Borradores de ECONOMÍA

The Heterogeneous Effect of Minimum Wage on Labor Market Flows in Colombia

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No. 1213
2022

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The Heterogeneous Effect of Minimum Wage on Labor Market Flows in Colombia♦

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Abstract

We provide evidence of the negative effect of the minimum wage on labor market flows, such as job creation, job destruction, hiring, and separations in Colombia. Depicting firms' minimum wage (MW) compliance cost, we find evidence of an adverse effect of increases on MW compliance cost on employment. This negative effect is explained mainly by a reduction in job creation and hiring rate and the rise in job destruction and separations. In contrast to the evidence for developed economies, our results are in line with the predictions of the standard search model. We also explore this differential effect by firm size and age. We found that an increase in the MW compliance cost has relatively critical negative impacts on small and medium-sized firms (with less than 250 employees); and new and young firms (lower than six years old).

JEL *Clasification*: J08, J21, J23, J30, J63, E24, L25

***Keywords*:** minimum wage compliance cost, job destruction, job creation, worker and job reallocation, churning, firms's size, firm's age, and young workers.

♦ All remaining mistakes are our own. The authors are researchers of the Labor Market Group Analysis -Gamla- from the Office for Monetary Policy and Economic Information at the Central Bank of Colombia. Corresponding author: lflorefl@banrep.gov.co

Efectos heterogéneos del salario mínimo en los flujos del mercado laboral Colombiano[♦]

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Resumen

Este paper presenta evidencia del efecto del salario mínimo sobre flujos del mercado laboral colombiano: la tasa de creación, de destrucción, las contrataciones, separaciones y el nivel de empleo. Usando una medida del costo de cumplimiento (CC) del salario mínimo a nivel de firma, encontramos que incrementos en el costo de cumplimiento tienen efectos negativos en el nivel de empleo. Este efecto es explicado por una reducción en la tasa de creación y contratación, además, de un aumento en la tasa de destrucción y separación de las firmas. En contraste con la evidencia encontrada en los países desarrollados, nuestros resultados van en línea con la predicción de los modelos de desempleo de equilibrio (o modelos de búsqueda). Adicionalmente, se exploran los efectos diferenciales del CC por tamaño y edad de la firma. Los resultados indican que un incremento en el CC tiene un efecto negativo importante en las empresas de tamaño pequeño y mediano (con menos de 250 empleados), y en las empresas nuevas y jóvenes (menores de 6 años).

***Clasificación JEL*:** J08, J21, J23, J30, J63, E24, L25

***Palabras claves*:** Costo de cumplimiento del salario mínimo, tasa de destrucción, tasa de creación, reasignación de trabajadores y trabajos, edad y tamaño de la firma.

[♦] Todos los errores son responsabilidad de los autores. Los autores son investigadores del Grupo de Análisis del Mercado Laboral –Gamla- de la Subgerencia de Política Monetaria e Información Económica del Banco de la Republica. Autor corresponsal: lflorefl@banrep.gov.co

1. Introduction

One of the most salient developments in contemporary applied labor economics is the study of labor market dynamics. Literature on labor dynamics studies workers and job flows in its more empirical component. On the one hand, worker flows are hires and separations of workers from existing firms; on the other hand, job flows are the creation and destruction of job positions by these firms. The study of the worker and job flows goes beyond the traditional aggregates as employment levels or aggregate employment. The labor flows allow decomposing changes in employment levels; they represent the mechanisms of how workers and firms interact at micro levels and contribute to the traditional labor market stocks (Davis and Haltiwanger, 1992; Davis, Faberman, and Haltiwanger, 2006; Hyatt and Spletzer, 2013; Davis, Haltiwanger, and Schuh, 1996a,b).[1]

Even though the effects of MW on employment have been amply studied, this topic remains highly controversial; there is not a real consensus on the negative effects of this policy in the literature on labor economics[2]. There is a first wave in the literature, based on traditional macro econometrics methods, which was prominent in its findings of adverse effects of increments in MW[3]. The second wave of literature on WM effects mainly focused on using quasi-experiments it is characterized by the finding of a null effect or even positive effect of the MW on employment. For this set of studies, the cost of exploiting exogenous sources of variations comes from the fact that effects are identified for particular populations, usually the fast food industry in specific jurisdictions of the United States (Card and Krueger, 1994; 1995; 2000; Card, 1992a; 1992b; Katz and Krueger, 1992; Cenzig et al., 2018). For these and other reasons, Neumark and Wascher (2000) cast doubts on some of the nule findings.[4]

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[1] See Flórez, Morales, Medina, and Lobo (2020); Morales, Hermida, and Dávalos (2019) for the case of Colombia.

[2] See for instance Welch, 1974; Mattila, 1978; and Brown, Gilroy and Kohen,1982; Card, 1992a; 1992b; and Card and Krueger, 1994; 1995; Neumark and Wascher, 2008; Neumark, 2018; Cenzig, Dube, Lindner and Zipperer, 2018, among others.

[3] For a review, see Brown Gilroy and Kohen, 1982.

[4] In line with these conclusions, Neumark and Washer (2008, chapter 3), and Neumark (2018, p.4) asserts that, according to the evidence, the minimum wage has adverse effects on employment. This conclusion is based on studies about economies as diverse as Canada, Colombia, Costa Rica, Mexico, Portugal, The United Kingdom, and the United States. Meta-analyses conducted by Doucouliagos and Stanley (2009) found a negligible effect of the minimum wage on teenage employment in the United States. In this strand of the literature, De linde Leonard, Stanley, and Doucouliagos (2014) reported that the minimum wage had no significant effect on employment in the United Kingdom. The same conclusion was reached by Belman and Wolfson (2014, chapter

The most recent trend in the literature is comprised of studies that use panel data of either individuals or firms. In the former case, the effect is identified by comparing individual affected or not by the policy, given they are in different districts or different percentiles of the wage distribution.[5] Some of these studies show minor adverse employment effects or no significant effect. In the case of firm panels, some studies use the compliance cost associated with increments of the minimum wage (Hirsch, Kaufman, and Zelenska, 2015).

The study of the effects of minimum wage can be benefitted substantially by adopting the perspective of labor flows. In general, almost all economic literature on the impacts of MW policy has focused on employment levels or the distribution of wages. All literature on labor market flows remarks that underlying forces determine the traditional employment level stock. Worker and job flows are the decomposition of changes in employment levels; therefore, identifying the effect of labor market policies on these flows allows disentangling the magnitude of the underlying forces that govern the changes in the employment stocks. Furthermore, an analysis based on labor market flows would allow identifying how the effects of a given policy on jobs creation or destruction depict the observed behavior of the employment stock. Therefore, the effect of MW can be decomposed, first, by its effect on job movements throughout its effect on job creation and destruction, and second, by the worker's movements throughout its effects on hires and separations. A study of the effects of the MW on all labor market flows might give a comprehensive portrait of the channels through which MW affects employment levels.

However, despite the tremendous literature on the effect of MW on employment, very few studies explore the effect of the MW on labor flows. Some of the few examples of this approach are Dube, Lester and Reich (2016), Gittings and Schmutte (2016) for United States, Brochu and Green (2013) for Canada, Portugal and Cardoso (2006) for Portugal and more recently Bossler and Gerner, 2020 for Germany. These studies are built over the MW literature by adopting a more comprehensive approach to the effects of MW on employment,

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4). However, Bruttel (2019) has extracted mixed results from different papers for Germany since the introduction of a statutory minimum wage in 2015.

[5] Neumark and Wascher, 2004a; 2004b; Neumark, Schweitzer, and Wascher, 2004; Neumark, Cunningham, and Siga, 2006; Yuen, 2003; Campolieti, Fang and Gunderson, 2005a; 2005b; Burkhauser, Couch, and Wittenburg, 2000a; 2000b; Neumark and Wascher, 2008; Sabia 2009; Giuliano, 2013; Campos, Esquivel and Santillán, 2017; Nguyen, 2017; Dube, Lester, and Reich, 2010; Bossler and Gerner, 2020; Georgiadis, Kaplanis, Monastiriotis, 2020; Manning, 2021

identifying the channels through the labor flows. More specifically, in the case of Dube, et al. (2016) and Brochu and Green (2013), the authors identify the effect of changes in MW on worker flows: hires, separations, and turnover rates for the most affected population (teens and restaurant workers), exploiting the state variation of the MW. The authors generally found a strong response in worker's flows (reduction on hires and separations) but a zero effect on employment levels.

In addition to exploring MW on worker flows, Gittings and Schumette (2016) also explore the MW effect on job flows, creation, and destruction. The authors find no significant effects on the level of employment and job flows but a negative effect on worker reallocation. They argue that MW has differential effects depending on market conditions such as turnover and labor market tightness. In the case of Portugal and Cardoso (2006), the paper aims to identify effects on proxies to job flows, job creation, and destruction; unfortunately, in their definitions, job flows are restricted to job creation and destruction as a result of the born or death of firms. Under this definition, the main components of creation and destruction, which are existing firms' expansion or shrinking, are not included. More recently, in line with the previous literature, Bossler and Gerner, (2020) evaluated the effect of the new MW in Germany. Even though the authors do not directly evaluate the effect of MW on worker flows, the authors argue that one of the main channels for the employment adjustment on MW increases is the reduction of hirings rather than an increase in layoffs.

