Minimum Wages, Firm Pay Policies and Employment Flows

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Abstract

This paper provides new evidence on the minimum wage impact on employment flows, using Costa Rica's distinctive occupation-based setting. I use administrative data from 2006-2017 to estimate firm-level minimum wage exposure and compute dynamic responses to the policy. Results indicate that firms increase their pay premiums in compliance with the policy. However, higher minimum wages have a negative and persistent impact on hiring rates and induce a temporary increase in separation rates. Job-to-job separation rates, on the contrary, decline after a minimum wage increase. I propose a wage-posting model with endogenous job creation to rationalize the results.

JEL Codes: D22, D24, E24, J23, J24, J31, J38

1 Introduction

What are the effects of higher minimum wages on employment flows? An extensive body of literature has studied the policy's effects on employment levels, finding a small to null impact. Still, there is remarkably less information on the minimum wage effects on employment flows.

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From a theoretical perspective, minimum wages have ambiguous effects on employment flows. By increasing the minimum wage, fewer matches are profitable for firms, decreasing vacancy creation and rising layoffs. Conversely, higher minimum wages improve employers' ability to retain and attract new workers, potentially increasing hirings and decreasing voluntary quits. From the empirical point of view, identifying the policy's effect is challenging due to the high data requirements, as it is necessary to have a reliable linked employer-employee structure to construct flow rates accurately. Overall, the bulk of empirical evidence comes from studies restricting to specific sectors and demographics, such as teens and restaurant workers.

In this paper, I study Costa Rica's labor market between 2006 and 2017. This country represents a testing ground as its occupation-specific minimum wage setting extends the policy's incidence to the entire labor market segment. Additionally, the country experienced sizeable and permanent minimum wage increases during the analysis period that, jointly with the distinctive minimum wage setting, provides useful variation to identify the policy's incidence. Finally, Costa Rica offers rich administrative data to explore the potential effects of higher minimum wages on employment flows.

I combine different administrative datasets covering the universe of firms and workers in Costa Rica's formal sector to estimate firm-level exposure. More precisely, I define exposure as the firm-level compliance cost to the minimum wage policy, i.e., the increase in the total wage bill that a firm has to pay to satisfy the new minimum wage requirements. A one percentage point, for instance, means that the firm has to increase its wage bill by one percent to bring all of its current employees up to the new minimum wage levels. This variable, however, is potentially endogenous. Hence, I construct an instrument exploiting the fact that firms are differentially exposed to the common minimum wage adjustments based on their occupational composition. More precisely, the instrument consists of the occupation-specific minimum wage increases, weighted by the firm's occupational composition in 2007. Afterward, I estimate a sequence of regressions estimating a minimum wage change effect on firm outcomes at different year horizons. In other words, I explore if differential exposure to the minimum wage leads to differential changes in firm-level hirings and separation rates.

The paper starts by showing that higher minimum wages induce firms to increase their pay premium. I estimate a time-variant two-way fixed-effect model (TV-AKM) (Engbom and Moser (2020); Lachowska et al. (2020)) to measure the firm pay premium and examine how it behaves in conformity with the minimum wage changes. Under this specification, the firm fixed-effect, which precisely captures the idiosyncratic pay policy, is allowed to vary over time through a set of flexible firm-year fixed effects. Focusing on

the pay premium is relevant as it accounts for the policy's spillover effects on workers not directly exposed by the policy.[1] Furthermore, studying the nature of pay dynamics in response to the minimum wage is key to rationalize the policy's reallocative effects (Dustmann et al. (2019)) and its impact on inequality (Autor et al. (2016); Engbom and Moser (2018)). The analysis results indicate that a one percent increase in the average wage induced by the minimum wage increases the firm pay premium between 0.16 and 0.18 percent. Hence, the minimum wage prompts low-paying firms to catch up with higher-paying firms.

Firms respond to higher minimum wages by reducing their employment levels. Nonetheless, the magnitude of the adjustment is relatively small, with an elasticity[2] converging around -0.14. These small disemployment effects are line with recent empirical work (e.g., Cengiz et al. (2019); Harasztosi and Lindner (2019); Dube (2019a)).

In contrast with the relatively small effects on levels, employment flows show a more substantial response to the policy. A one percentage point increase in compliance cost reduces firm-level hiring rates between 12.4 and 17.0 percent. Conversely, the policy does not have an adverse incidence in poaching hire rates (job-to-job transitions). In other words, hirings from other firms do not decline with higher minimum wages.

Separation rates increase with higher minimum wages. Nevertheless, the impact is transitory, taking place around one and two years after the minimum wage change. For years in which the estimated effect is significant, separation rates rise around 15 percent after a one percentage point increase in firm-level compliance cost. The positive impact on separations is consistent with the disemployment effects previously documented. Nevertheless, job-to-job and separations to nonemployment exhibit a contrasting response. Separation to nonemployment rate follows a similar behavior to the aggregate rate, with an effect peaking one-three years after the minimum wage increase. Separation from poaching (employer-to-employer transitions) rates are not affected in the short term and decline in the longer term to stabilize around 14.4-17.0 percent lower than the initial levels before the minimum wage increase. Overall, the results imply that higher minimum wages reduce employer-to-employer flows.

I propose a wage posting model featuring worker and firm heterogeneity, jointly with endogenous vacancy creation, based on Burdett and Mortensen (1998) and Engbom and Moser (2018). Under this framework, a minimum wage hike affects the competitive labor market environment in two ways. First, it reduces the mass of firms operating in the mar-

[1] Autor et al. (2016); Engbom and Moser (2018); Cengiz et al. (2019) show, both empirically and theoretically, that raising the minimum wage has ripple effects throughout the wage distribution.

[2] The elasticity is defined as the percent change in employment due to a one percent increase in the labor costs induced by the minimum wage.

ket. Second, higher minimum wages compress the wage distribution, forcing even high-paying firms to increase their wages to retain their pay rank. According to the model, the decrease in the job-to-job separation rates comes from a decline in the number of offers attractive enough to motivate the worker to leave her current employer for another firm. Such a reduction in the offer arrival rate results from firms increasing their wages in compliance with the policy, improving their ability to retain workers, and fewer employers competing in the labor market. The decrease in hirings comes from the compression in the profit margins due to higher labor costs. However, the effect is moderated by less congestion in the market. Specifically, since a given vacancy is more likely to contact a worker, then employers have more incentives to create vacancies. The estimation of the model is currently in progress.

The paper proceeds as follows. Section 2 describes the salient features of Costa Rica's minimum wage policy. Section 3 describes the data and provides some descriptive statistics, while Section 4 discusses the empirical strategy of the paper. Section 5 presents and discusses the results and Section 6 explains the setup of the theoretical model (in progress).

Related literature and contribution: This paper makes a direct contribution to the minimum wage literature exploiting microdata to report the policy's incidence on firms. The bulk of studies focus on worker outcomes (e.g., Dube (2019b); Dustmann et al. (2019); Derenoncourt and Montialoux (2019); Clemens and Wither (2019)), inequality (Autor et al. (2016); Engbom and Moser (2018)), and employment levels (Cengiz et al. (2019); Harasztosi and Lindner (2019)).

