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 construct firm-level minimum wage exposure measures and transition rates from administrative data from 2006-2017 to estimate short and longer-term 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.

Keywords: Minimum Wage, Employment Flows, Firm Pay Policies, Job-to-Job Transitions

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 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 turn profitable for firms, decreasing hirings 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 linked employer-employee structure to construct flow rates accurately. Overall, the most reliable empirical evidence comes from studies restricting the analysis to specific sectors and demographics, such as teens and restaurant workers, either due to data constraints or a low-binding minimum-wage setting.

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.

Specifically, I assemble a comprehensive dataset covering the universe of firms and workers in Costa Rica's formal sector. I estimate a firm-level minimum wage exposure, defined as the increase in the total wage bill that a firm has to pay to satisfy the new minimum wage requirements. Put differently, it is the cost of compliance for firms when minimum wages increase. 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 begins 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 wage premium, is allowed to vary over time through a set of flexible firm-year fixed effects. Results indicate that a one percent increase in the average wage induced by the minimum wage initially 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. Focusing on the pay premium is relevant as it captures 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)).

Firms respond to higher minimum wages by reducing their employment levels. Nonetheless, the magnitude of the adjustment is relatively small, with own-wage elasticities[2] converging around -0.12. These modest 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 the cost of compliance to the minimum wage reduces firm-level hiring rates between 14.2 and 17.4 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.

Separations increase with higher minimum wages. Nevertheless, the impact takes place between two and three years after the minimum wage change. For such years, separations increase around 20 percent after a one percentage point increase in firm-level compliance costs. The positive impact on separations is consistent with the disemployment effects previously documented. The transitory increase is explained by a contrasting behavior between job-to-job and separations to nonemployment. Separations to nonemployment exhibit a similar behavior to the aggregate rate, with an effect peaking two-three years after the minimum wage increase and then moderating as the horizon expands. Separation from poaching (employer-to-employer transitions) rates are not affected in the short term and decline in the longer term to stabilize around 20 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

[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.

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 market. 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. The decrease in hirings comes from the compression in the profit margins. 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 4 discusses the empirical strategy of the paper, while Section 3 describes the data and provides some descriptive statistics. 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. 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, potentially associated with minimum wages compressing profit margins, inducing firms to layoff workers, and creating fewer vacancies. 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.

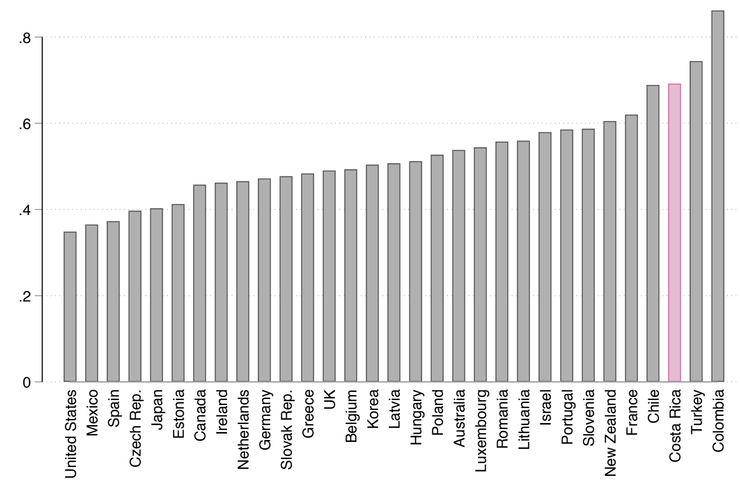
Additionally, this paper contributes to the literature exploring the dynamic behavior of firm pay policies over time. Engbom and Moser (2020) for Sweden and Lachowska et al. (2020) for Washington State, for instance, implement the time-varying extension of the AKM implemented in this paper to assess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