As in this previous literature, this paper aims to identify the effect of changes in MW policies on labor market flows for a developing country such as Colombia; our data allow analyzing all standard labor market flows: hires, separation, job creation, job destruction, churning and net employment growth for all economic sectors in the private formal sector. We use administrative records of the social security payments from the Integrated Record of Contributions to Social Security (PILA from its acronym in Spanish) of Colombia, which is a middle-income country, and constitute an interesting case for the study of MW effects for two reasons. On the first hand, the minimum wage is a binding price for the average firm in Colombia. According to the official source of labor statistics (National Department of Statistics – DANE from its acronym in Spanish), around 42,5% of all formal workers in 2019 earned between one and half minimum wage. On the other hand, in terms of traditional indexes (ratio MW to median wage), minimum wage in Colombia have been traditionally high compared to similar countries. The MW to median wage ratio in Colombia was nearly 92% in 2020, higher than similar countries such as Chile and México and the average ratio of OECD countries (55%). From these characteristics, one can expect that in the Colombian labor market effects of the minimum wage might be sizeable (Arango and Flórez, 2020; and Arango, Flórez and Guerrero, 2020).

One of the critical distinctions of our paper compared to previous literature is our rich dataset. PILA has the link between employee-employer for all formal sectors for 2009-2019. Taking advantage of this rich dataset, we can compute all labor flows rates (job and worker flows), including churning and net employment growth. Given the high prevalence of minimum wage earners among the salaried formal workers, we argue that this is an advantage of our research design. Most of the literature use information restricted uniquely to the food industry or specific populations such as young workers (Dube, et al., 2016; Brochu, Green, 2013 and Gittings and Schumette, 2016), given that MW is binding mainly in this population. However, in our case, we can explore the effect of minimum wage on all workers across all economic sectors.

Additionally, our dataset allows us to explore the effect of the MW on the worker flows (hiring and separations), job flows (job creation and job destruction), and the churning rate. We find a significant effect of the MW on the level of employment, which is explained by a significant effect not only on the worker flows (Dube, et al., 2016; Brochu and Green, 2013) but also on the job flows (Gittings and Schumette, 2016; Portugal & Cardoso, 2006).

In contrast to the previous literature, we also focus on identifying the heterogeneous effects of MW for different types of firms. Regarding the effects by firm typology, we explore this heterogeneity based on the literature on "who create jobs?" and explore different MW effects by firm's size and age (Baldwin and Picot, 1995; Davis, Haltiwanger and Schuh, 1996a; De Wit and De Kok, 2014; Lawless, 2014). Our identification strategy resembles seminal papers in the literature as Card and Krueger (1994) and Dube, Naidu, and Reich (2007), which use the monetary increase in payroll directly derived from MW variations, or in other words, the compliance cost of the MW policy. We use the compliance cost associated with increases in MW through a period of 10 years as a source of exogenous variation to identify the effect of MW on labor flows. As in the case of Hirsch et al. (2015), our study improves on this literature because our data allows computing this compliance cost at the firm level through all economic sectors.

The most standard model of unemployment equilibrium models and the model with endogenous separations (Pissarides, 1994; Pissarides, 2000) would unambiguously predict that increases in MW would increase separations. As expected, higher wages imply that some of the matches already took place are no longer profitable for the firms. Our empirical results align with this theoretical prediction; nevertheless, this has not been the case in the existing literature on the matter. In all evidence of the effect of MW on flows, rising MW has economic and significant effects on worker flows, but not necessarily on employment stocks because some of the effects cancel out each other. These authors find, as expected, that an increase in MW reduces hiring rates, but surprisingly, it also reduces separations rates; the effect on employment cancels out. This finding is mostly explained using supply arguments: better wages reduce quits and, in this way, reduce turnover. Formal theoretical extensions of the canonical unemployment equilibrium model can get this sort of prediction; for instance, the inclusion of sunk cost (Brochu and Green, 2013), or labor market ladder type models (Dube, et al., 2016). Nevertheless, in any case, the great advantage of our paper and the recent studies of MW effects on labor flows is that they reach a better understanding of the channels through which the MW affects employment stocks. In our case, we go further by considering job flows and the churning rate as well.

Our contribution to the literature can be summarized as follow. As in the case of Dube, et al. (2016), Brochu and Green (2013), Portugal and Cardoso (2006), Gittings and Schumette (2016), and Bossler and Gerner, (2020), we can disentangle the effect of MW on employment, between its effect on hires and separations. Furthermore, we do the same in terms of job creation and destruction. Finally, we assess the effect of MW on churning rates at the establishment level. To the best of our knowledge this is the first paper that contrasts the effects of MW on the level of employment through both channels: workers and job flows, using the standard definitions of the literature on labor dynamics (Davis, et al., 2006). Another contribution of this paper is that we can identify the heterogeneous effect of MW for different types of firms; exploring heterogeneous effects across different types of firms is uncommon in the literature. Finally, we contribute with the empirical evidence of the identification of MW effects. As in the case of Hirsch et al. (2015), since we have payroll data, we compute compliance costs at the firm level. Furthermore, we compute this compliance cost for all industries in the economy. In the case of Hirsch et al. (2015), the authors focus on identifying some specific franchisees' effects on quick-service restaurants in Georgia and Alabama.

This paper is organized into seven sections, including this introduction. In the second section, we present a brief description of the unemployment equilibrium search model that rationalizes some of our findings. In the third section, we present the data description and the definition of labor market flows. In the fourth section, we discuss how minimum wage is determined in Colombia and what we know about the MW in Colombia. In the fifth section, we present the empirical strategy and the definition of MW compliance cost. In section sixth, we discuss our empirical findings, and finally last section summarizes our results.

2. Theoretical Framework: The Effects of Minimum Wage from the Search Model.

This section proposes a theoretical framework that illustrates the effects of MW wage predicted by the simplest version of the search model (Pissarides, 2000). The model assumes that information about workers and vacancies in the trading process is costly. There are many firms and workers, and each operates as an atomistic competitor. The aggregate equilibrium state is one where firms and workers maximize their respective objective functions, subject to the matching and separation technologies, and where the flow of workers into unemployment is equal to the flow of workers out of unemployment.

A well-behaved matching function gives the number of jobs formed at any moment in time as a function of the number of workers looking for jobs and the number of firms looking for workers. The number of job matches taking place per unit time is given by the matching function[6]:

$$mL = m(uL, vL)$$

Where L are workers in the labor force, u denotes the unemployment rate, and v is the number of vacant jobs as a fraction of the labor force. Given the matching function, we can explain the evolution of the mean unemployment rate, $\dot{u}$, which is given by:

[6] $m(u,v)$ is assumed increasing in both its arguments, concave, and homogeneous of degree. Given this assumption, $q(\theta)$ corresponds to $m(u/v\,,1)$ where $q'(\theta) \leq 0$, and $\theta = v/u$. Thus, $m(u,v) = \theta q(\theta)u$. Moreover, any inward shift of the matching function represents an increase in the efficiency of the matching.

$$\dot{u} = \lambda(1-u) - \theta q(\theta)u.$$

This familiar expression corresponds to the difference between the average proportion of workers that flow into unemployment, $\lambda(1-u)$, during a time interval and the proportion that flow out of unemployment, $\theta q(\theta)u$. In this case, λ, θ, and $q(\theta)$ represent, respectively, the process of job destruction, the ratio of vacancy to the unemployment rate, $\theta = v/u$, also referred to as the labor market tightness and the probability that a vacant place is filled with an unemployed worker. The term $\theta q(\theta)$ is the probability that unemployed workers become employed. In steady-state, we have the following equation (1) which represents the Beveridge curve:

$$u = \lambda/[\lambda + \theta q(\theta)]; \qquad \partial u/\partial\lambda > 0; \;\; \partial u/\partial\theta < 0 \qquad (1)$$

Job creation occurs when a firm and a searching worker meet and agree to form a match at a negotiated wage. Before this can take place, however, the firm must open a job vacancy and search, and unemployed workers must also search. Let J define the present discounted values of an occupied job and V the present discount value of expected profit from a vacant job. In an infinite horizon, under perfect capital markets, we can write the following Bellman equations:

$$rV = -pc + q(\theta)(J - V),$$

$$rJ = p - w - \lambda J,$$

where p (>0) and pc (>0) correspond to the output of a job and the fixed cost of hiring per time unit. Assuming that in equilibrium $V = 0$, then $J = pc/q(\theta)$ implies that the expected profit from a new job is equal to the expected cost of hiring a worker. Using the last two equations, we obtain:

$$p - w = (r + \lambda)pc/q(\theta) \qquad (2),$$

where it is clear that the labour cost should be equal to the marginal product of labour under no hiring cost. Equation (2) corresponds to the job creation condition. As in the case of the firm, the Bellman equations that describe the worker's behavior are given by:

$$rU = z + \theta q(\theta)(W - U)$$

$$rW = w + \lambda(U - W)$$

Where U and W describe the present-discounted values of expected income streams of unemployed and employed workers, respectively. The present-discounted value of being unemployed (U) depends on the benefits (z) received while being unemployed and the expected income stream of being employed, with probability $\theta q(\theta)$. On the other hand, the present discounted value of being employed (W), depends on the wage income (w) received while being employed and the expected income loss given the exogenous probability of job destruction shock (λ). Without on-the-job search, workers stay in their jobs for as long as $w \geq z$, a sufficient condition for this to hold is that $p \geq z$, which is imposed. The wage rate is determined using the generalized Nash bargaining solution as:

$$\underset{w_i}{\text{Max}}\, \zeta = \beta \log(W_i - U) + (1 - \beta) log\, (J_i - V)$$