The information on employment flows is limited. Costa Rica's occupation-specific minimum wage setting is crucial as the policy extends to the entire labor market segment. Hence, I can account for heterogeneity in capital-labor substitution across sectors (Herrendorf et al. (2015); Garita (2020a)). But additionally, the sizeable and permanent minimum wage adjustments are suited to explore dynamic responses. Brochu and Green (2013) and Dube et al. (2016) are the most recent and representative related analyses using worker and firm-level data. Both studies find that separations and hires fall substantially following a minimum wage increase. On the contrary, my paper reports an increase in separation rates. Brochu and Green (2013) and Dube et al. (2016) restrict the analysis to restaurants and low-skilled teen workers. Similarly, they provide immediate and short term responses to the policy. These elements possibly explain the difference in the results.

Additionally, this paper contributes to the literature exploring the dynamic behavior of firm pay policies over time. Engbom and Moser (2020) for Sweden and Lachowska et al. (2020) for Washington State, for instance, develop the time-varying extension of the

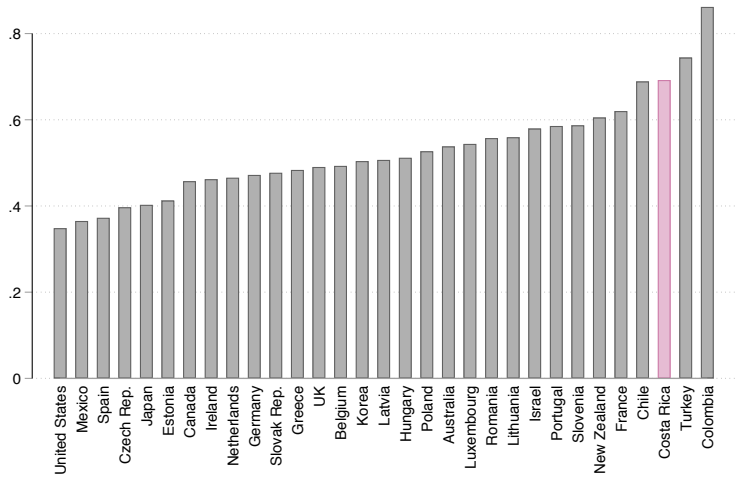
AKM implemented in this paper to assess the role of firms in earnings inequality and persistence in the pay policies over time. In this paper, I contribute to this literature by showing that minimum wages shape firm pay dynamics. Therefore, imposing a time-invariant firm fixed-effect, as the traditional AKM model, could be an invalid assumption in economies with a strong and evolving labor market regulation.

2 Minimum Wage Setting

The minimum wage policy in Costa Rica is substantially more differentiated than in most of the OECD countries. This country implements a multi-tiered system of legal wage floors that vary by occupation, so minimum wage rates are essentially set by skill level. Adjustments are made twice a year, with new levels becoming effective in January and July, and decisions are carried out by the National Council of Salaries (NCS), a national-level tripartite commission formed of three representatives from labor unions, three from the Chamber of Commerce (private-sector companies) and three from the Central Government. The negotiating process is widely publicized, and the central purpose of the policy is to protect low-wage workers by establishing a wage floor that ensures basic living conditions to these individuals.

Overall, Costa Rica has a highly binding minimum wage. Figure 1 offers an international comparison, placing Costa Rica as one of the economies with the highest minimum wage.

Figure 1: Kaitz Index Across OECD countries
(Percentage of median wage. 2015)



Notes: Minimum relative to median wages of full-time workers
Source: OECD LFS

Workers are organized into three broad categories. The first group is of occupations associated with the production process (blue-collar workers). The second one, generic, applies to white-collar or administrative occupations. The third one covers specific occupations such as domestic workers and reporters. The first two groups are further divided into four skill categories: unskilled, semi-skilled, skilled, and specialized. Finally, there is an additional legal wage floor for workers with a bachelor's degree (undergraduate diploma) and university graduates (5-year university degree or *Licenciatura*). Table 1 summarizes the most important categories.

Table 1: Costa Rica: Minimum Wages by Skill Groups

	Minimum Wage (Low Skilled=100)	Kaitz Index	Percentage Increase 2006-2017	
			Nominal	CPI-Deflated
Low Skilled	100	0.82	122.8	27.7
Semi Skilled	122	0.77	118.0	25.0
Skilled	127	0.74	113.1	22.1
Technical Low-Skilled	143	0.61	107.3	18.8
Specialized	146	0.67	108.2	19.3
Technical High-Skilled	194	0.68	107.3	18.8
Bachelors University	216	0.55	107.3	18.8
University Graduate	290	0.45	107.3	18.8

Notes: The Kaitz Index is defined as the ratio of minimum wage to median wage. The monthly minimum wage for a low skilled worker in 2020 is 316,965 CRC, approximately US$560.
Source: Ministry of Labor and Social Security (MTSS)

Starting 2009, Costa Rica experienced a rapid decline in the inflation rate, a direct result of the adoption of an inflation-targeting regime, and the abrupt decrease in the international price of commodities due to the great recession (See Figure 3). These elements lead to an automatic and significant increase in the minimum wage between 2009 and 2016, as the 1998 agreement opened the room for negotiation only in cases of atypically high inflation rates and given the fact that inflation expectations slowly adjusted to the new inflationary steady state. In late 2011, the NCS and the Central Government agreed upon a new formula that takes into account recent but now expected inflation and GDP per capita during the past five years. Such a transition explains why the minimum wage behavior stabilizes in real terms after 2016.

Figure 2: Minimum Wage Minimorum
(CPI-2015 Deflated. January 2000=100)

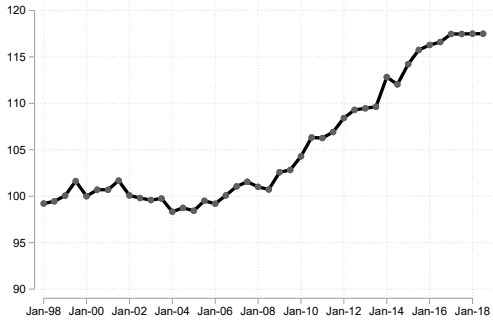
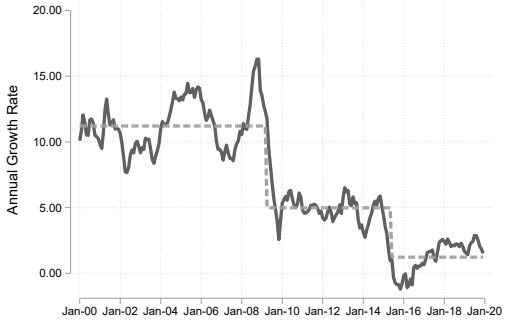


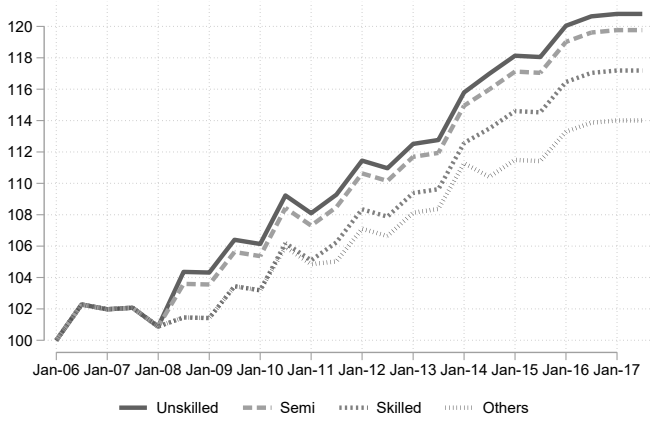
Figure 3: Annual Inflation Rate
(CPI-2015)