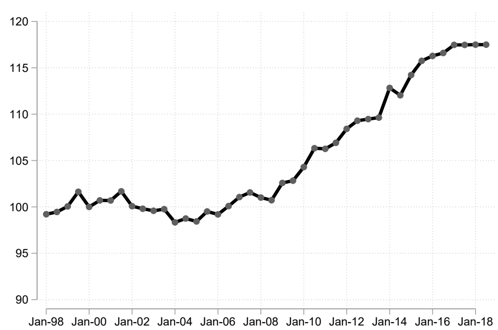
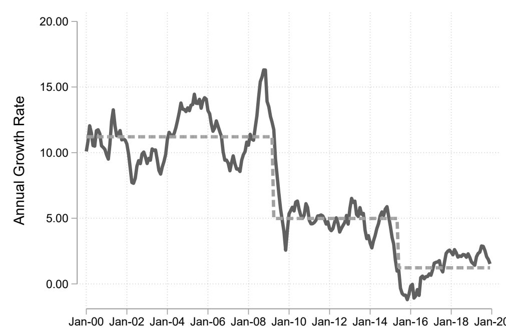


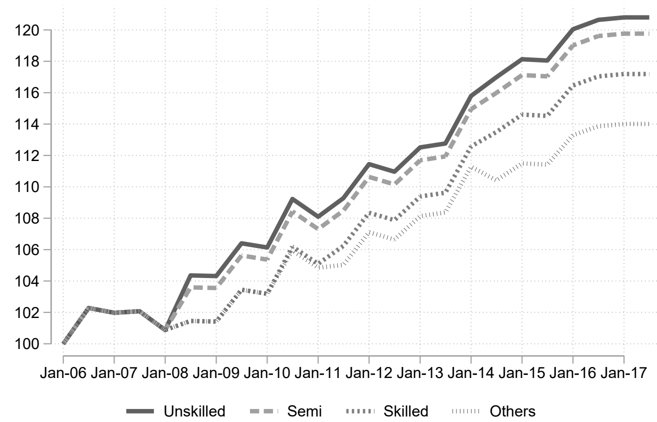
Figure 3: Annual Inflation Rate
(CPI-2015)



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.

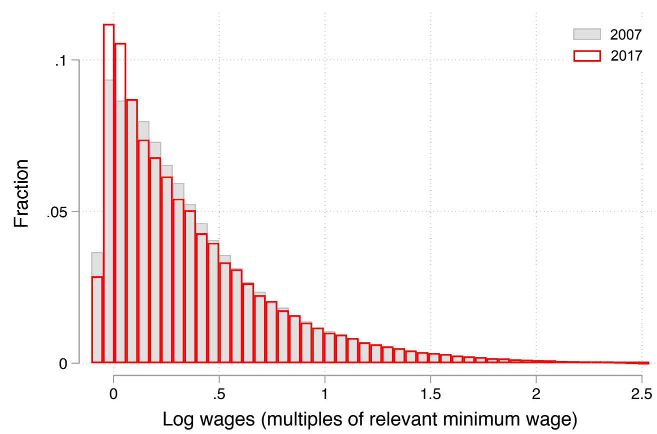
Figure 4: Costa Rica: Minimum Wage by Skill Groups
(CPI-2015 deflated. January 2006=100)



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 (2020), I provide more details about the data cleaning process.

For the remaining of the analysis, I restrict the sample to full-time workers aged 18 to 60 employed by a private-sector firm. Hence, I exclude self-employed individuals, households, non-profit firms, and state-owned enterprises, representing around 30 percent of total firm-year observations in the dataset.

3.2 Employment Flows

I follow the standard literature (e.g., Hyatt, Crane, Sorkin) 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 firm j and spend less than one quarter either in nonemployment or working for other firms, and then return to firm j. 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, Faberman, Haltiwanger, 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.
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 information sources with such detail. Most of prior work measures of treatment intensity based on firm

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:

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

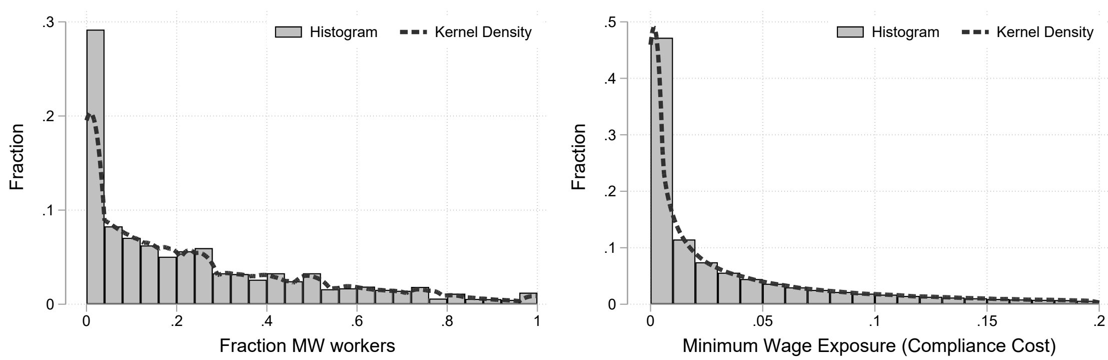
Where $mw_{o,t+1}$ is the percent change in the real minimum wage for occupation o relative to 2007 levels and $z_{j,o,2007}$ is the respective occupational share in firm j, estimated in 2007. By fixing the occupational shares to the 2007 levels, I analyze if firms with a particular occupational composition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