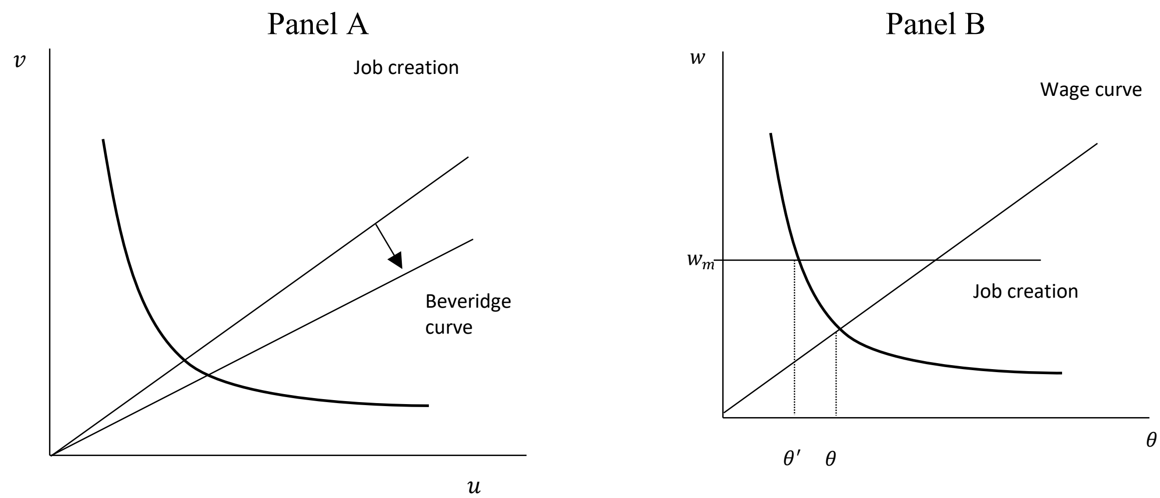
where $0 \leq \beta \leq 1$ and $(1 - \beta)$ are the relative bargaining power of the worker and the employer, respectively. Solving the first-order condition and the previous Bellman equations we have the equilibrium wage rate:

$$w = (1 - \beta)z + \beta p(1 + c\theta) \quad (3)$$

Equations (1), (2), and (3) jointly determine the equilibrium of the unemployment and the vacancy rate or the *labor market tightness* (θ). Figure 1 presents the equilibrium using the job creation curve, the Beveridge curve, and the wage curve.

The effect of a minimum wage can be analyzed using these main equations. Remember that workers are willing to work if their $w \geq z$, then if the minimum wage is set between $z < m_w \leq (1 - \beta)z + \beta p(1 + c\theta)$, from equation (3), it is still profitable to create jobs, then the job creation curve moves to the right. Therefore, there is an increase in vacancies and a reduction in the unemployment rate (the *labour market tightness* increase). However, if the minimum wage is higher than the equilibrium wage, $m_w > (1 - \beta)z + \beta p(1 + c\theta)$, as presented in Figure 1, it is less profitable for the firms to create vacancies, moving the job creation curve to the right (panel A). The new equilibrium with a minimum wage would be a low vacancy rate and a high unemployment rate (*the labour market tightness* falls) (Figure 1, Panel B).

Figure 1. Search model equilibrium with minimum wage:
$m_w > (1-\beta)z + \beta p(1 + c\theta)$



Then in the most standard search model with exogenous job destruction, an increase of the minimum wage above the equilibrium wage (which is the case of Colombia) produces a reduction in job creation. This prediction persists even in the case of endogenous job destruction. In this case, increasing the minimum wage affects not only job creation but also job destruction, making some existing matches no longer profitable for the firms (Pissarides, 2000; chapter 2). This search model is a good guide for predicting our results, which, as we will present in the next section, a higher MW produces a reduction in job creation (hirings) and an increase in job destruction (separations).

3. Data and Labor Market Flows Definitions

The data we use in this paper are administrative records of the social security from PILA, which is managed by the health ministry in Colombia. It contains information on the payroll of all formal firms in Colombia.[7] From this information, we can construct an employer-employee linked panel with all labor flows at the firm level, which, as defined in Davis et

[7] We exclude establishments that can be classified as state-owned enterprises by their legal character. In 2019, this type of enterprise accounted for 2.3% of the private firms used in the analysis.

al. (1996a), is an economic and legal entity with one or more plants where production takes place. In the last year of the PILA (2019), we collect information on 422,271 firms and 5'571,273 formal workers. We adopt the literature standards and define a job as a position a worker has taken. In this paper, we adopt the standard definitions of labor flows established in Davis et al. (1996a).[8]

Labor flows are comprised of worker flows, hires and separations, job flows, creation, and destruction. All our flows are computed quarterly; we refer to the hires in firm j at period t, (h_{jt}), as all new workers in payroll at that period. Analogously, separations in firm j at period t, (s_{jt}), are individuals who left the firm in period t, but were on the payroll the previous period. Regarding job flows, we refer as job creation in firm j at period t, as positive net growth in the period, i.e. $\mathrm{c_{jt}} = 1_{\{\Delta \mathrm{e_{jt}}>0\}}\Delta \mathrm{e_{jt}}$. In contrast, job destruction in firm j at period t, is the total reduction in the payroll in the period, i.e. $\mathrm{d_{jt}} = -1_{\{\Delta \mathrm{e_{jt}}<0\}}\Delta \mathrm{e_{jt}}$. A firm can only experience the creation or destruction in a single period. At any moment, the identity expressed in equation (4) must hold, expressing that changes in employment are equivalent to the difference between hires and separations and between job creation and job destruction.

$$\Delta \mathrm{e_{jt}} = h_{jt} - s_{jt} = \mathrm{c_{jt}}\ or\ \mathrm{d_{jt}} \qquad (4)$$

Working flows are usually aggregated in a single measure of worker reallocation, hires plus separations ($h_{jt} + s_{jt}$), and job flows are aggregated in a measure of job reallocations, which at firm level it is equal to the job creation or job destruction ($c_{jt}\ or\ d_{jt}$), finally churning flows are the result of the difference of worker reallocation and job reallocation i.e., $ch_{jt} = h_{jt} + s_{jt} - (c_{jt}\ or\ d_{jt})$. Churning is a measure of the excess of worker reallocation in relation to job reallocation, which can be interpreted as a measure of worker replacement (Florez et al., 2020, Morales and Lobo, 2017). There can be two reasons for churning flows. On the one hand, quits that the firm needs to replace. On the other hand, a reconfiguration of the labor force when the firm needs to hire and fire workers as a strategy for improving the quality of their workforce or reconfigure its skill mix composition by replacing one type of job for another (Burgess, Lane and Stevens, 2000). As it is standard in

[8]. The definitions and notation used in this section follow Flórez, et al., 2020 and Morales and Medina, 2017.

the literature, all these flows are presented as a percentage of the employment's moving average of order two.

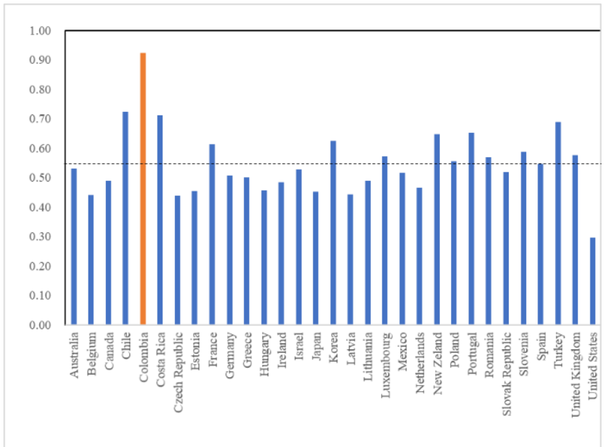
4. Minimum Wage Policy in Colombia

In Colombia the National Miminimum Wage (MW) is determined by a tripartite committee group coordinated by the Ministry of Labor: representatives of firms, workers, and the Goverment. Under Law 278 from 1996, the Permanent Commission for Salaries and Labour Policies Coordination must "[...] establish in a concerted manner the general minimum wage, taking into account that a decent quality of life must be guaranteed for the worker and his family.". Among the variables taken into account to determine the minimum wage each year are: next year's inflation target, the productivity growth, the contribution of wages to the national income, the GDP growth, and the inflation observed last year (Arango and Florez, 2020). If there is no consensus on the thirty (30) of December of each year, the Government will determine the minimum wage increase.

