

# The Burden of the Minimum Wage Evidence from Portugal \*

**PROSPER**

Universidade Católica Portuguesa

October 4, 2022

## Abstract

Who bears the burden of the minimum wage? Using firm-level financial information linked to longitudinal employer-employee microdata from Portugal, we assess the effects of an isolated minimum wage increase in Portugal through 3 possible channels of adaptation: laying-off workers; increasing prices; or diminishing firm owners' surplus. To identify the burden on workers, we compute the employment to own-wage elasticity and find that it is -0.50; or -0.68 if the firm is financially distressed. The elasticity is calculated by studying firm closures separately with a logit model, and we argue that when studying both together, OLS will overestimate the unemployment effects. Furthermore, we find that consumers bore 78.6% of the increase in labour costs caused by the minimum wage rise, while firm owners bore 21.4%. However, if a firm is in financial distress, its owners will increase their cost-bearing to 51.8%.

**Keywords:** Minimum Wage, Employment, Firm closures, Logit model.

---

\*[joana.silva@ucp.pt](mailto:joana.silva@ucp.pt). We are grateful to Pedro Raposo for useful comments. We remain responsible for any errors. We thank Programa Operacional de Assistência Técnica (POAT) for financial support. We declare that we have no relevant or material financial interest that relate to the research described in this paper.

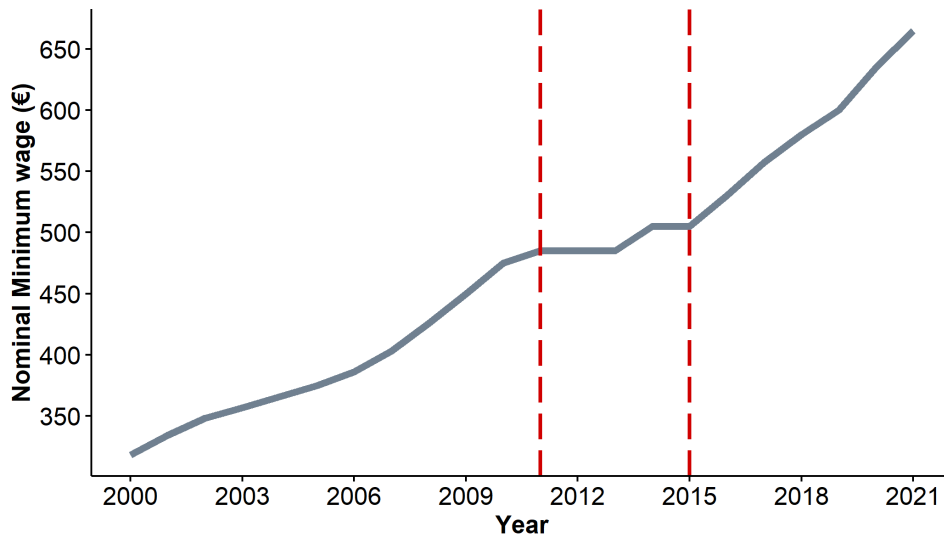
# Contents

1	Introduction	3
2	Institutional Context	5
3	Data	7
4	Employment and Wage Effects of the Minimum Wage	9
5	Incidence of the Minimum Wage	18
6	Entry Rate Robustness	20
7	Conclusion	21
	Bibliography	22
A	Additional Figures and Tables	25

# 1 Introduction

In recent years, Portugal has been subject to several increases in the nominal minimum wage aimed at improving the purchasing power of workers, fostering social cohesion by mitigating income inequality and, ultimately, reducing poverty. For firms, an increase in the national minimum wage corresponds to an increase in labour costs. In face of this, firms may either adjust by laying-off some workers to decrease labour costs, by increasing the price of their products to increase revenues or simply by decreasing profits (Harasztosi and Lindner, 2019). This leads us to inquire about the aggregate impact of the minimum wage increases and question: Who bears the burden of an increased minimum wage?

**Figure 1: Evolution of the Minimum Wage in Portugal**



**Source:** Data from INE.

**Notes:** This figure shows the evolution of the Portuguese national minimum wage in nominal terms. The time frame analysed in this paper is between the dashed red lines. The updates of the minimum wage start in January of each year except for 2014 when it was only enacted in September.

This paper answers the aforementioned question by analyzing the effects of a minimum wage increase on labour market outcomes through a quasi-experimental framework. Using matched employer-employee data from Portugal, we exploit a discontinuity in the minimum wage growth trajectory arising during the financial crisis (2010-2014), when minimum wages were frozen for three years until the 2014 revision, as shown in 1. Because the minimum wage was stable for 3 years, we are able to isolate the minimum wage shock in a context where many firms were financially vulnerable. Furthermore, this paper takes a step further by providing a comprehensive take of the firms' adjustment channels, looking at the impact on the firm's employment, wages, profits and prices.