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.

ment 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 (2020), I discuss the identification assumptions and tests to argue for their plausibility.

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 $\Delta_0 \ln Y_{j,t} = \alpha_0 + \beta_0 Exposure_{j,t} + \gamma_0 X_j + \nu_{s,t} + u_{j,t}$

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

With $Y_{j,t}$ denoting firm's j employment flow rate (hiring and separation rates), $\Delta_h Y_{j,t+h} = Y_{j,t+h} - Y_{j,t-1}$ the cumulative difference at horizon h. $\nu_{s,t+h}$ denotes a set of industry (2-digit)-year controls and X_j a battery of firm-level characteristics in 2006-2007.[7] 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 down wages below the respective marginal product of labor. As recently discussed in

[7] 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

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 (Flinn, 2011), 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[8]) 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[9].

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

[9] 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[10]. 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)).

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

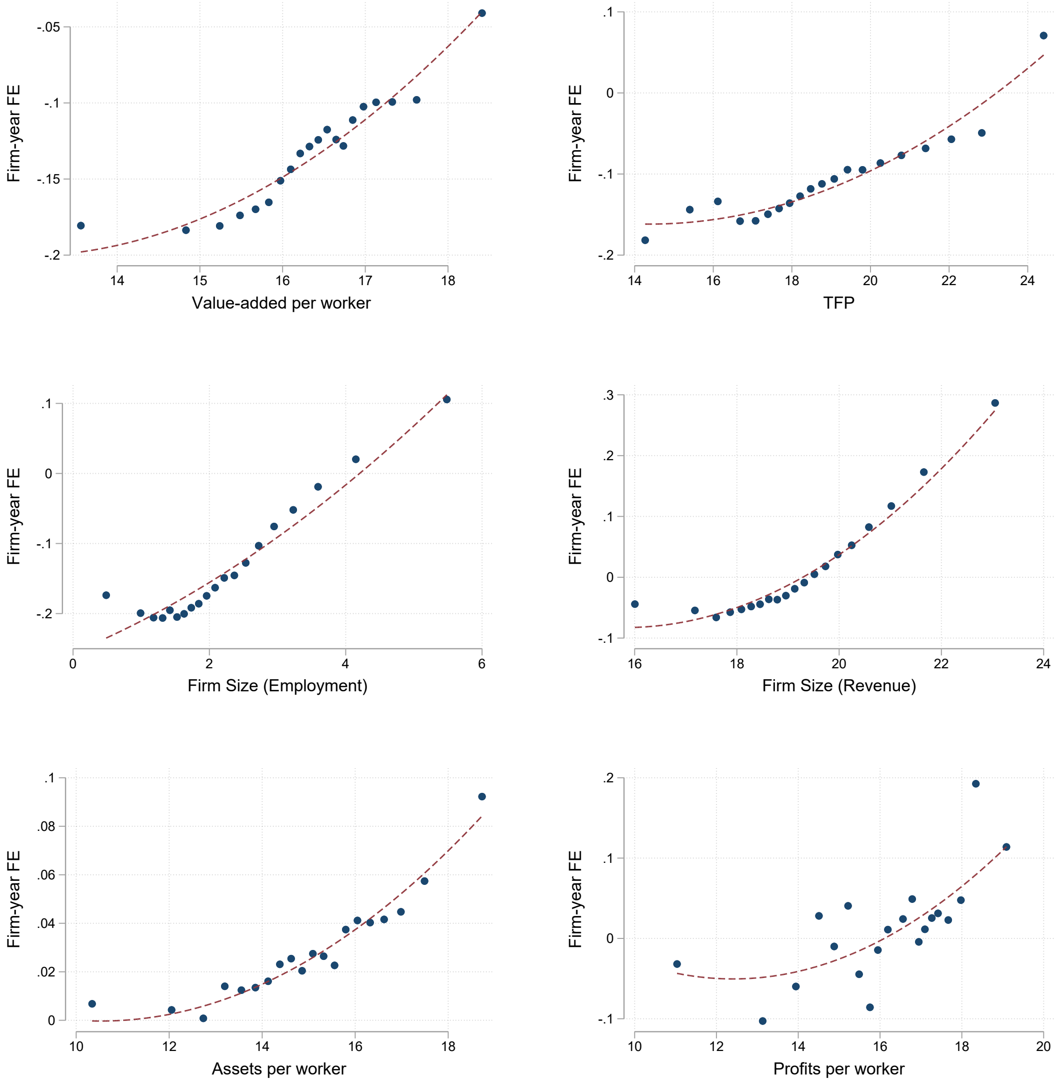
Table 4: TV-AKM Results

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