Figure 2 shows the minimum wage with respect to the median wage for Colombia and other developed and developing countries. While for the OECD countries, this ratio was around 55% in 2020, the same measure is around 92% for Colombia. This ratio is higher compared to medium-income countries similar to Colombia, such as Chile, Mexico, and Costa Rica. Using the information from PILA, we have that this ratio is around 71%. This evidence shows that in the case of Colombia, the minimum wage is highly restrictive (see also Maloney and Nuñez, 2003).

In the case of Colombia, there is also evidence of the adverse effects of the minimum wage on employment (Bell, 1997). Using a panel of the industrial sector at the establishment level, Bell (1997) estimated an employment elasticity with respect to the minimum wage of between 0.15% and 0.33% for non-skilled workers and between 0.03% and 0.24% for skilled workers. More recently, Arango and Rivera (2020) have found evidence of a negative effect on formal employment in the industrial sector. The authors suggest a significant effect on unskilled workers from firms with less than 100 workers. They found that 1% increase on the minimum wage reduces formal employment by 0.7% in a period between one and two years. Moreover, evidence of a negative effect on informality have also found by Arango and Florez (2020), and Arango, *et al*., (2020).

Figure 2: Minimum wage relative to median wage in 2020



Source: Data extracted on 9 Jun 2022 from OECD.Stat

Similar to Colombia, for other developing countries, Andalón and Pagès (2008) found adverse effects on the formal employment of minimum wage legislation in Kenya and increased labour informality. They report that the effect is high, especially for those workers who have a wage close to the minimum wage. Given an increase in the minimum wage, employers tend to replace workers with low qualifications with slightly more qualified workers. Millea, Rezek, Shoup, and Pitts (2017) examine some effects of the legislation on the sectoral minimum wage introduced in 2002 in South Africa. Their results do not suggest that there are effects on formal employment for any demographic group covered by the regulation, although they do suggest effects for informal workers. However, the introduction of the minimum wage in the agricultural sector in South Africa, which took place in March 2003, reduced employment in that sector but increased compliance with non-wage benefits (Bhorat, Kanbur and Stanwix, 2014). Broecke, Forti and Vandeweyer (2017) summarize the evidence found in some developing countries. They show that, although, on average, the effects on employment are not large in general, there is evidence of important negative effects for the most vulnerable groups, such as young people and low-skilled workers.

However, few papers have explored the effect of the minimum wage on the labour market flows for developed economies. Some papers have studied the effect of the minimum wage on job creation, job destruction, hiring and separations in the case of Portugal, the

United States, Canada, and Germany (Dube, et al., 2016; Brochu and Green 2013; Portugal and Cardoso, 2006, Gittings and Schumette, 2016 and Bossler and Gerner, 2020). However, none have studied the effect of minimum wage on labor flows for the case of a developing economy such as Colombia with a binding minimum wage.

5. Empirical Strategy

5.1 Minimum Wage Compliance Cost

As explained in the previous section, in the case of the Colombian labor market, every year, firms are compelled to follow the MW policies; therefore, they must adjust their wages according to the new minimum wage. One of the channels through which firms can adjust is by changing the level of employment; firms do this by changing their hires, separation, job creation, and destruction. The aggregation of all these labor flows determines the aggregate changes in the whole labor demand.

The use of measures of compliance cost of MW changes has a long tradition in applied labor economics, it has been a source of exogenous variation used in many studies. In their seminal paper Card and Krueger (1994) use a rough definition of MW compliance as simply the ratio $MW_t/W_{i,j,t-1}$. This previous measure is imprecise because it is not computed for the workers affected by changes in the MW, but for all workers (i), and it does not consider by how much these workers are affected. Other papers have similar measures, for instance, the share of the employees affected by the changes in the MW (Dube, Naidu, and Reich, 2007; Card, 1992; Bossler and Gerner, 2020). Nevertheless, this latter measure does not consider the difference between previous wages and the new minimum wage, which can be sizeable in large payrolls. The computation of a precise MW compliance measure would require detailed payroll information. Hirsch *et. al* (2015) has been able to account for the price and quantity dimension of the MW. They compute a MW for each employee; therefore, they can identify for workers affected by the policy the difference between the wage before MW increase and the new MW. Even though the MW compliance cost in Hirsch *et* al. (2015) is precisely computed, they can only do this for a sample of 81 fast-food chain restaurants in two US states for three years. We would construct this measure for all private formal firms of all economic sectors of the Colombian economy, and we can follow these firms during 10 years.

Following Hirsch *et. al* (2015), in this paper, we have detailed information on the payroll for each employee in each firm in the sample, with the advantage that our sample is the complete census of formal firms in the economy. This comprehensive dataset allows us to construct a detailed measure of the compliance cost of the MW policies; this variable is sometimes referred to in the literature as GAP. The GAP comes from the difference in the payroll cost at the level of the firm before and after a MW increment; it is a measure of how costly adjusting the wages of workers for which such an increment applies (Garita (2020) uses a similar identification strategy, and Draca et al., 2011). The following equations represent our measure of MW compliance cost:

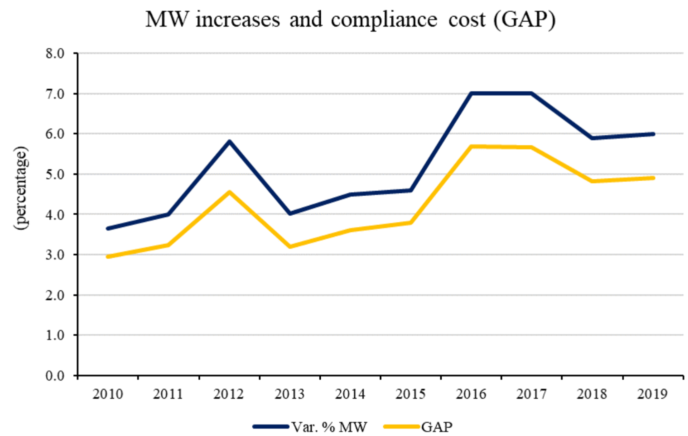
$$GAP_{jt} = 1 + \left[\frac{\sum_{i\epsilon\{W_{t-1}<MW\}}\left(MW_t d_{i,j,t-1} - W_{i,j,t-1} d_{i,j,t-1}\right)}{\sum_{i\epsilon\{W_{t-1}<MW\}}\left(W_{i,j,t-1} d_{i,j,t-1}\right)}\right] \tag{5}$$

where, *MW* represents the minimum wage in period *t*, $W_{i,j,t-1}$ is the wage of worker *i* in firm *j* before the rise in MW take place, analogously, $d_{i,j,t-1}$ are working days of worker *i* in firm *j* before the rise in MW as well. Note that all summations are defined over the set of workers with wage smaller than the MW after the change. The GAP is the relative difference, of the payroll before and after the increment in MW, for workers who are indeed affected for such a change, given their wage must be accomplish with the minimum wage law. There for the GAP change.

Figure 3 panel A present the diagram of the GAP for a firm *j*, while panel B present the dynamics of the GAP aggregated for all firms and the MW across time. Notice that changes in MW are transmitted to the GAP with a less proportion implying that no all workers are cover by the MW. Moreover, since 2015 the growth rate of the MW and the GAP (around 6%), has been significantly high compared to the last five previous years in which they growth at a rate around 4%. Table A1 from appendix show the descriptive statistics of the GAP measure for the period 2009-2019. In average for this period the GAP was 1.044, with a standard deviation of 0.021, this implies that in average a compliance cost fluctuates from his mean (4.4%.) between 6.6% and 2.2%. The GAP also varies by firms' size and age.

For example, in average it is lower for small and medium firms compared to large firms (+250 employees), and higher for new and young firms compared to oldest and consolidates firms (more than 6 years).

Figure 3



Source: PILA, authors calculations.

5.2 Estimation of MW Effects on Labor Market Flows at Establishment Level

As in previous literature, we assume that the GAP is a source of exogenous variation for identifying the effects of changes in MW on the labor market flows. The MW "bite" computed through the GAP is an exogenous measure since it is the result of the quasi-experiment resulting from the changes in MW. These changes directly affect workers that were earning the minimum wage and workers as well that had wages greater than the previous MW, but smaller than the new one. The MW compliance cost is exogenous because a competitive firm cannot precisely predict it. This argument is valid for Colombia because, as explained in section 3 of this paper, the MW in Colombia is determined by a tripartite committee group: representatives of firms, workers, and the Government. Moreover, if there is no consensus on the thirty (30) of December of each year, the Government will determine the minimum wage increase. In these circumstances, it is impossible for an individual firm to determine the MW and, therefore the GAP. Moreover, given that the discussion of the MW is given in December of each year, we use as a reference the worker's composition of the firm in the third quarter, previous to the increase in the MW (in the following section, we present additional exercises changing the time reference for the worker's composition of the firm).