Notes: The Minimum wage minimorum is the lowest level of the multi-tier system, corresponding to low-skilled occupations
Source: Ministry of Labor and Social Security (MTSS) and Central Bank of Costa Rica (BCCR)

The NCS decided to increase the minimum wage of the lower-skilled categories relatively more on three occasions (2008, 2012 and 2014). Hence, by 2017, low-skilled occupations experienced a sharper increase in the legal wage floor (see Figure 4). As it can be read from the NCS minutes that contain the discussion around each minimum wage adjustment decision (MTSS, 2008, 2012, 2014), the resolution of increasing low-skilled legal wage floors relatively more was mostly because under the new inflation rates, the indexation would lead to a small increase that would break a long period of two-digit growth rates, causing some social and political discontent. In other words, inflationary inertia was the main factor behind the decision-making process and the upward trend observed between 2008 and 2016.

Figure 4: Costa Rica: Minimum Wage by Skill Groups
(CPI-2015 deflated. January 2006=100)



Notes: "Others" include specialized occupations, and university graduates.
Source: Ministry of Labor and Social Security (MTSS)

The steady increase in the real minimum wage translated into a higher bite of the minimum wage into the wage distribution. As shown in Figure 5, the mass of earnings around the relevant minimum wage significantly increased in 2017 relative to 2007.

Figure 5: Wage Distribution

Notes: Figure shows the frequency distribution of monthly log earnings in 2008 (last year before the steady increase in the real minimum wage), and in 2017 (when the adjustments stabilized in real terms). The red outlined bars show the earning distribution in 2017, and the grey solid bars show 2008. Labor earnings are CPI-2015 deflated. Sample selection restricts to full-time workers aged 18-60 employed by the private-sector.

3 Data and Descriptive Statistics

3.1 Main Dataset

I combine different administrative datasets that collectively comprise the universe of workers and firms in Costa Rica's formal sector. The first source of information is a monthly linked employer-employee data (CR-LEED) that I construct using raw firm-level records reported to the Costa Rican Social Security Fund and secured by the Central Bank of Costa Rica (BCCR). This data matches workers and employers from 2006 to 2017 and identifies each person with the legal person identifier and each employer with a legal tax identifier that facilitates the merging with other related information. By nature, these reports exclude part of the informal sector since they only include individuals contributing to social security. For each worker, I observe sociodemographics such as age, nationality, sex, and residence. In terms of the job match, I observe monthly labor earnings, full-time status, and if the employee is on paid-leave (maternity or sick-leaves, for example). Jobs are likewise organized into occupations according to the tasks and duties that are undertaken in the job, consistent with the International Standard Classification of Occupations (ISCO) at a 4-digit level.

The second dataset comes from the universe of corporate tax returns presented by firms from 2005 to 2018 (REVEC), which consists of annual balance sheets and income statements. I construct firm-level measures of performance and productivity from these records. Since both workers and firms are identified using the same legal identifiers, it is straightforward to combine both data sources. The outcome is a clean and comprehensive picture of the labor market, representing a significant advantage concerning existent literature, as most of the related studies lack at least one dimension of information. For instance, the administrative structure of it allows tracking with high precision firm entry and exit and, additionally, identifying and labeling employment flows and job-to-job transitions. Furthermore, I can observe the workforce and wage bill composition of each firm at a high detail to compute accurate and granular measures of exposure to the minimum wage.

One limitation, however, is that employers do not report the number of hours the employee worked. I overcome this shortcoming by restricting to full-time workers and exploiting the longitudinal history and panel structure to identify atypical wage reports. In Garita (2020b), I provide more details about the data cleaning process.

3.2 Employment Flows

I follow the standard literature (e.g., Decker et al. (2014); Sorkin (2018); Crane et al. (2019); Song et al. (2019)) to measure employment transitions and construct the employment flow rates. Briefly, I consider job matches that span two consecutive quarters. If the worker's employer changes without any gap in earnings, then I label the flow as a job-to-job transition. On the contrary, if the worker spends two or more quarters without earnings, I mark the transition as a movement from or to nonemployment. One crucial difference between Costa Rica's data relative to other sources of information is its monthly frequency. Such high frequency allows me to detect the timing and the nature of the transitions accurately.

I define hires or accessions as the number of workers who started a new job at the firm. I do not consider an accession those individuals previously working at the specific firm and spend less than one quarter either in nonemployment or working for other employers, and then return to the firm. Separations are defined as the number of workers who leave the firm. As before, I rule out individuals who quit the firm for less than one quarter to later return. As in Davis et al. (2013), I express labor market flows from $t-1$ to t as rates by dividing by the average of employment in $t-1$ and t.

3.3 Descriptive Statistics

Table 2 summarizes the primary descriptive statistics for the firms in the sample in 2007. In this case, exposure is measured as the fraction of minimum wage workers employed by the firm. Firms with higher exposure are low-paying and smaller, both in terms of revenues and employment. These firms, additionally, are relatively more labor-intensive. Hiring rates strongly decline as exposure increases. Conversely, separation rates are higher for highly exposed firms.

Table 2: Summary Statistics by Exposure Intensity. 2007

	All	Fraction of Minimum Wage Workers			
		0-25	25-50	50-75	75-100
Wage Bill	16.54	17.09	16.31	16.04	15.57
Average Wage	13.99	14.24	13.92	13.76	13.50
Revenue	18.70	19.14	18.47	18.27	17.98
Workers	41.06	64.65	21.35	16.39	11.39
Labor Share	0.17	0.18	0.16	0.16	0.14
Export Share	0.03	0.04	0.03	0.02	0.01
Capital-Labor Ratio	7.35	8.41	7.24	6.66	4.99
Hiring Rate	8.7	9.6	9.2	6.3	2.6
Hiring Rate (EE)	3.3	3.8	3.0	2.0	0.8
Hiring Rate (NE)	5.4	5.8	6.2	4.3	1.8
Separation Rate	8.9	7.4	8.4	8.9	9.1
Separation Rate (EE)	3.5	3.4	3.4	3.6	3.6
Separation Rate (NE)	5.4	4.0	5.0	5.3	5.5
Firms	18,646	9,835	3,452	2,287	3,072
(Fraction of total)	100	52.7	18.5	12.3	16.5

Notes: Export and labor share as proportion of revenues, profitability defined as profits per revenue. Export share include firms with zero exports. Capital-Labor ratio (fixed assets divided by number of workers) in millions of 2012 CRC. EE denotes employer-to-employer transitions and NE flows from and to nonemployment.
Source: CR-LEED

4 Empirical Strategy

4.1 Minimum Wage Exposure

I define minimum wage exposure as the percentage increase in firm j's wage bill required to bring all of its current employees up to the new minimum wage[3]:

$$Exposure_{j,t} = \frac{\sum_{i,o} \max\left(w_{o,t}^{min} - w_{i,j,o,t-1}, 0\right)}{\sum_{i,o} w_{i,j,o,t-1}}$$

This variable can also be interpreted as a firm-level compliance cost or a firm-specific minimum wage increase. It measures the distance between each worker's wage and the next year's minimum wage level.[4] By definition, this exposure measure requires complete worker-level detail for an accurate estimation.[5] The granular detail in the Costa

[3]Both wages and minimum wages are deflated using the CPI

[4]Between 2006 and 2015, minimum wages were adjusted in January and June of each year. I use the January level for constructing the exposure measure.