Notes: Figures show the binned scatterplot relating the firm-year fixed effect estimated from the TV-AKM model and firm-level characteristics, with the red line representing the best quadratic fit. Regressions include 2-digit industry and year fixed effects. Size measured as log of workers and log revenues. Nominal variables deflated using 2012-GDP deflator.

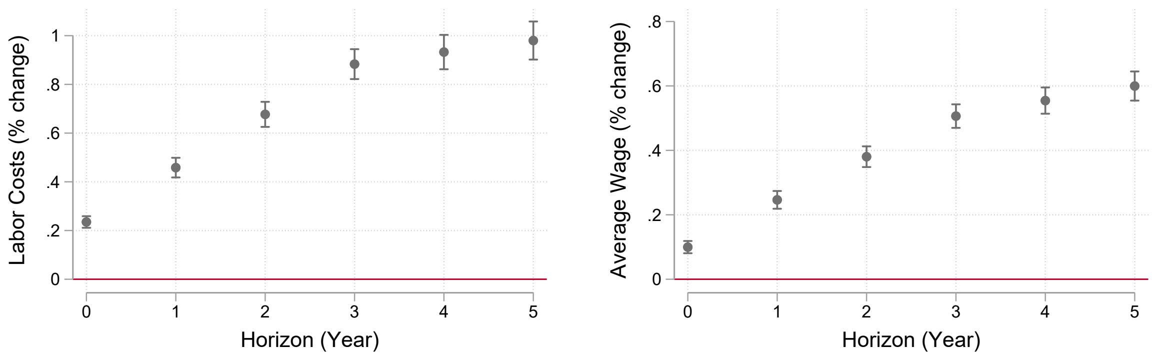
Source: CR-LEED

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. One 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



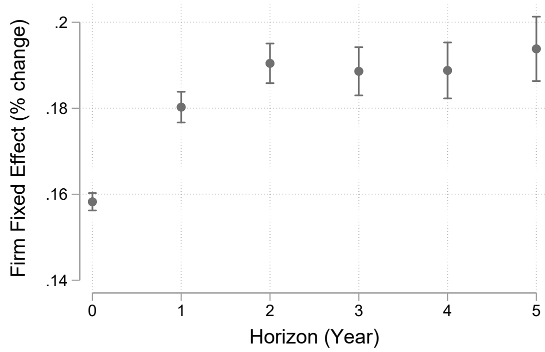
(a) Impulse Responses

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 estimated effects on the firm wage premium, captured by the time-variant employer fixed effect in the log additive wage specification. I express the impact as an elasticity with respect to the average wage, i.e., the percent change in the firm's pay premium associated with one percent increase in the average wage induced by the minimum wage.[11] Overall, the results of the estimation indicate that higher minimum wages induce low-paying firms to increase their wage premiums. The estimated elasticity increases as the horizon expands, to stabilize around 0.19. In other words, a one percent increase in the average wage induced by the minimum wage induce firms to increase their pay premium by 0.19 percent. This result is in line with the decline in the contribution of employer heterogeneity in explaining wage dispersion documented in Table 4, sustaining the notion that minimum wage policies reduce wage inequality through compression in the firm wage premium dispersion (e.g., Engbom and Moser (2018), and Dustmann et al. (2019).

[11] 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).