The regressions we estimate in the paper can be represented by equation (6), where *j* stands for firm and *t* for a quarter. Dependent variables, LF_{jt}, are the labor flow rates: hiring, separation, creation, destruction, churning, and net growth rates. The effect of the GAP can change by quarter because the firms receive the shock in the first quarter, but the magnitude of the effect may diminish throughout the year; notice that the GAP measure change by year and firm. We include firm fixed effects (α_j) and time fixed effects (T_t), which can also capture the unobserved heterogeneous level of productivity by firm. All errors are clustered by firm. In addition, we include some characteristics of the firms as gender composition shares and age composition shares (X_{jt}).

$$LF_{jt} = \alpha_j + \beta_1 lnGAP_{jt} + \sum_{Q=2}^{4} \beta_Q lnGAP_{jt} * 1\{Quarter = Q\} + \beta_5 X_{jt} + T_t + u_{jt} \quad (6)$$

The effect of the minimum wage during the first quarter of the year is measured by the coefficient β_1, and the effect in the second, third and last quarter is given by $\beta_1 + \beta_2$, $\beta_1 + \beta_3$, and $\beta_1 + \beta_4$, respectively. At any moment, the identities expressed in equation (4) hold. Therefore, the effect of MW on hires (job creation) and separations (job destruction) depict the channels through which the MW determines changes in employment level. Furthermore, the effects of MW on churning -the excess of worker reallocation relative to job reallocation- would describe how much of the effect on worker flows are explained by worker replacement, without implying destruction or creation of job positions.

5.3. General Results

The results of the estimation of equation (6) on the entire sample are presented in Table 1. In this case, to calculate the MW compliance cost, we assume as reference payroll the structure of the firm's employment observed in the last quarter previous to the MW increase.[9]The first finding is that the MW compliance cost significantly impacts all labor flows. Regarding worker flows, we find that MW has a positive effect on separations and a

[9] We also replicate these results using the average payroll observed in the year previous to the increase in the MW. Finally, we also use the average payroll observed in the second semester previous to the MW increase. The results are discussed in the robustness check section.

negative effect on hiring. The effect on hiring is important and relatively constant throughout the year; in the first quarter, we have a reduction of 0.4 percentage points (pp) per 1% increase in GAP, with a total effect of -0.95 pp through the year. The effect on separations decays through the year; during the first quarter, an increment of 1% in the GAP increases the separation rate in 0.63 pp, and by the last quarter, the effect is only 0.1pp. We find similar evidence in the case of job creation and destruction rates; MW compliance cost increases job destruction and reduces job creation. The effect on job creation rate starts with a reduction of 0.47 pp per 1% increment in the GAP, which remains relatively constant throughout the year. Nevertheless, the effect on the job destruction rate is a reduction of 0.55 pp per 1% increase in the GAP in the first quarter, but by the end of the last quarter, it is only 0.1 pp.

The effects of MW compliance costs estimated on worker and job flows are consistent with the ones estimated for the employment net growth rate. On the one hand, we identify a positive effect on separations and job destruction, and on the other hand, we identify a negative effect on hiring and job creation; in all cases, these effects go in the direction of reductions in the net employment growth rate. Since the effect on separation and job destruction rates decay through the year, the effect on employment growth mimics this behavior; for the first quarter, the effect is almost -1% (per 1% of increase in the MW compliance cost), but in the last quarter it is close to -0.4%. The total effect for the year is around -2%. Our estimations go in line with the predictions of the standard search model (Pissarides, 2000). These results contrast with the null results found by some authors in the case of developed economies (Dube et al., 2016; Brochu and Green, 2013; and Portugal and Cardoso, 2006); who justify their findings as a consequence of a reduction in hirings but also in separations trough lower quits.

Finally, we comment on the effects of MW compliance costs on churning rates. The effect on churning rate in the first quarter is positive, but fades towards the end of the year; nevertheless, the annual effect remains positive, and the drop in job creation mainly drives it. As we will see in the next section, the effect on median and big firms explains the positive effect on the churning rate. In summarizing, we find a negative effect of MW compliance cost on employment growth. This effect is sizeable but decays towards the year's end, ending at less than half of the magnitude observed in the first quarter. However, for the whole year, this effect is around -2% (as observed Table 1). This negative effect is determined simultaneously by a negative effect on hiring and job creation and a positive effect on separations and job destruction. The adverse effects of hiring and creation are relatively steady through the year, while the effects of separations and job destruction decay importantly throughout the year, especially the former.

Table 1: Effects of MW Compliance Cost on Labor Flows

	Job destruction rate	Job creation rate	Separation rate	Hiring rate	Churning rate	Employment net growth (%)
β1	0.5499***	-0.4740***	0.6283***	-0.3955***	0.1569***	-1.0239***
	(0.0169)	(0.0125)	(0.0173)	(0.0138)	(0.0117)	(0.0229)
β1 + β2	0.0689***	-0.0522***	0.1291***	0.0080	0.1205***	-0.1211***
	(0.0139)	(0.0167)	(0.0148)	(0.0175)	(0.0120)	(0.0238)
β1 + β3	0.1703***	-0.3206***	0.1930***	-0.2978***	0.0455***	-0.4908***
	(0.0150)	(0.0148)	(0.0155)	(0.0157)	(0.0117)	(0.0225)
β1 + β4	0.1000***	-0.2730***	0.1059***	-0.2671***	0.0118	-0.3730***
	(0.0157)	(0.0142)	(0.0162)	(0.0152)	(0.0115)	(0.0230)
All year round	0.8890***	-1.1198***	1.0564***	-0.9524***	0.3348***	-2.0088***
	(0.0410)	(0.0375)	(0.0433)	(0.0419)	(0.0351)	(0.0525)
Observations	3,070,254	3,070,254	3,070,254	3,070,254	3,070,254	3,070,254
Number of firms	155,065	155,065	155,065	155,065	155,065	155,065

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%. The variable Ln GAP represents the logarithm of the Compliance Cost. The regressions include as controls: gender and age composition of the firms. Standard errors are presented in parentheses. The coefficients and standard errors for the all year round estimation are computed using the delta method on the basis of a quarterly estimation; these coefficients stand for the sum of the four quarterly coefficients.
Source: PILA, authors calculations.

5.4. Heterogeneous Effects

In this subsection, we analyze the heterogenous effects of MW compliance costs by different types of firms and employees. In the case of heterogeneity by firms, we estimate equation (6) by different types of firms according to their size and age. This section closely follows the literature on "who creates jobs." These are a series of studies that seek to identify differences in job creation rates and labor flows in general across different types of firms (Birch 1981, Baldwin and Picot, 1995; Davis et al., 1996a; De Wit and De Kok, 2014; Lawless, 2014, Florez et. al., 2020). We use the most standard categorization and divide firms into four size groups: firms with 2-20 employees, 21-100, 101-250, and more than 250 employees. Most importantly, the groups are selected using dynamic classification, which consists in classifying the firms according to their annual moving average size (Davis et al. 1996b). Regarding the firm's age, we estimate regressions according to the following groups: firms from 1-4 years, 5-6 years, and more than 6 years.

Table 2 shows the heterogeneous effects by firm size. In general, small firms (2-20 employees), and medium sized firms (21-100, 101-250 employees) have a similar set of effects as the ones described in Table 1. In the case of medium and small firms, there is a negative effect of MW compliance cost on employment growth which is especially sizeable. The elasticity is close to -1.4% in the first quarter (i.e. an increase in compliance cost of 1% reduces the net employment growth rate by 1.4 %); this effect decay through the year. The total effect on employment growth for the whole year is between -2.7% for the small firms and -2.5% for medium-sized firms, respectively. This negative effect of MW compliance cost on employment growth for small and medium firms results from a combination of effects on workers and job flows that explains the reduction in employment. On the one hand, we have that MW compliance cost has a positive effect on separations and job destruction (with its peak in the first quarter); on the other hand, it reduces hiring and job creation, with a significant effect on medium-size firms. Both effects contribute to a reduction in employment growth.

An interesting finding is that the impact of MW is higher on hiring and job creation than on separations and job destruction. The employment losses are bigger because new matches (between workers and firms) are frustrated because of a new high MW. This is true in the case of medium-size firms. For instance, for firms between 101 and 250 employees, the effect of 1% increment in MW compliance cost for the whole year is a reduction of 1.94 pp in job creation and a reduction of 1.87 pp in hiring. In the case of job destruction, this semi-elasticity increases 0.52 pp, with an increase of 0.59 pp in separations rate. This finding implies that with the new higher MW, firms are less willing to create new jobs and hire new workers for existing vacancies.

Moreover, in the case of small and medium firms, the effect of the MW on churning is negative or not significant. These results are consistent with the hypothesis that labor market rigidities, such as the MW policies, reduce the fluidity of the labor market. (Bassanini and Garnero, 2013; Blanchard and Portugal, 2001; Decker, Haltiwanger, Jarmin and Miranda, 2014; Haltiwanger, Hyatt, McEntarfer, Sousa and Tibbets, 2014; Messina and Vallanti, 2007; Micco and Pages, 2012; Florez et al., 2020). Finally, a surprising finding is that larger firms (250+ employees) react differently to changes in MW. The first thing to notice is that we do not find a significant effect of MW compliance cost on the job destruction rate. We find a positive and significant effect on separation rate in the first and third quarters, but the magnitude of this effect is substantially less than in the cases of small and medium firms. The effect on job creation and hiring rate are also negative and significant for the whole year. The fact that there is an effect on separations but no effect on job destruction implies that churning must increase in the first quarter. Indeed, we identify a positive and significant effect of MW compliance cost on churning for the larger firms in the first quarter of the year; it seems that in the case of large firms, the channel through which they respond to an increase in the MW is different. Given the increase in the MW, during the first quarter of the year, it seems they reconfigure his payroll, replacing workers for existing job positions, but not through an increase in job destruction. In general, larger firms may be able to afford the cost imposed by a high minimum wage, implementing a strategy of more rotation of their workers (increasing hirings and separations), with a small reduction in the employment growth -1.8% (Flórez, et al. 2020).