[5]The existing literature has proven that such data requirement is difficult to meet, as there are not many

Rican data represents a pivotal advantage to overcome these limitations, as I can construct accurate exposure measures for each firm in the labor market, regardless of its size or industry. If $Exposure_{j,t}$ increases by one percentage point, then the minimum wage policy is forcing the firm to increase its wage bill by one percent. Draca et al. (2011) also used a similar metric to measure minimum wage exposure, calling it the wage gap.

$Exposure_{jt}$ is measured based on the labor composition the period before the minimum wage change. In other words, it measures the firm-level increase in the wage bill induced by the minimum wage if the employer does not change its employment structure. Using current minimum wage changes and individual wages could be misleading as it would capture adjustments that the firm already implemented to comply with the policy. However, $Exposure_{jt}$ is still potentially endogenous, as it could be correlated to unobservables affecting firm outcomes. For example, an unobserved productivity shock can lead to changes in the employment composition and levels, simultaneously affecting minimum wage exposure and changes in outcome variables. Additionally, exposure could be correlated to unobservables that simultaneously put the firm closer to the minimum wage and the exit margin. To address this issue, define $z_{j,o,t}$ as the occupational share: the number of workers employed in occupation o relative to the total employment within the firm. Then, the exposure measure can be decomposed as the weighted average of exposure in each occupation category:

$$Exposure_{j,t} = \sum_{o} z_{j,o,t} Exposure_{j,o,t}$$

This structure precisely emphasizes that firms are going to be differentially exposed to the common minimum wage adjustments based on their occupational composition. Hence, I consider $Exposure^{IV}_{j,t}$, an instrument for $Exposure_{j,t}$, defined as follows:

$$Exposure^{IV}_{j,t} = \sum_{o} z_{j,o,2007} mw_{o,t+1}$$

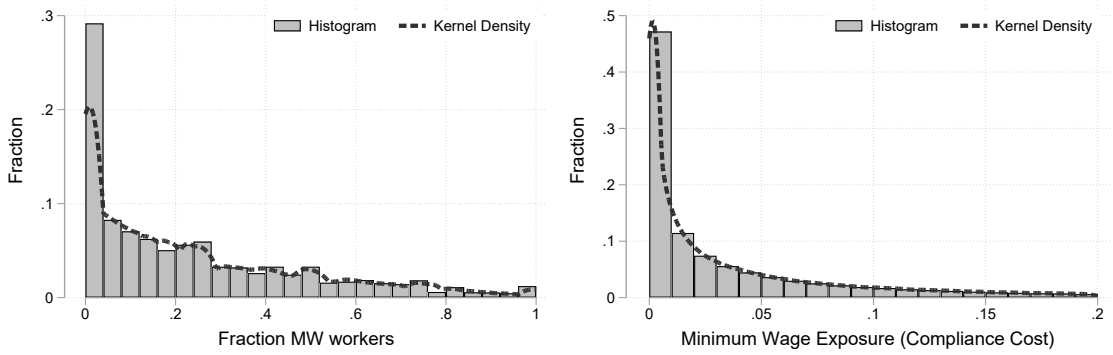
Where $mw_{o,t+1}$ is the percent change in the real minimum wage for occupation o relative to 2007 levels and $z_{j,o,2007}$ is the respective occupational share in firm j, estimated in 2007. By fixing the occupational shares to the 2007 levels, I analyze if firms with a particular occupational composition experience differential changes in outcomes following the minimum wage increases. The $Exposure^{IV}_{j,t}$ variable can be interpreted as a firm-level

information sources with such detail. Most of prior work measures of treatment intensity based on firm average wages, due to lack of worker-level data. As explain by Draca et al. (2011); Mayneris et al. (2018), any continuous measure of treatment intensity based on firm average wage is potentially noisy, especially when defining groups based on treatment.

minimum wage increase, using the initial occupational shares as weights. The instrument is, by nature, a shift-share instrument and, as shown by Goldsmith-Pinkham et al. (2020), the empirical strategy is numerically equivalent to a generalized method of moments (GMM) estimator with the occupation shares as instruments and a weight matrix composed by the occupation-specific minimum wage increases.

Figure 6 summarizes the distribution of minimum wage exposure across firms in 2007. Consistent with the nature of the policy, there is a considerable concentration of firms with zero exposure. However, there is substantial variation in the degree of exposure among the rest of the firms. Besides, Table 3 confirms Costa Rica's setting extends to a large proportion of the labor market segment. Low binding minimum wage policies are characterized by an unpromising variation of minimum wage exposure, forcing researchers to restrict the analysis on specific sectors and demographics. Moreover, such a lack of variation has been a point of debate. Part of the literature argues that a low binding minimum wage policy is insufficient to detect the policy's true impact on firms (e.g. Sorkin (2015); Meer and West (2016); Neumark (2019); Clemens and Wither (2019)).

Figure 6: Histogram of Minimum Wage Exposure Measures (2007)



Notes: Figures show the histrogram of the firm-year estimated exposure to the minimum wage. Figure on the left shows the fraction of minimum wage workers employed by each firm. Figure on the right displays the wage gap (benchmark minimum wage exposure measure).
Source: CR-LEED

Table 3: Minimum Wage Exposure by Industry

Industry (2-digit ISIC Rev. 4)	Mean	Median
Agriculture, fishing and mines	0.25	0.19
Manufacturing	0.22	0.15
—*Food products*	*0.21*	*0.14*
—*Wearing apparel*	*0.30*	*0.27*
—*Wood and of products of wood and cork*	*0.31*	*0.30*
—*Rubber and plastics products*	*0.15*	*0.06*
—*Computer, electronic and optical products*	*0.12*	*0.07*
—*Manufacture of machinery and equipment*	*0.19*	*0.11*
Electricity , gas and water	0.17	0.07
Construction	0.20	0.14
Wholesale and retail trade	0.17	0.11
Accommodation and food service activities	0.20	0.14
Transportation and storage	0.19	0.11
Information and communication	0.15	0.08
Financial and insurance activities, real estate	0.12	0.04
Professional, scientific and technical activities	0.18	0.13
—*Management consultancy activities*	*0.11*	*0.03*
—*Advertising and market research*	*0.18*	*0.13*
—*Security and investigation activities*	*0.21*	*0.16*
Education	0.24	0.18
Human health and social work activities	0.22	0.18
Arts, entertainment and recreation	0.18	0.11
Other service activities	0.21	0.17

Notes: Table shows the fraction of minimum wage workers by industry in 2006-2007 (average.

In Garita (2020b), I discuss the identification assumptions and tests to argue for their plausibility. Overall, the F-statistic for all horizons confirm a robust first-stage (see Table 5).