Figure 9: Minimum Wages and Firm Pay Premium



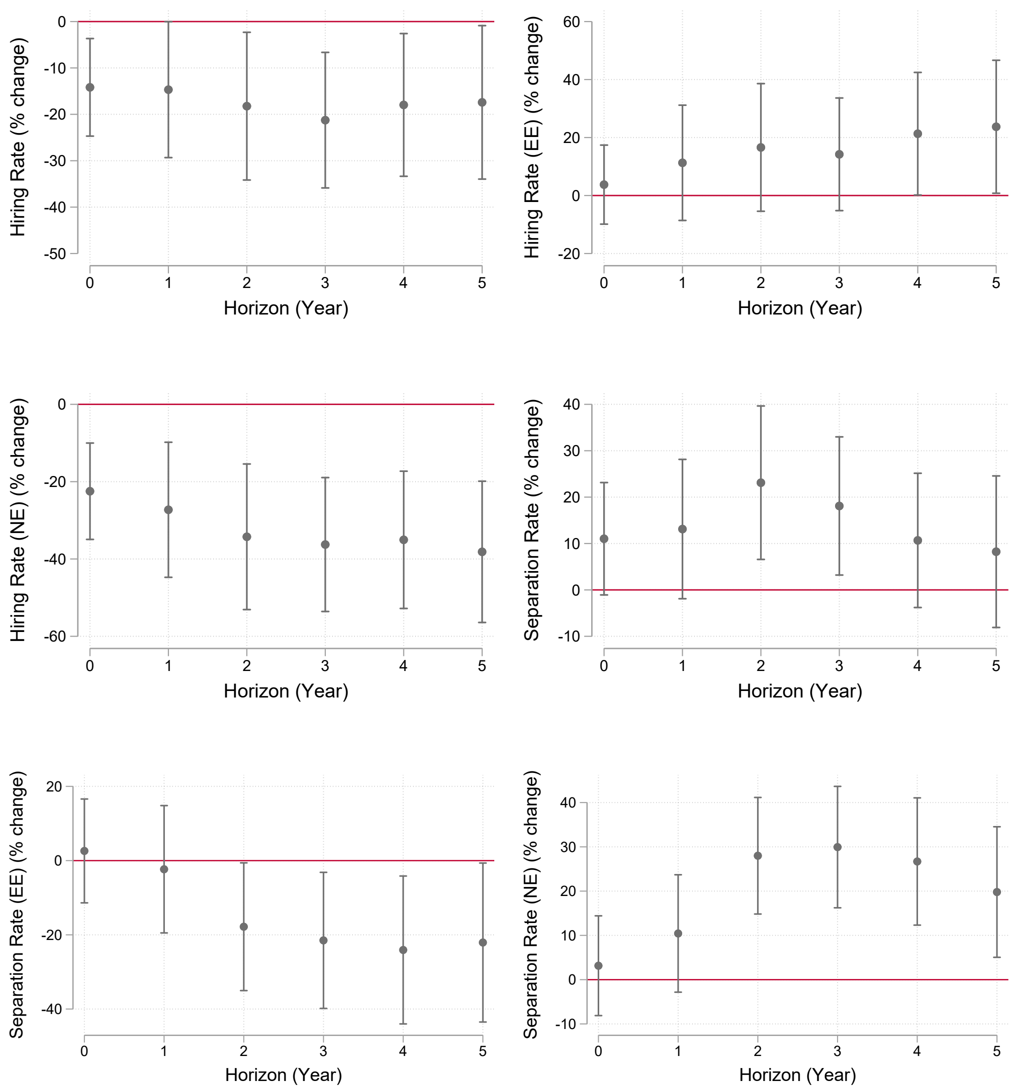
Notes: Figure shows the percentage increase in the firm pay premium associated to one percent increase in the average wage, alongside 95 percent confidence intervals estimated using boostrapped standard errors.

5.2 Minimum Wages and Employment Flows

Table lists the estimates of the response for a firm with average exposure[12] relative to a firm with zero exposure. Column (1) corresponds to the 2006-2007 outcome response, which serves to explore the existence of pre-trends. As explained previously, this period corresponds to the conclusion of a long phase in which the real minimum wages were stable, and employers completely anticipated adjustments (See Figure **??**). Unfortunately, it is not possible to extend the analysis before 2006 because of data limitations but, consistent with a causal interpretation of the effects, no response is statistically significant at this date, and the magnitude of the coefficients is sufficiently close to zero.

