. and Herrera-Prada, L. (2017). Do Payroll Tax Breaks Stimulate Formality? Evidence from Colombia's Reform. *Economia: Journal of the Latin American and Caribbean Economic Association*, 18(1): 3-40.

Lazear, E. (1990). Job Security Provisions and Employment. *The Quarterly Journal of Economics*, 105(3): 699-726.

Maloney, W. (2004). Informality Revisited. *World Development*, 32(7): 1159-1178.

MinTrabajo (2012). Abec de la Ley de Formalizacin y Generacin de Empleo.

Nordstrom, O. (2011). Scarring Effects of the First Labor Market Experience. *IZA Discussion Paper No. 5565*.

International Labor Organization (2018). Panorama Laboral 2018 Amrica Latina y el Caribe.

Saez, E., Schoefer, B. and Seim D. (2019). Payroll Taxes, Firm Behavior, and Rent Sharing: Evidence from a Young Workers' Tax Cut in Sweden. *American Economic Review*, 109(5): 1717-1763.
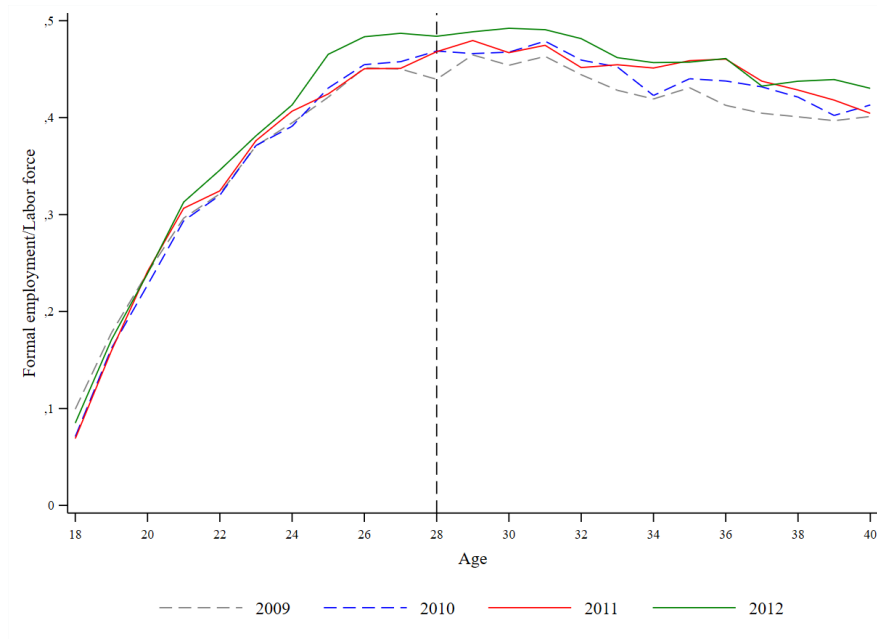
Skedinger, P. (2014). Effects of Payroll Tax Cuts for Young Workers. *IFN Working Paper*, 1031.

Summers, L. (1989). Some Simple Economics of Mandated Benefits. *The American Economic Review*, 79(2): 177-183.

Appendix
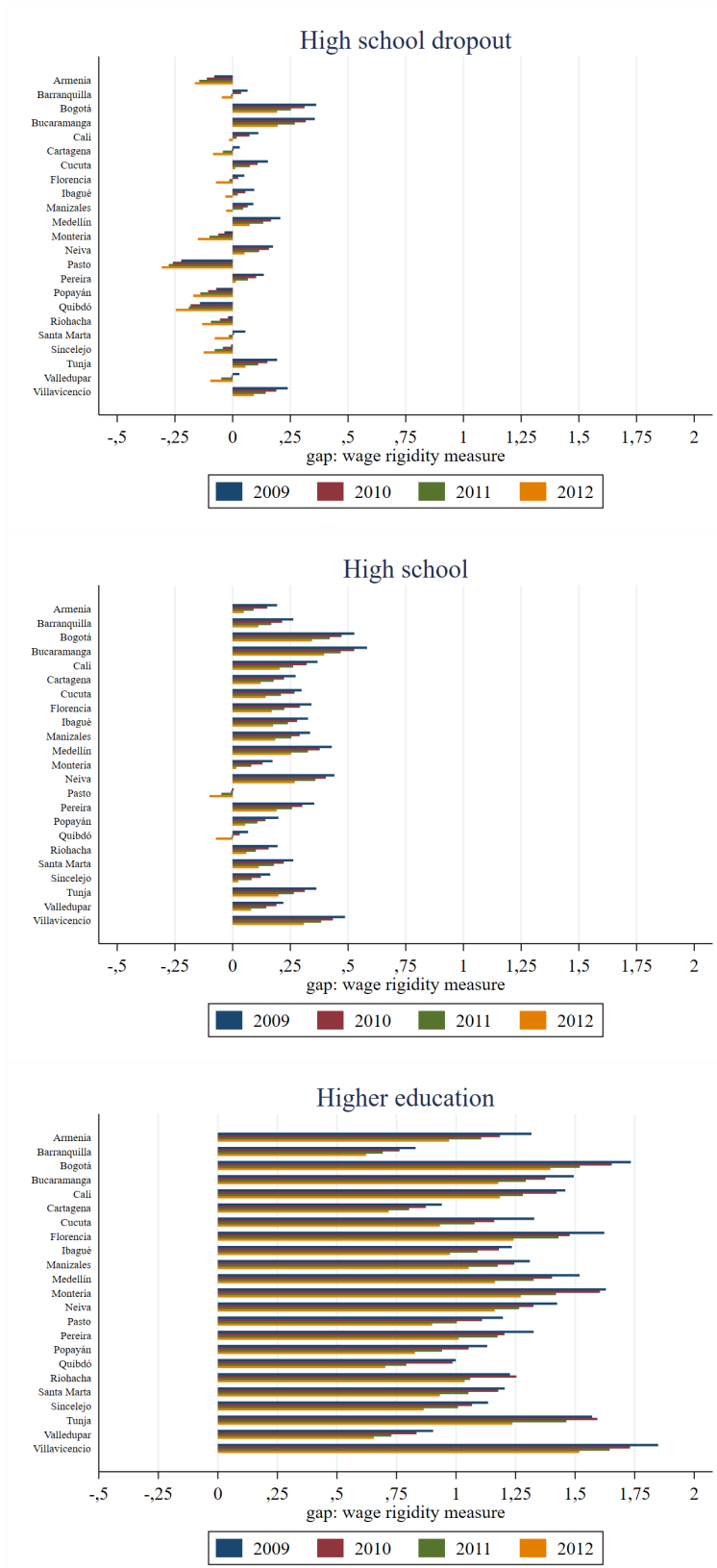
Figure 11: Formal employment rate

Figure 12: Formal employment rate

Figure 13: Measure of wage rigidity for different levels of education in different Colombian cities

Source: Household survey LIHS.

Table A1

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
$S * Post$	-0.0250**	0.0222***	0.0228***	0.0032	0.0014
	(0.0104)	(0.0069)	(0.0080)	(0.0053)	(0.0090)
Observations	85,377	130,960	130,960	130,960	130,960
R-squared	0.3249	0.0974	0.1774	0.0915	0.0324
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: *** Significant at 1%, ** significant at 5% and * significant at 10%. Standard errors clustered at the city level.