Table 2: Heterogeneous Effects by Firms Size

	Job destruction rate	Job creation rate	Separation rate	Hiring rate	Churning rate	Employment net growth (%)
A. Size 1 (>= 2 and <= 20)						
β1	0.8721***	-0.5481***	0.8944***	-0.5259***	0.0445***	-1.4203***
	(0.0198)	(0.0137)	(0.0207)	(0.0152)	(0.0136)	(0.0263)
β1 + β2	0.2538***	-0.0317*	0.2787***	-0.0067	0.0499***	-0.2854***
	(0.0167)	(0.0186)	(0.0180)	(0.0196)	(0.0142)	(0.0273)
β1 + β3	0.2961***	-0.2693***	0.2856***	-0.2798***	-0.0210	-0.5655***
	(0.0174)	(0.0173)	(0.0184)	(0.0182)	(0.0137)	(0.0261)
β1 + β4	0.1881***	-0.2480***	0.1727***	-0.2635***	-0.0309**	-0.4361***
	(0.0181)	(0.0162)	(0.0191)	(0.0171)	(0.0134)	(0.0260)
All year round	1.6102***	-1.0972***	1.6314***	-1.0759***	0.0424	-2.7073***
	(0.0522)	(0.0450)	(0.0558)	(0.0494)	(0.0410)	(0.0686)
Observations	2,051,079	2,051,079	2,051,079	2,051,079	2,051,079	2,051,079
Number of firms	127,387	127,387	127,387	127,387	127,387	127,387
B. Size 2 (> 20 and <= 100)						
β1	0.5560***	-0.6879***	0.6084***	-0.6354***	0.1049***	-1.2438***
	(0.0311)	(0.0328)	(0.0327)	(0.0342)	(0.0226)	(0.0510)
β1 + β2	0.0150	-0.1487***	0.0424	-0.1214***	0.0547**	-0.1637***
	(0.0248)	(0.0394)	(0.0266)	(0.0400)	(0.0228)	(0.0516)
β1 + β3	0.1912***	-0.3658***	0.1586***	-0.3984***	-0.0652***	-0.5570***
	(0.0275)	(0.0300)	(0.0288)	(0.0311)	(0.0220)	(0.0438)
β1 + β4	0.1852***	-0.3111***	0.1236***	-0.3726***	-0.1231***	-0.4962***
	(0.0287)	(0.0292)	(0.0297)	(0.0305)	(0.0217)	(0.0443)
All year round	0.9473***	-1.5135***	0.9329***	-1.5279***	-0.0287	-2.4608***
	(0.0736)	(0.0834)	(0.0783)	(0.0903)	(0.0631)	(0.1152)
Observations	763,501	763,501	763,501	763,501	763,501	763,501
Number of firms	53,337	53,337	53,337	53,337	53,337	53,337
C. Size 3 (> 100 and <= 250)						
β1	0.3581***	-0.7270***	0.4554***	-0.6297***	0.1947***	-1.0851***
	(0.0971)	(0.1381)	(0.1027)	(0.1396)	(0.0634)	(0.1853)
β1 + β2	-0.1586**	-0.4591***	-0.0555	-0.3561***	0.2061***	-0.3005*
	(0.0758)	(0.1321)	(0.0809)	(0.1332)	(0.0629)	(0.1630)
β1 + β3	0.0658	-0.4492***	0.0234	-0.4917***	-0.0849	-0.5151***
	(0.0841)	(0.1056)	(0.0873)	(0.1044)	(0.0606)	(0.1470)
β1 + β4	0.2546***	-0.3024***	0.1667*	-0.3903***	-0.1758***	-0.5569***

	(0.0920)	(0.0862)	(0.0946)	(0.0883)	(0.0640)	(0.1335)
All year round	0.5199**	-1.9377***	0.5899**	-1.8677***	0.1401	-2.4576***
	(0.2225)	(0.2965)	(0.2362)	(0.3073)	(0.1747)	(0.3803)
Observations	151,047	151,047	151,047	151,047	151,047	151,047
Number of firms	11,699	11,699	11,699	11,699	11,699	11,699
D. Size 4 (> 250)						
β1	0.1504	-0.5731***	0.3982***	-0.3253*	0.4957***	-0.7235***
	(0.1112)	(0.1916)	(0.1181)	(0.1957)	(0.0962)	(0.2352)
β1 + β2	-0.2534**	-0.3803**	-0.1873	-0.3142*	0.1323	-0.1269
	(0.1185)	(0.1788)	(0.1272)	(0.1779)	(0.0910)	(0.2339)
β1 + β3	0.2954***	-0.4088***	0.3028***	-0.4014***	0.0147	-0.7042***
	(0.1036)	(0.1319)	(0.1084)	(0.1335)	(0.0789)	(0.1733)
β1 + β4	0.1687	-0.0418	0.1331	-0.0774	-0.0711	-0.2105
	(0.1114)	(0.1092)	(0.1147)	(0.1157)	(0.0766)	(0.1681)
All year round	0.3611	-1.4040***	0.6469**	-1.1182***	0.5715**	-1.7651***
	(0.2938)	(0.4103)	(0.3174)	(0.4280)	(0.2569)	(0.4833)
Observations	104,627	104,627	104,627	104,627	104,627	104,627
Number of firms	5,495	5,495	5,495	5,495	5,495	5,495

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%. The variable Ln GAP represents the logarithm of the Compliance Cost. The regressions include as controls: genre and age composition of the firms. Standard errors are presented in parentheses. The coefficients and standard errors for the all year round estimation are computed using the delta method on the basis of a quarterly estimation; these coefficients stand for the sum of the four quarterly coefficients.
Source: PILA, authors calculations.

Table 3 shows heterogeneous effects by firm's age. The categorization considers new firms (less than 4 years old), young firms (5-6 years old), and old firms (6+ years old). In general, all groups of firms have a similar set of effects; nevertheless, the effects are larger for new firms and fall as they age. For firms of all ages, we find evidence that MW compliance cost has a negative effect on employment net growth. In the case of new and old firms, this effect is negative and significant, with a decreasing trend towards the end of the year. The negative effect for the whole year is -3.7% for new firms and -1.7% for older firms. In general, for all firms, the MW compliance cost has a negative effect on the hiring and job creation rate; these effects reduce in magnitude after the first quarter of the year.

Similarly, we find that compliance cost increases separations and job destruction in a decreasing way. However, new firms present the most sizeable adverse effects on job creation (-2.1pp) and hiring rate (-2.0pp), for the whole year. Moreover, the increase in separations (1.7pp) and job destruction (1.6) is also higher for new than older firms. Similar to the previous finding, we only find a significant effect on the churning rate (for the whole year) for the case of older firms. Although there is a positive effect on churning for new and young firms (firms with less than 6 years), during the first half of the year, this effect vanishes quickly and becomes insignificant for the whole year. In contrast, for old firms, we find a positive and persistent effect on churning rate (0.4pp), which explains the positive effect found in Table 1. It seems that in the case of old firms (as in the case of large firms), they can afford the high cost imposed by a minimum wage, implementing a strategy of more rotation of their workers (increasing hirings and separations for the same level of creation and destruction).