In fact, the literature has found that firms react to increases in labour costs caused by the new minimum wage in three ways (MaCurdy, 2015): by adjusting employment or employment-related aspects (such as the decrease in employment (Neumark and Wascher, 2007), in working hours (Bossler and Gerner, 2020) or substituting minimum wage workers for capital or more qualified labour), by decreasing profits, or by passing on the costs to consumers. It is not clear, from a theoretical stand, which of these effects

dominate. As explored in the seminal paper of [Stigler \(1946\)](#), while in a competitive market a minimum wage above market clearing leads to a decrease in employment, in a monopsonistic environment employment can increase. Other theoretical nuances exist, like the minimum wage acting like an efficiency wage ([Shapiro and Stiglitz, 1984](#)) or the higher availability of workers decreases the search friction in the labour market ([Belman and Wolfson, 2014](#)), etc.

The theoretical ambiguity forces us to resort to empirical testing. We adopt a specification that is well-established in the literature ([Machin et al., 2003](#); [Draca et al., 2011](#); [Harasztosi and Lindner, 2019](#)). We measure firms' exposure to the minimum wage using the proportion of workers receiving less than the minimum wage of 2014 in the years before, by firm. The idea is to compare between firms with different magnitudes of the minimum wage shock. Because some firms were legally obliged to increase more their labour costs than others because some firms have more minimum wage workers than others.

The analysis in this paper proceeds in two parts. Firstly, we estimate the elasticity of employment to own wage. We show several ways of computation and argue that the most precise one is to estimate the employment effects coming from firm closures and layoffs/hirings separately, and then combining the two estimates. Using the aforementioned method, we find that the minimum wage increase of 2014 decreased employment by  $-2.27\%$  and increased wages by  $4.55\%$ ; which mounted to an elasticity of employment to own wage of  $-0.50$ ; or  $-0.68$  if the firm is in financial distress. As it is possible to observe in [Figure 2](#), these results are situated on the left side of the range of estimates from a selection of studies and can be roughly classified as medium elasticities<sup>1</sup>, and is in line with the Portuguese literature ([Pereira, 2003](#); [Silva, 2008](#); [Centeno et al., 2011](#)).

Secondly, we study the firms' adjustment margins and identify the incidence of minimum wage costs. Linking our matched employer-employee dataset with firm-level financial data, we look at the evolution of some accounting figures, such as profits and implied prices, which allow us to infer to which extent firms are able to transfer the burden to consumers. We find that  $78.6\%$  of the increase in labour costs was passed to consumers and  $21.4\%$  was borne by firms. However, if a firm is in financial distress, the firm will bear more of the burden ( $51.8\%$ ). One explanation that can be given is that firms in financial distress were in this situation in the first place due to low revenue compared to their productive capacity, and could not afford to have even less revenue.

This paper makes the following contributions. First, it contributes to the study the implications of minimum wage increases on employment. The literature finds mixed evidence regarding the size and direction of the effects ([Card and Krueger, 1994](#); [Cengiz et al., 2019](#); [Jardim et al., 2018](#); [Gopalan et al., 2021](#)), although most studies report negative employment results ([Neumark and Shirley, 2022](#)).

Secondly, we make a methodological contribution, by showing that a very common specification in the minimum wage literature, found in papers like [Machin et al. \(2003\)](#); [Draca et al. \(2011\)](#); [Harasztosi and Lindner \(2019\)](#); [Bossler and Gerner \(2020\)](#); [Drucker et al. \(2021\)](#), may be overestimating the total employment results by not dividing firm closures from the other changes in employment at firm-level.

Thirdly, we add to the literature which studies the effect minimum wage raises on firm closures. [Draca et al. \(2011\)](#) finds that firms which are close to the edge of exiting are more prone to decide to leave the market when the minimum wage is raised. [Luca and](#)