4.2 Employment Flow Analysis

The main goal of the paper is to estimate if differential exposure to the minimum wage leads to differential changes in relevant firm outcomes. To account for dynamics in the response, I estimate a sequence of regressions based on the local projection framework proposed by Jordà (2005). For firm j at year t and horizon $h = 1, ..., 5$, I consider the following specification[6]:

[6]For $h = 0$, consider $\Delta_0 Y_{j,t} = \alpha_0 + \beta_0 Exposure_{j,t} + \gamma_0 X_j + \nu_{s,t} + u_{j,t}$

$$\Delta_h Y_{j,t+h} = \alpha_h + \beta^h Exposure_{j,t} + \sum_{i=0}^{h-1} b_i Exposure_{j,t+1+i} + \gamma_h X_j + \nu_{s,t+h} + u_{j,t+h} \quad (1)$$

With $Y_{j,t}$ denoting firm's j employment flow rate (hiring and separation rates, time-variant firm fixed effect), $\Delta_h Y_{j,t+h} = Y_{j,t+h} - Y_{j,t-1}$ the cumulative difference at horizon h.[7] $\nu_{s,t+h}$ denotes a set of industry (2-digit)-year controls and X_j a battery of firm-level characteristics in 2006-2007.[8] As discussed above, one p.p. increase in $Exposure_{j,t}$ means that the minimum wage policy is pushing firms to increase their wage bills by one percent to comply with the new requirements.

In case of a single and permanent minimum wage increase, a local projection of $\Delta_h \ln Y_{j,t+h}$ on $Exposure_{j,t}$ would be enough to capture short and longer-term responses to a single period minimum wage change at t. However, minimum wages also vary between $t+1$ and $t+h$ following the initial change captured in $Exposure_{j,t}$. Therefore, the h-period cumulative change in outcome Y combines the impact of the initial and subsequent minimum wage changes. To account for this staggered nature, equation (1) controls for those minimum wage changes between $t+1$ and $t+h$ through the $\sum_{i=0}^{h-1} b_i Exposure_{j,t+1+i}$ term. Hence, β^h would be the coefficient of interest: the firm-level response to a minimum wage change in t at different year horizons, controlling for subsequent minimum wage changes.

As mentioned previously, one issue is that $Exposure_{j,t}$ is likely to be endogenous. Then, for each relevant year horizon h, I instrument the exposure term using the instrument discussed previously, $Exposure^{IV}_{j,t+h} = \sum_o z_{j,o,2007} mw_{o,t+h}$.

4.3 TV-AKM Framework

A primary motivation behind this research is to understand how institutional settings such as minimum wage policies shape employers' pay policies and the firm pay premium's dispersion. As explained in Song et al. (2019), some firms pay workers with similar skills relatively more than others, and the distribution in these pay premia is closely tied to wage inequality and allocative patterns. As summarized in Card et al. (2018), part of this conduct is the result of the pervasive market power that employers have to mark

[7] In case of employment, I consider $\Delta_h \ln Y_{j,t+h} = \ln Y_{j,t+h} - \ln Y_{j,t-1}$, i.e., the cumulative log difference.

[8] I measure and fix these characteristics in the 2006-2007 as these two years represent the ending of a long period of real minimum wage stability, as previously discussed. Variables include export share, import share, profitability, labor share, capital share, average industry-level exposure. These covariates control for the relative importance of capital and labor within the firm, international trade exposure, firm size, and how close the firm is to the exit margin. I additionally include the square of these variables, and the average industry-level exposure in 2006-2007

down wages below the respective marginal product of labor. As recently discussed in Berger et al. (2019) and Manning (2020), minimum wage policies can counter the monopsony power of firms and potentially improve the worker's bargaining power, driving to a reduction in firm premia dispersion. In the spirit of recent research and to shed new light on this channel, I implement a time-variant AKM model (TV-AKM) as proposed by Lachowska et al. (2020) and Engbom and Moser (2020). The basic idea behind this model is that the log earnings or wage of individual i at time t can be decomposed as the sum of a worker time-invariant component α_i, capturing permanent worker heterogeneity and unobserved ability differences (such as return to school or innate ability), a firm component ψ_{jt} that precisely can be interpreted as firm-specific relative pay premiums (including rent sharing or compensating differentials), γ that captures the role of time-varying worker characteristics (education-specific age effects[9]) and an error component ε_{it} collecting shocks to human capital, person-specific job match effects, and other factors:

$$w_{it} = \alpha_i + \psi_{J(i,t),t} + X'_{it}\gamma + \varepsilon_{it} \tag{2}$$

In equation (2), $J_{(i,t),t}$ is a function that indicates the employer identity of worker i in year t, and such specification differs from the standard AKM model as firm effects are time-variant. The proposed extension is highly appropriated for this investigation as imposing stability on the employer pay policies over time represents a strong assumption that is at odds with Costa Rica's minimum wage policy. But also it addresses some limitations encountered in the conventional AKM framework that have been pointed out in the literature (e.g., Lopes de Melo (2018); Bonhomme et al. (2019)). In specific, one frequent criticism is that the estimation of the fixed effects relies on job-to-job transitions that are usually limited in modern labor markets. When moving to a firm-year combination, workers remaining employed in the firm contribute to identifying the employer's fixed effect. Yet, the model rests on the strict exogeneity condition $\mathbb{E}[\varepsilon_{it}|i, jt, t, X_{it}] = 0$, i.e, that worker mobility is uncorrelated with the time-varying residual components of wages. Estimation is analogous to the standard AKM approach; I estimate equation (2) using OLS for workers and firms in the largest connected set.[10]

[9] I follow Card et al. (2018) by including normalized age dummies that deal with the collinearity issue between age, cohort, and time.

[10] The identification of the firm's fixed effects is reached within a set of firms and workers connected through workers' mobility. In this case, each firm-year combination is treated as a single vertex of the workers and employers' network. Mobility is defined by switches between different employers and individuals that remain with the same employer during the sample period. Additionally, the identification requires the normalization of one firm-by-year combination within this connected set, instead of an entire firm normalization. The final connected set represents close to 99% of the firm-year observations in the estimating sample.

The main results of this empirical exercise are summarized in Table 4.[11] The worker fixed effects are more dispersed than the firm pay policies, and they dominate the wage regression. The specification has a strong explanatory power, with an adjusted R^2 close to 90 percent. Firm-specific policies play an important role as they explain around by explaining 14.9 percent of the variation in wages. The correlation and covariance between the worker and the firm effects, which is an indicator for assortative matching, is positive and sizeable, a good sign since important studies report a low and even negative correlation that reflects restricted mobility issues (see Lopes de Melo (2018)).