Table 3: Heterogenous Effects by Firms Age

	Job destruction rate	Job creation rate	Separation rate	Hiring rate	Churning rate	Employment net growth (%)
A. Age 1 (<= 4)						
β1	0.7636***	-0.8218***	0.8977***	-0.6877***	0.2681***	-1.5854***
	(0.0827)	(0.0698)	(0.0829)	(0.0760)	(0.0630)	(0.1208)
β1 + β2	0.2444***	-0.3297***	0.3367***	-0.2375***	0.1845***	-0.5741***
	(0.0810)	(0.0762)	(0.0820)	(0.0809)	(0.0636)	(0.1236)
β1 + β3	0.3233***	-0.4837***	0.2842***	-0.5228***	-0.0782	-0.8070***
	(0.0850)	(0.0701)	(0.0846)	(0.0755)	(0.0620)	(0.1222)
β1 + β4	0.3248***	-0.4277***	0.2174**	-0.5351***	-0.2149***	-0.7525***
	(0.0871)	(0.0688)	(0.0863)	(0.0746)	(0.0611)	(0.1247)
All year round	1.6562***	-2.0628***	1.7359***	-1.9830***	0.1595	-3.7190***
	(0.2804)	(0.2330)	(0.2798)	(0.2546)	(0.2104)	(0.3987)
Observations	252,327	252,327	252,327	252,327	252,327	252,327
Number of firms	39,180	39,180	39,180	39,180	39,180	39,180
B. Age 2 (> 4 and <= 6)						
β1	0.5966***	-0.6473***	0.6438***	-0.6001***	0.0944**	-1.2439***
	(0.0525)	(0.0451)	(0.0541)	(0.0498)	(0.0432)	(0.0766)
β1 + β2	0.0699	-0.2674***	0.1167**	-0.2205***	0.0936**	-0.3373***
	(0.0472)	(0.0533)	(0.0496)	(0.0560)	(0.0440)	(0.0784)
β1 + β3	0.1466***	-0.4067***	0.1320***	-0.4213***	-0.0293	-0.5533***
	(0.0491)	(0.0489)	(0.0504)	(0.0519)	(0.0414)	(0.0758)
β1 + β4	0.1623***	-0.3987***	0.1376***	-0.4234***	-0.0494	-0.5610***
	(0.0501)	(0.0465)	(0.0513)	(0.0497)	(0.0406)	(0.0762)
All year round	0.9754***	-1.7200***	1.0301***	-1.6653***	0.1094	-2.6955***
	(0.1470)	(0.1360)	(0.1516)	(0.1504)	(0.1329)	(0.2064)
Observations	319,612	319,612	319,612	319,612	319,612	319,612
Number of firms	22,690	22,690	22,690	22,690	22,690	22,690
C. Age 3 (> 6)						
β1	0.5472***	-0.4250***	0.6216***	-0.3507***	0.1487***	-0.9723***
	(0.0186)	(0.0129)	(0.0191)	(0.0144)	(0.0122)	(0.0247)
β1 + β2	0.0630***	-0.0103	0.1208***	0.0475**	0.1156***	-0.0733***
	(0.0145)	(0.0184)	(0.0155)	(0.0193)	(0.0126)	(0.0257)
β1 + β3	0.1125***	-0.2929***	0.1562***	-0.2491***	0.0876***	-0.4053***
	(0.0154)	(0.0161)	(0.0162)	(0.0170)	(0.0123)	(0.0236)
β1 + β4	0.0083	-0.2339***	0.0429**	-0.1994***	0.0691***	-0.2422***
	(0.0163)	(0.0154)	(0.0169)	(0.0164)	(0.0121)	(0.0241)
All year round	0.7310***	-0.9621***	0.9414***	-0.7516***	0.4209***	-1.6931***
	(0.0418)	(0.0393)	(0.0449)	(0.0439)	(0.0366)	(0.0519)
Observations	2,394,337	2,394,337	2,394,337	2,394,337	2,394,337	2,394,337
Number of firms	81,818	81,818	81,818	81,818	81,818	81,818

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%. The variable Ln GAP represents the logarithm of the Compliance Cost. The regressions include as controls: gender and age composition of the firms. Standard errors are presented in parentheses. The coefficients and standard errors for the all year round estimation are computed using the delta method on the basis of a quarterly estimation; these coefficients stand for the sum of the four quarterly coefficients.
Source: PILA, authors calculations.

5.5. Robustness check

As a robustness check, we replicate the Table 1 adding city and sectoral trends to control for the differential productivity by city-sectors; the results are very similar to the originals (see Table A2, Appendix). Furthermore, we change the GAPS's employment baseline using two different reference of the firm's payroll: the average firm size of the year previous to the increase in the MW and the second semester of the year previous to the increase of the MW. Table A3 in the appendix presents the results when using the average firm's size one year previous to the increase in the MW. The results are similar to those in Table 1, with the signs and significant levels. However, there is a slightly change in the magnitude of some coefficients: for example, the total effect on employment growth is higher (-3.2%), mainly explained by a higher effect on job creation and hiring rates (the full-year effect was -2.0 pp and -1.8pp respectively). In this case, the results of churning are still significant and positive. Table A4 in the appendix presents the results when using the average payroll of the firm in the second semester previous to the MW increase. In this case, we also find similar results to the ones presented in Table A3.

Moreover, to evaluate the potential endogeneity of our GAP measure when there is an anticipation of the MW increases by the firm, we follow two strategies: First, we estimate our results only for the years when there is an agreement on the MW increment by the tripartite committee (given in the years 2012, 2014, 2018, 2019). We believe that any possible anticipation to the increment in the MW is more difficult in the case when there is an agreement on the MW by the tripartite committee than in the case that only the Government determines this. In the latter case, the Government should follow the parameters presented by the Law 278 in 1996. Result of this robustness check are presented in appendix, Table A5.

A second strategy is to estimate the GAP discounting element that determines the MW increment (such as the inflation target and the labor productivity). This new GAP only captures the compliance cost that responds to the unexpected increase in the MW. See the results in Table A6 in appendix. As in the previous cases, the results are similar to the baseline estimation, and our main conclusions remain.

6. Final remarks.

In this paper, we use administrative records (PILA) from the social security payments in Colombia to explore the effect of the MW during the period 2009 to 2019. As it has been used in the literature, we exploit the exogenous variation of the MW compliance cost imposed on the firms when there is an increment in the MW each year. Moreover, we take advantage of a rich dataset at the establishment level and compute all labor flows rate to explore the effect of MW compliance cost on hiring, separations, job creation, job destruction, and employment growth rate. These flows allow us to decompose the effect of MW through his channel of labor flows, job creation and destruction, and worker flows, hiring and separations. This study gives a complete portrait of the channels through which MW affects the level of employment.

We find that MW compliance cost has a positive effect on separations and a negative effect on hiring. While the effect on hiring is important and relatively constant through the year, the effect on separations decays through the year. The effects are similar in the case of job creation and job destruction. As the identity of the labor flows holds, we can explain the adverse effects of MW on employment growth through a negative effect on the job and worker flows. We find a negative effect on employment growth that decay toward the end of the year, being for the whole year around -2%, which is determined simultaneously by a negative effect on hirings and job creation and a positive effect on separations and job destruction. In contrast to the evidence found for developed economies (Dube, Lester and Reich, 2016; Gittings and Schmutte , 2016; Brochu and Green, 2013 and Portugal and Cardoso, 2006) we find that an increase in the compliance cost due to a higher MW has a positive effect on separations and job destruction. The previous finding is in line with the results suggested by the standard search and matching models (Pissarides, 2000).

Exploring heterogeneous effects by firm size, we found that in the case of medium-size firms (with 21-100, 101-250 employees) and small firms (with 2-20 employees), there is a larger negative effect of MW compliance cost on employment growth. As in the aggregate case, the reduction in employment by an increase of MW complain cost is explained by a negative effect on job creation and hirings rate and a positive effect on separations and job destruction. The negative effect on hiring and job creation is the most significant, especially in medium firms, which implies that new matches (between workers and firms) are frustrated because of a new high MW.

An interesting finding is that larger firms (250+ employees) react differently to changes in MW. The first thing to notice is that we do not find a significant effect of MW compliance cost on the job destruction rate. However, we also find a positive and significant effect on separations and a negative effect on job creation and hiring rate. The fact that there is an effect on separations but no effect on job destruction implies a positive effect on the churning, especially during the first quarter. These results imply that large firms respond to an increase in the MW, through a different channel than small and medium firms. While medium and small firm's reduction their employment level as a respond to a high MW compliance cost, large firms prefer to reconfigure their payroll. They do this reconfiguration by improving the quality of their labor force or changing its skill mix composition (Burgess, Lane and Stevens, 2000), reducing the impact on the level of employment. Therefore, larger firms may be able to afford the cost imposed by a high minimum wage, implementing a strategy of more rotation of their workers (excess of worker reallocation in relation to job reallocation), with a smaller reduction in the employment growth -1.8% (Flórez, et al. 2020).

Furthermore, exploring heterogeneous effects of MW compliance cost by firm age, we find that firms at all ages negatively affect net employment growth, with a decreasing trend towards the last quarter of the year. Moreover, for all firms age, the MW compliance cost has a negative effect on the hiring and job creation rate; and a positive effect on separations and job destruction. However, new firms present the most sizeable adverse effects on job creation and hiring rate; these effects for the whole year are around -21pp and -2pp, respectively. Moreover, the increase in separations rates is also higher for new firms compared to older firms (around 0.8pp).

In summary, our results align with the theoretical guidance of the search matching models, which predict a negative effect of MW on job creation (hirings) and a positive effect on job destruction (separations). As previously found in the literature for the case of Colombia, we find evidence of an adverse effect of an increase in MW compliance cost on the employment level. This negative effect is explained mainly by reducing job creation and hiring. These results imply that new matches (between workers and firms) are frustrated when there is an increase in the MW compliance cost. By firms' characteristics, we found that these results seem to be relatively important to small firms (with 2-20 employees) and medium-size firms (with 21-100, 101-250 employees), as well as for new (less than four years old) and young firms (between 4 and 6 years old). In the case of large and older firms, it seems that they respond to an increase in the MW compliance cost through a different channel. It seems this type of firm may be able to afford the cost imposed by a high minimum wage, implementing a strategy of worker substitutition with a smaller reduction in employment.