[12] Appendix **??** contains the full point estimates for both the employment and the wage based exposure measure.

Figure 10: Firm Characteristics and Minimum Wage Exposure



Notes: Figures show the binned scatterplot relating the firm-level fraction of workers exposed to the the minimum wage and firm outcomes, with the red line representing the best quadratic fit. Regressions include 2-digit industry and year fixed effects. Nominal variables deflated using 2012 GDP deflator. Total factor productivity index (TFP) estimated using a control function approach a la Ackerberg et al. (2015). Capital-Labor Ratio in millions of 2012 CRC. Worker and firm fixed-effects estimated using a time-varying AKM model

Figure **??** illustrates the estimated response of labor costs, average wages, and employment for the firm with average minimum wage exposure. Exposed firms experience a statistically significant and sharper increase in their labor costs and average wage. In 2009, the average exposed firm experiences 15.7 percent higher labor costs than firms with zero exposure, and by the last years, the effect stabilizes around 60 percent. As specified in Figure **??** and Table **??**, the minimum wage hikes prompts not only the wages below the new legal wage floor but also those at an adjacent range of the corresponding wage floors, which rationalizes the marked upsurge in the labor costs. Similarly, the averagely exposed firm exhibits an increase in the average wage between 35 and 40 percent by the end of the analysis.

Firms absorb part of the rise in labor costs by cutting their employment stock. As noted in Table **??**, since the first years of analysis, exposed firms reduce employment. By 2017, the impact stabilizes around -0.227, meaning that firms with average exposure to the minimum wage reduce employment by 22.7 percent relative to firms with zero exposure. Despite the employment cut, I collect evidence suggesting that employers make an effort to improve the quality of their workforce: from the TV-AKM model I estimate a worker fixed effect that basically captures the unobserved time-invariant ability of the employee and then I compute the average of these fixed effects for each firm to evaluate its response in consonance with the minimum wage. As seen in Figure **??**, the average worker fixed effect in firms with average exposure increases between 1 and 2.5 percent relative to firms with zero exposure. The firm's labor share of output, defined as the firm-level wage bill over revenue, also increases relatively more in exposed firms. This result is coherent with the burgeoning research positing that product and labor market power weakens the labor share and that regulation such as minimum wages could precisely counter this ability of employers to set wages to accumulate monopsonistic rents (e.g., Robinson (1933); Berger et al. (2019); De Loecker et al. (2020)).

Figure **??** and Table **??** include the results concerning the employment flows. Exposed firms experience lower hiring rates than firms with no minimum wage workers. A firm with average exposure experiences between 0.011 and 0.023 percentage points lower hiring rates than firms with zero exposure, an equivalent of 9.9-20.7 percent in terms of the average hiring rate in 2007 (see 2). There is no statistically significant response in the poaching rates, so minimum wage exposure neither enhances nor undermines the firm's capacity to attract employees from other businesses. Hence, most of the negative impact is through firms cutting down incorporations from the non-employment pool. Minimum wage hikes also increase separations: a firm with average exposure marks an increase in the separation rate of between 0.014 and 0.021 percentage points, within 9.4 and 14.1 percent relative to the average hiring rate in 2007. However, the positive impact is mainly concentrated in transitions to the non-employment separations, since the poaching separation rates in exposed firms decrease relative to non-exposed firms. In particular, the poaching separation rate for the average firm decreases between 7.4 and 16.2 percent relative to the observed rates in 2007, suggesting that the minimum wage policy helps firms to retain workers from moving to other firms. Overall, these findings are in line with concerns expressed by academics and policymakers on the adverse impact that labor market regulation has on employment dynamism.