[11]The contribution of worker, firm and assortative matching in explaining the observed variance of wages can be estimated using the following decomposition: $Var(w_{ijt}) = Var(\hat{\alpha}_i) + Var(\hat{\psi}_{J(i,t),t}) + Var(X'_{it}\hat{\beta}) + 2 \times Cov(\hat{\alpha}_i, \hat{\psi}_{J(i,t),t}) + 2 \times \sum Cov(.) + var(\hat{\varepsilon}_{it})$

Table 4: TV-AKM Results

Panel A: Descriptive Statistics	
Number Worker-Year Obs.	9,023,508
Number Workers	1,544,411
Number Firms	52,248
Largest Connected Set	99.04
Mean Log Wages	12.90
Panel B: Main Results	
Variance Worker FE	0.182
Variance Firm FE	0.055
Correlation Worker and Firm FE	0.153
Adj. R^2	0.919

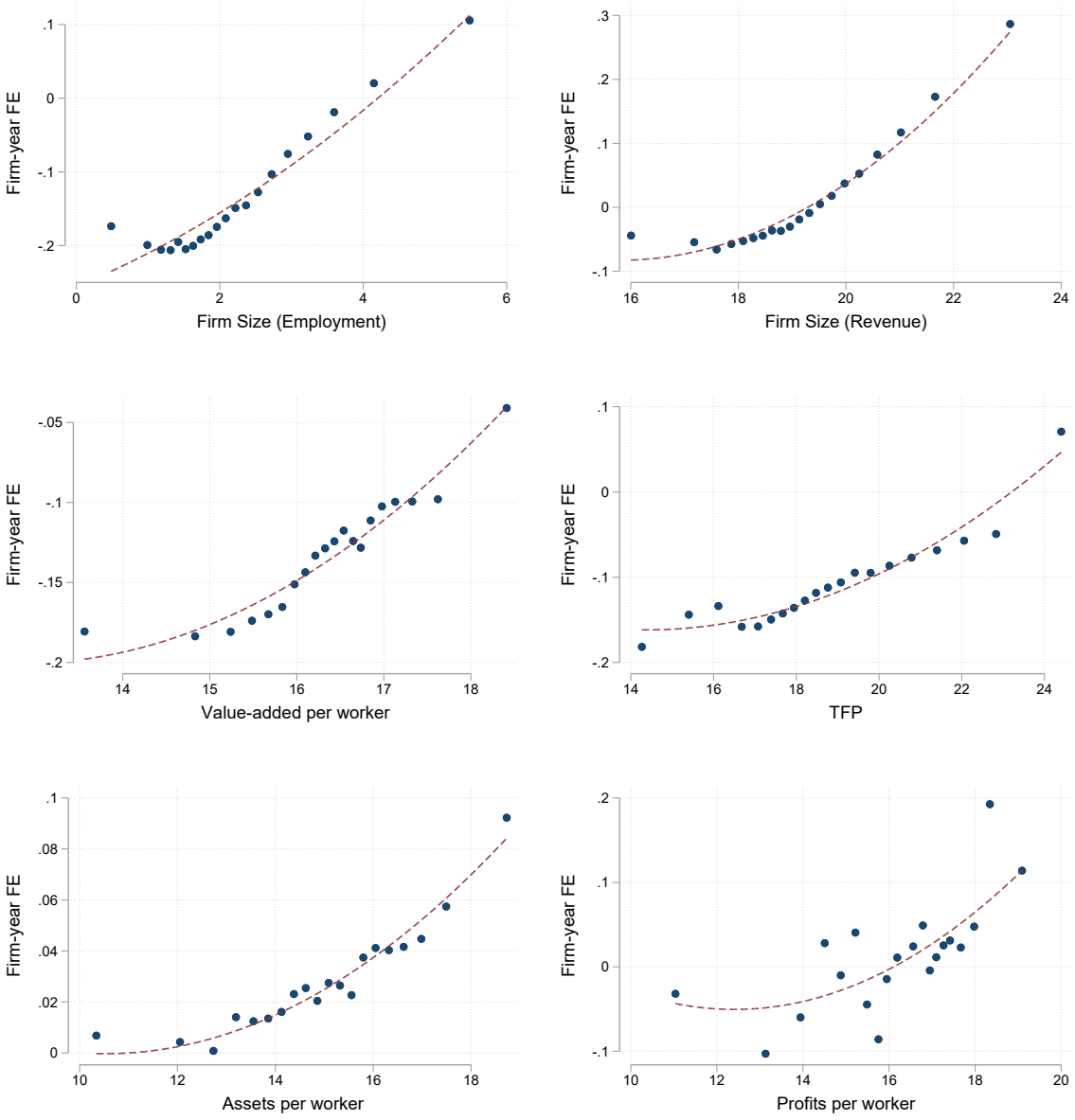
Panel C: Variance Decomposition		
	Variance Component	Share of Total (%)
Variance Log Wages	0.311	100
Variance Worker FE	0.184	59.0
Variance Firm FE	0.046	14.9
Variance X_{it}	0.006	2.0
$2 \times Cov(\hat{\alpha}_i, \hat{\psi}_{jt})$	0.040	13.0
$2 \times \sum Cov(.)$	0.014	4.5
$Var(\hat{\varepsilon}_{it})$	0.021	6.7

Panel D: Contribution of Firm Heterogeneity to Wage Dispersion (% of Total)	
2006-2008	0.156
2009-2011	0.138
2012-2014	0.142
2015-2017	0.169

Notes: Largest connected set is stated in terms of the fraction of worker-years. Results include education-specific year fixed effects. Source: CR-LEED

The second step is to show that the firm-fixed effects capture something reasonably close to the firm pay policy. To accomplish so, I estimate the bivariate relationship between the computed firm-year fixed effects and firm-level measures of performance and productivity. Figure 7 emphasizes a clear and positive correlation between the employer fixed effects and productivity (value-added per worker and TFP index), size (employment and revenue), capital intensity (fixed assets per worker) and profitability.

Figure 7: Firm Pay Premium and Characteristics

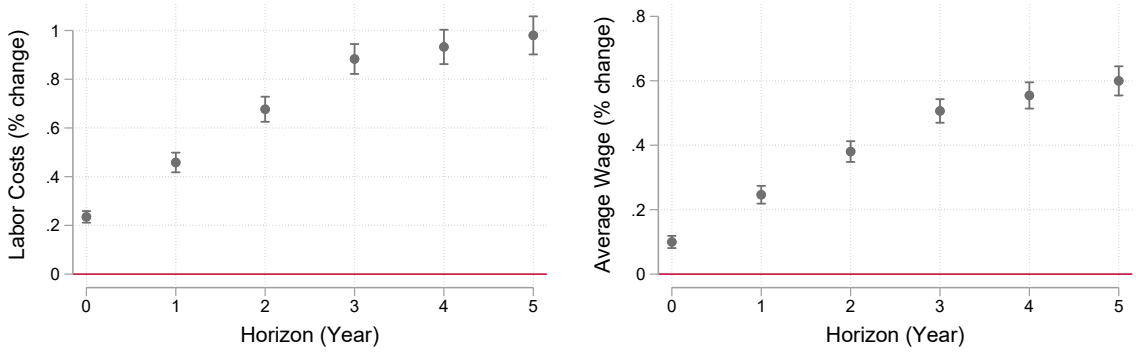


5 Estimation Results

5.1 Minimum Wages and Firm Pay Policies

Figure 8 reports the labor costs (total wage bill) and average wage responses to one percentage point increase in minimum wage exposure. More precisely, a percentage point increase in minimum wage exposure means that the firm has to increase its total wage bill by one percent to comply with the new minimum wage levels. Overall, the results validate that higher minimum wages persistently raised labor costs for firms.

Figure 8: Minimum Wages, Labor Costs and Average Wages



Notes: Figures show the response to a one percentage point in firm-level minimum wage exposure, calculated using equation (1), including 95 percent confidence intervals estimated using robust standard errors.