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Appendix

Table A1: Summary statistics for GAP

	Observations	Mean	Std. Dev.
All	**3070254**	**1.0435**	**0.0215**
By Size			
Size 1 (>=2 and <=20)	2051079	1.0423	0.0228
Size 2 (>20 and <=100)	763501	1.0455	0.0191
Size 3 (>100 and <=250)	151047	1.0474	0.0154
Size 4 (>250)	104627	1.0472	0.0140
By Age			
Age 1 (<=4)	252327	1.0485	0.0218
Age 2 (>4 and <=6)	319612	1.0498	0.0226
Age 3 (>6)	2394337	1.0425	0.0212

Source: PILA, own calculations

Table A2: Estimation with sectoral and city trends

	Job destruction rate	Job creation rate	Separation rate	Hiring rate	Churning rate	Employment net growth (%)
β1	0.5530***	-0.4799***	0.6307***	-0.4022***	0.1554***	-1.0329***
	(0.0169)	(0.0125)	(0.0173)	(0.0138)	(0.0117)	(0.0229)
β1 + β2	0.0718***	-0.0573***	0.1311***	0.0020	0.1185***	-0.1291***
	(0.0139)	(0.0166)	(0.0148)	(0.0175)	(0.0120)	(0.0238)
β1 + β3	0.1731***	-0.3247***	0.1946***	-0.3033***	0.0430***	-0.4979***
	(0.0150)	(0.0148)	(0.0155)	(0.0157)	(0.0117)	(0.0225)
β1 + β4	0.1027***	-0.2763***	0.1070***	-0.2719***	0.0087	-0.3789***
	(0.0157)	(0.0142)	(0.0162)	(0.0152)	(0.0115)	(0.0230)
All year round	0.9006***	-1.1382***	1.0634***	-0.9754***	0.3256***	-2.0389***
	(0.0410)	(0.0375)	(0.0433)	(0.0419)	(0.0351)	(0.0525)
Observations	3,070,254	3,070,254	3,070,254	3,070,254	3,070,254	3,070,254
Number of firms	155,065	155,065	155,065	155,065	155,065	155,065

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%. The variable Ln GAP represents the logarithm of the Compliance Cost. The regressions include as controls: genre and age composition of the firms and average wage, as well. Standard errors are presented in parentheses. The coefficients and standard errors for the all year round estimation are computed using the delta method on the basis of a quarterly estimation; these coefficients stand for the sum of the four quarterly coefficients.
Source: PILA, authors calculations.

Table A3: GAP with average year employment previous to MW increase

	Job destruction rate	Job creation rate	Separation rate	Hiring rate	Churning rate	Employment net growth (%)
β1	0.6508***	-0.7930***	0.7435***	-0.7002***	0.1854***	-1.4438***
	(0.0196)	(0.0158)	(0.0198)	(0.0170)	(0.0123)	(0.0274)
β1 + β2	0.1821***	-0.2685***	0.2651***	-0.1855***	0.1660***	-0.4506***
	(0.0162)	(0.0183)	(0.0168)	(0.0192)	(0.0124)	(0.0264)
β1 + β3	0.2175***	-0.5138***	0.2578***	-0.4734***	0.0807***	-0.7312***
	(0.0161)	(0.0162)	(0.0166)	(0.0171)	(0.0121)	(0.0241)
β1 + β4	0.1352***	-0.4298***	0.1619***	-0.4032***	0.0533***	-0.5650***
	(0.0166)	(0.0155)	(0.0170)	(0.0165)	(0.0119)	(0.0241)
All year round	1.1856***	-2.0051***	1.4283***	-1.7624***	0.4854***	-3.1906***
	(0.0488)	(0.0451)	(0.0506)	(0.0495)	(0.0379)	(0.0628)
Observations	3,677,799	3,677,799	3,677,799	3,677,799	3,677,799	3,677,799
Number of firms	164,383	164,383	164,383	164,383	164,383	164,383

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%. The variable Ln GAP represents the logarithm of the Compliance Cost. The regressions include as controls: genre and age composition of the firms and average wage, as well. Standard errors are presented in parentheses. The coefficients and standard errors for the all year round estimation are computed using the delta method on the basis of a quarterly estimation; these coefficients stand for the sum of the four quarterly coefficients.
Source: PILA, authors calculations.

Table A4: GAP with average employment in the second semester previous to MW increase

	Job destruction rate	Job creation rate	Separation rate	Hiring rate	Churning rate	Employment net growth (%)
β1	0.6266***	-0.7713***	0.7300***	-0.6679***	0.2068***	-1.3979***
	(0.0173)	(0.0140)	(0.0177)	(0.0153)	(0.0117)	(0.0242)
β1 + β2	0.1202***	-0.2005***	0.2156***	-0.1051***	0.1908***	-0.3207***
	(0.0137)	(0.0169)	(0.0146)	(0.0178)	(0.0117)	(0.0237)
β1 + β3	0.2111***	-0.4878***	0.2542***	-0.4447***	0.0861***	-0.6989***
	(0.0147)	(0.0150)	(0.0153)	(0.0159)	(0.0114)	(0.0223)
β1 + β4	0.1245***	-0.3984***	0.1544***	-0.3685***	0.0599***	-0.5229***
	(0.0153)	(0.0142)	(0.0157)	(0.0152)	(0.0112)	(0.0224)
All year round	1.0823***	-1.8580***	1.3542***	-1.5862***	0.5437***	-2.9404***
	(0.0417)	(0.0399)	(0.0439)	(0.0443)	(0.0351)	(0.0544)
Observations	3,578,867	3,578,867	3,578,867	3,578,867	3,578,867	3,578,867
Number of firms	161,568	161,568	161,568	161,568	161,568	161,568

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%. The variable Ln GAP represents the logarithm of the Compliance Cost. The regressions include as controls: genre and age composition of the firms and average wage, as well. Standard errors are presented in parentheses. The coefficients and standard errors for the all year round estimation are computed using the delta method on the basis of a quarterly estimation; these coefficients stand for the sum of the four quarterly coefficients
Source: PILA, authors calculations.

Table A5: Estimation for years with agreed MW increase

	Job destruction rate	Job creation rate	Separation rate	Hiring rate	Churning rate	Employment net growth (%)
β1	0.4398***	-0.4250***	0.5339***	-0.3308***	0.1883***	-0.8648***
	(0.0248)	(0.0195)	(0.0256)	(0.0216)	(0.0182)	(0.0336)
β1 + β2	0.0164	0.0241	0.0891***	0.0968***	0.1455***	0.0077
	(0.0209)	(0.0253)	(0.0223)	(0.0267)	(0.0188)	(0.0351)
β1 + β3	0.1606***	-0.3327***	0.1948***	-0.2984***	0.0684***	-0.4933***
	(0.0232)	(0.0222)	(0.0241)	(0.0237)	(0.0184)	(0.0339)
β1 + β4	0.0561**	-0.2089***	0.0671***	-0.1979***	0.0220	-0.2650***
	(0.0242)	(0.0216)	(0.0249)	(0.0233)	(0.0181)	(0.0345)
All year round	0.6729***	-0.9425***	0.8850***	-0.7304***	0.4242***	-1.6153***
	(0.0663)	(0.0625)	(0.0700)	(0.0694)	(0.0570)	(0.0862)
Observations	1,288,855	1,288,855	1,288,855	1,288,855	1,288,855	1,288,855
Number of firms	136,351	136,351	136,351	136,351	136,351	136,351

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%. The variable Ln GAP represents the logarithm of the Compliance Cost. The regressions include as controls: genre and age composition of the firms and average wage, as well. Standard errors are presented in parentheses. The coefficients and standard errors for the all year round estimation are computed using the delta method on the basis of a quarterly estimation; these coefficients stand for the sum of the four quarterly coefficients.
Source: PILA, authors calculations.

Table A6: GAP excluding the surprise of MW increase

	Job destruction rate	Job creation rate	Separation rate	Hiring rate	Churning rate	Employment net growth (%)
β1	0.8412***	-0.7072***	0.9645***	-0.5839***	0.2466***	-1.5485***
	(0.0265)	(0.0193)	(0.0272)	(0.0215)	(0.0184)	(0.0360)
β1 + β2	0.1457***	-0.1217***	0.2361***	-0.0312	0.1809***	-0.2673***
	(0.0222)	(0.0260)	(0.0234)	(0.0273)	(0.0190)	(0.0376)
β1 + β3	0.2736***	-0.4915***	0.3107***	-0.4544***	0.0742***	-0.7651***
	(0.0239)	(0.0232)	(0.0246)	(0.0247)	(0.0184)	(0.0358)
β1 + β4	0.1741***	-0.4043***	0.1807***	-0.3977***	0.0132	-0.5784***
	(0.0250)	(0.0225)	(0.0256)	(0.0240)	(0.0182)	(0.0366)
All year round	1.4346***	-1.7247***	1.6920***	-1.4673***	0.5148***	-3.1593***
	(0.0636)	(0.0571)	(0.0669)	(0.0641)	(0.0540)	(0.0809)
Observations	3,070,254	3,070,254	3,070,254	3,070,254	3,070,254	3,070,254
Number of firms	155,065	155,065	155,065	155,065	155,065	155,065

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%. The variable Ln GAP represents the logarithm of the Compliance Cost. The regressions include as controls: genre and age composition of the firms and average wage, as well. Standard errors are presented in parentheses. The coefficients and standard errors for the all year round estimation are computed using the delta method on the basis of a quarterly estimation; these coefficients stand for the sum of the four quarterly coefficients.
Source: PILA, authors calculations.


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