Exposed firms also featured a sharper increase in total revenues. As shown in Figure **??**, during the first years of exposure, revenues in average exposed firms expanded between 8.7 and 11.5 percent more. As pointed out in Mayneris et al. (2018); Hau et al. (2020), these findings are at odds with the neoclassical theory that anticipates a contraction in the firm's output due to the reduction in employment and the decline in competitiveness because of the increase in the labor costs. Two prime elements could be behind in this revenue response: a price adjustment and a productivity response. Unfortunately, I do not observe firm-level output and input prices, but given the negative response in employment and the aggregate behavior of price indexes during the study, it is unlikely that the price mechanism dominates in explaining the increase in revenues. On the contrary, I find a productivity improvement in exposed firms. Value-added per worker increases between 6.7 and 9.1 percent more in units with average exposure than firms with zero exposure levels, while the TFP index increases around 0.04 and 0.06 percent. The documented response in productivity is consistent with recent micro studies focusing in particular sectors (e.g., Coviello et al. (2018) for department stores and Ruffini (2020) for nursing homes) to show that a minimum wage increase improves workers' productivity and the quality of service offered by exposed firms[13].

Firms positively adjust the capital and intermediate input demand in response to the minimum wage. As highlighted in Figure **??**, firms with average exposure to the policy experiment materials or intermediate input levels [14] between 8.3 and 13.5 percent higher and capital levels within 20 and 30 percent higher than firms with no exposure. The capital-labor ratio in the average exposed firm sets between 9.3 and 18.6 percent above the observed value in firms with zero exposure. These findings suggest a positive and significant elasticity of substitution between capital, intermediate inputs, and labor.

Altogether, these responses lead to a non-significant impact on profitability in the first years of exposure that later turns positive and statistically significant in the final years of analysis. This finding is at odds with the short-term negative impact documented by Draca et al. (2011); Harasztosi and Lindner (2019); Drucker et al. (2019), but consistent with the lack of a robust positive response in the short run as reported in Mayneris et al. (2018); Chen (2019). Firms with average exposure display profit margins (the ratio of prof-

[13]Two non-mutually exclusive explanations can be behind the TFP and labor productivity improvement: better managerial practices (Hau et al., 2020) and efficiency wages, i.e., labor turnover decreasing and workers performing better because of the rise in wages.

[14]Following De Loecker and Warzynski (2012); De Loecker et al. (2020), I use the cost of goods sold reported by firms as a proxy for intermediate input expenses.

its to total revenue). They are 0.014 percentage points higher than those of non-exposed firms, representing approximately 29.1 percent relative to the average profit margin in 2007 (0.048).

6 Theoretical Framework

This section is in progress.

7 Conclusions

This article exploited a comprehensive administrative dataset to shed new light on how firms behave under a restrictive minimum wage policy. The detail, frequency, and cross-sectional variation of the information, together with the changes in the minimum wage setting, constitute a valuable opportunity to provide robust evidence on the margins of the labor market's adjustment to an extensive institutional setting such as Costa Rica's minimum wage policy.

First, the paper presented new evidence characterizing firms that are more vulnerable to minimum wage variation. These units are low-productive, low-paying firms, labor-intensive, and closer to the margin of exit. Additionally, the article showed that minimum wage hikes increase workers' wages and that spillover effects are sizeable. As a result, minimum wage variation increases labor costs in exposed firms more. The minimum wage policy induces low-paying firms to increase their wages while motivates low-productive firms to leave the market. These elements, altogether, reduce between firm inequality and the role of firms in explaining the observed wage dispersion.

The paper contributes to the literature by showing that employment effects are non-zero, negative, but in range with recent estimations for other economies. The paper further offers new evidence on the link between minimum wage policies and employment dynamism by highlighting an adverse incidence on hiring while an increment in separations.

The paper further provides new conclusions on firms' intensive-margin response to minimum wages in a cohesive manner. Exposed firms experience a more considerable increase in revenues, consistent with a corresponding improvement in productivity. Additionally, capital-labor substitution and intermediate input usage accelerate in exposed firms in response to the policy. Exposed firms do not suffer a decline in profitability.

Finally, the paper offers fresh evidence on firm exit and entry behavior. Firms with a higher degree of exposure to the minimum wage policy exhibit a higher probability of leaving the market, but the impact disproportionately affects low-productive firms as the probability increases more for these units. On the other hand, the minimum wage policy seems to deter business creation as startup rates decline with an increment in minimum wage exposure.

The paper opens the door for theoretical work that analyzes the policy's aggregate implication and the main mechanisms that operate in a general equilibrium setting. Additionally, the strong bite of Costa Rica's minimum wage policy represents a valuable opportunity to explore how and to what extent this form of regulation affects the decision of firms with wage-setting power. Future efforts are concentrated in these two dimensions.

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