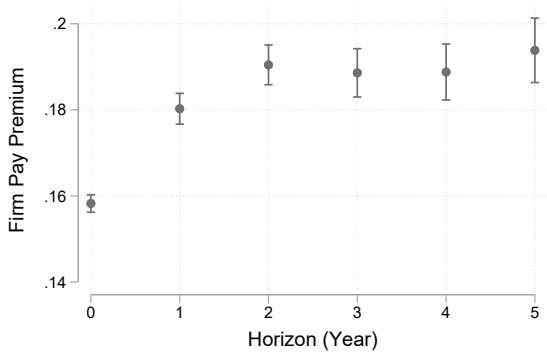
Figure 9 describes the firm wage premium response to a minimum wage change. I express the impact as the elasticity with respect to the average wage, i.e., the percent change in the firm's pay premium associated with a one percent increase in the average wage induced by the minimum wage.[12] The results of the estimation indicate that higher minimum wages induce low-paying firms to increase their wage premia. The estimated elasticity increases as the horizon expand to stabilize around 0.19. In other words, a one percent increase in the average wage induced by the minimum wage causes firms to increase their pay premium by 0.19 percent. The positive impact on the firm's pay premium provides empirical support to the set of models suggesting that minimum wages directly impact wage inequality by reducing between-firm pay differences (e.g., Engbom

[12]The elasticity corresponds to the ratio of the coefficient associated with the firm fixed effect and the average wage, both obtained separately from equation (1).

and Moser (2018); Flinn (2006); Flinn et al. (2017)). In fact, Table 4 reports a decline in the decline in the contribution of employer heterogeneity in explaining wage dispersion.

The dynamic behavior of the firm pay policy is a key driver of employment flows. If firms increase their relative pay, then the probability of a worker accepting a job offer would increase. Similarly, the firm's current employees would experience a decline in the number of outside offers attractive enough to motivate them to leave the firm. I will discuss the connection between the pay premium and the flow rate responses in further sections of the paper.

Figure 9: Minimum Wages and Firm Pay Premium



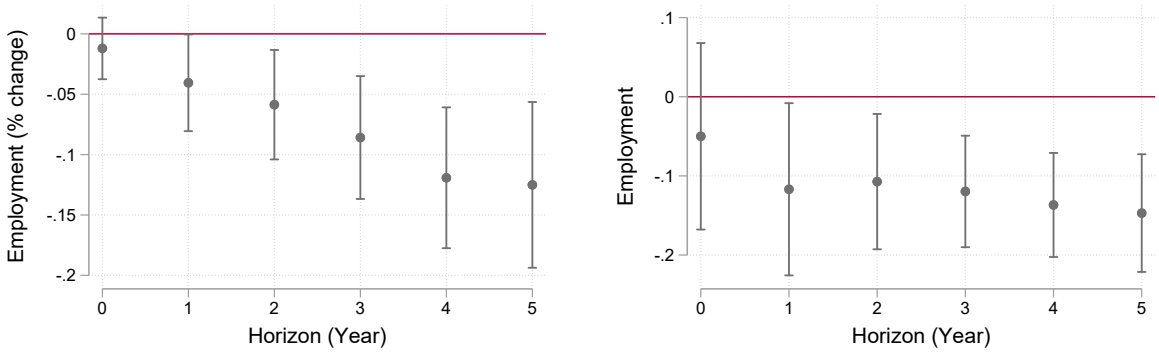
Notes: Figure shows the percentage increase in the firm pay premium associated to one percent increase in the average wage, alongside 95 percent confidence intervals estimated using boostrapped standard errors.

5.2 Minimum Wages and Employment

Figure 10 reports the main estimates for the employment levels. Higher minimum wages induce firms to reduce their employment levels. However, the impact takes a year to materialize, consistent with adjustment costs. Nevertheless, the estimated effect is relatively small. The elasticity with respect to labor costs stabilizes around -0.14 percent, meaning that a one percent increase in the labor costs induced by the minimum wage leads to a 0.14 percent decline in the employment stocks. Still, this estimate is within the range of empirical estimates found in recent work.[13]

[13]See Harasztosi and Lindner (2019); Dube (2019a) for a literature review on the employment effects.

Figure 10: Minimum Wages and Employment Levels



(a) Impulse Responses

(b) Elasticities w.r.t. Labor Costs

Notes: Figures on the left shows the response to a one percent point increase the compliance cost to the minimum wage, computed using equation (1), alongside 95 percent confidence intervals estimated using robust standard errors. Figures on the right shows the respective elasticity (percent change in the outcome variable due to one percent increase in the labor costs induced by the minimum wage) and 95 percent confidence intervals estimated using robust standard errors.

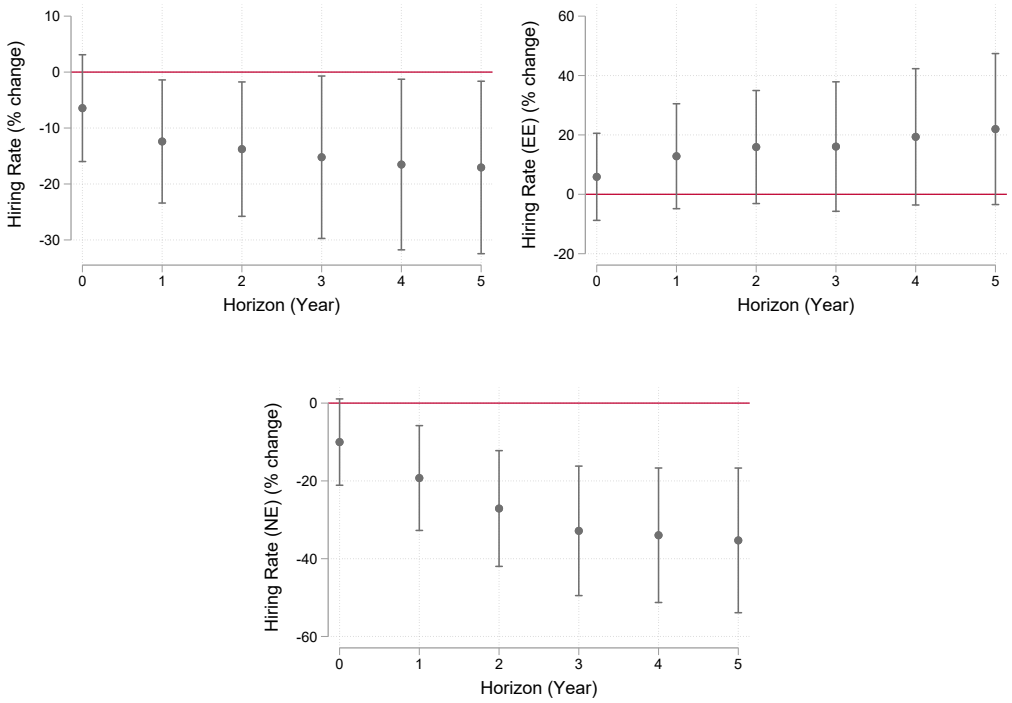
Table 5: Firm Outcome Responses to Minimum Wage Exposure

	Horizon (Year)					
	0	1	2	3	4	5
Hiring Rate	-6.444	-12.4*	-13.8*	-15.2*	-16.5*	-17*
	(4.87)	(5.61)	(6.13)	(7.41)	(7.78)	(7.86)
Hiring Rate (EE)	5.9	12.8	15.9	16.1	19.3	22.0
	(7.48)	(9.01)	(9.71)	(11.12)	(11.71)	(12.97)
Hiring Rate (NE)	-23*	-19.3*	-27.1*	-32.8*	-34*	-35.3*
	(5.66)	(6.87)	(7.59)	(8.49)	(8.82)	(9.49)
Separation Rate	5.0	14.2*	15.6*	10.6	9.8	2.2
	(5.64)	(6.83)	(7.55)	(8.24)	(8.74)	(9.05)
Separation Rate (EE)	2.6	-4.3	-5.0	-15.4*	-16.9*	-17*
	(6.32)	(6.65)	(7.04)	(7.45)	(7.90)	(7.91)
Separation Rate (NE)	2.7	15.6*	16*	15.9*	6.0	1.1
	(5.75)	(6.96)	(7.62)	(7.99)	(8.50)	(8.53)
Observations	142,360	120,310	101,791	85,657	71,258	57,805
F-Statistic	4,815	3,318	383	289	205	146
Overidentification Test	[0.219]	[0.127]	[0.128]	[0.505]	[0.942]	[0.571]

Notes: Table shows the log changes in the outcome variable to a one percent point increase the compliance cost to the minimum wage, following equation (1). Robust standard errors in parenthesis. Overidentification test reports the p-value (in brackets) for the null hypothesis that the instruments are valid (no misspecification). EE denotes employer-to-employer transitions and NE flows from and to nonemployment. * p<0.05

Table 5 and Figure 11 summarizes the estimated results on employment flows. Specifically, the plots show the percentage change in the flow rates associated with a one percentage point increase in the compliance cost (a one percent increase in the wage bill necessary to comply with the new minimum wage levels). First, higher minimum wages have an adverse and persistent effect on hiring rates. One percentage point in the cost of compliance leads to a decline in firm-level hiring rates. The impact starts at 12.4 and converges around 17 percent as the horizon expands. The decrease in the hiring rates is primarily driven by a reduction in accessions from nonemployment. Poaching rates, or hires from other employers, do not report a statistically significant effect. The decline in job creation is consistent with lower profit margins, as derived from search models with endogenous vacancy posting (e.g., Flinn (2006)).

Figure 11: Minimum Wages and Hiring Rates



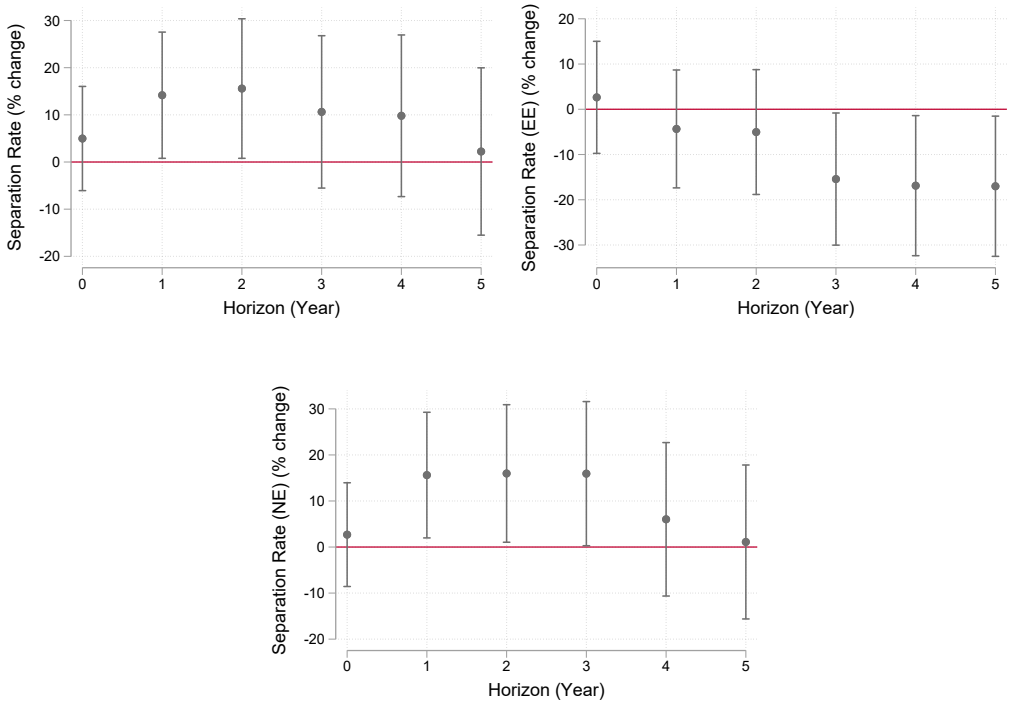
Notes: Figures show the percentage increase in the employment flow rates associated to one percent point increase the compliance cost to the minimum wage, alongside 95 percent confidence intervals estimated using robust standard errors. EE denotes employer-to-employer transitions and NE flows from and to nonemployment.

On the contrary, separation rates increase after the minimum wage increase, consistent with the reported disemployment effects previously discussed. These findings contrast the decrease in separations reported by prior work (e.g., Brochu and Green (2013); Dube et

al. (2016) and literature within). Two factors might explain the difference in the findings. First, the most recent literature restricts specific sectors and demographics (e.g., restaurants and teen workers), while my results extend to most of the labor market. Second, dynamics matter. As shown in Figure 12, the immediate responses to minimum wage changes are statistically non-significant in most cases, especially for separation rates. The bulk of related studies provide immediate or short-term responses to minimum wage changes.

Job-to-job separation rates decline in response to higher minimum wages. The effect, however, takes time to turn significant. The sign of this response is more aligned to prior literature documenting a fall in job transitions. The decline in job-to-job separations is possibly linked to two mechanisms. First, higher minimum wages increase firm exit and decrease firm entry (Garita, 2020b). Hence, the on-the-job arrival rates are likely to fall as fewer firms are competing in the market to attract workers (Flinn et al., 2017). Second, higher minimum wages motivate firms to pay relatively more. As shown previously, firms increase their pay premia in compliance with the policy. Hence, employed workers have fewer incentives to work for another firm as their current employer became relatively more attractive due to the minimum wage, consistent with a job-ladder model as in Cahuc et al. (2006).

Figure 12: Minimum Wages and Separation Rates



Notes: Figures show the percentage increase in the employment flow rates associated to one percent point increase the compliance cost to the minimum wage, alongside 95 percent confidence intervals estimated using robust standard errors. EE denotes employer-to-employer transitions and NE flows from and to nonemployment.

6 Theoretical Framework

This section is in progress.

7 Conclusions

This article estimates the minimum wage effects on employment flows using rich administrative datasets. Costa Rica's labor market provides advantageous conditions, as its occupation-specific minimum wage setting binds to a larger economy segment. The country also experienced sizeable and persistent minimum wage increases over the analysis period to explore dynamic responses.

First, the paper shows that the minimum wage induced low-paying firms to increase their pay premiums. As a result, between-firm dispersion falls. Such a response provides an empirical foundation to recent studies stressing the minimum wage effects on wage

inequality.

Firms reduce their employment levels, but the magnitude of the adjustment is relatively small. Still, the policy has a substantial impact on employment flows. Hiring rates decrease, and separation rates increase in response to higher wages. These margins suggest that the squeeze in the match profitability is a dominant mechanism. However, job-to-job separation rates decline after a minimum wage increase, stressing other mechanisms such as changes in the labor market congestion, affecting offer arrival rates, and workers' search behavior. The next stage of this research is to implement a model to analyze the relative importance of these alternative mechanisms and rationalize the main reduced-form results.

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