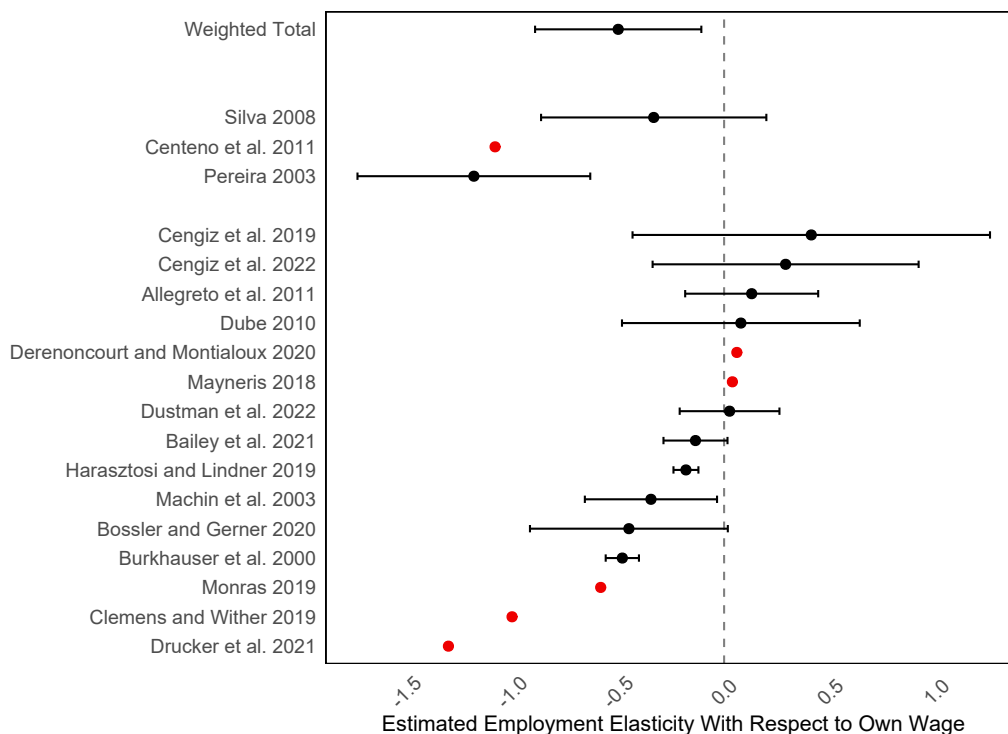
---

<sup>1</sup>According to [Dube \(2019\)](#) an own-wage elasticity less negative than  $-0.4$ , between  $-0.4$  and  $-0.5$  and more negative than  $-0.8$  can roughly be classified as small, medium and high in magnitude, respectively.

Luca (2019) finds the same for the restaurant industry. To get a more detailed impact of the shock we further compare financially distressed firms (FDF) with non-financially distressed firms (Non-FDF), like Alexandre et al. (2022) have done for the Portuguese case.

Lastly, we also contribute to the literature of Harasztosi and Lindner (2019); MaCurdy (2015) which analyses the channels of adaptation of firms to the minimum wage.

**Figure 2: Estimates from the Literature**



**Sources:** The estimates are from: Silva (2008), Centeno et al. (2011), Pereira (2003), Cengiz et al. (2019), Cengiz et al. (2022), Allegretto et al. (2011), Dube et al. (2010), Derenoncourt and Montialoux (2020), Mayneris et al. (2018), Dustmann et al. (2022), Bailey et al. (2021), Harasztosi and Lindner (2019), Machin et al. (2003), Bossler and Gerner (2020), Burkhauser et al. (2000), Monras (2019), Clemens and Wither (2019), Drucker et al. (2021). For the studies that did not present the estimates for the standard deviations of the elasticities, we used the estimates from Harasztosi and Lindner (2019).

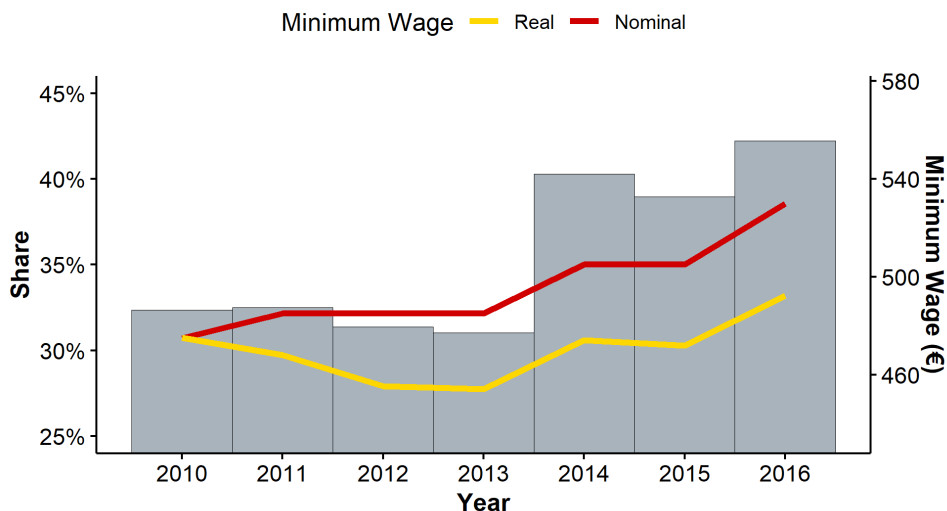
**Note:** In this figure we summarise some employment to own-wage elasticity estimates from the portuguese and international literature and present our estimate, the "Weighted Total" from the first row of Table 3. For those articles that presented the standard deviations of the elasticities, the estimates are displayed together with the 95% confidence intervals. The dashed vertical line divides the positive point estimates from the negative ones. In red are the estimates for which the authors did not calculate the standard deviation, so it was not possible to construct the confidence intervals. The first three estimates presented below the "Weighted Total" were detached from the others because they come from studies concerning the Portuguese economy.

## 2 Institutional Context

The minimum wage policy in Portugal is generally updated yearly in January (see Figure 3). The revised value for the minimum wage is determined in a discretionary manner, taking into account factors such as the rising cost of living, productivity growth, and the country's economic and financial stability, among others. The minimum wage is

defined for one month of full-time work, which is equivalent to 40 hours per week but is binding on an hourly basis.

**Figure 3: Average Minimum Wage Coverage by Firm**



**Sources:** Data from Quadros de Pessoal (QP) and INE.

**Note:** This figure shows the average share of minimum wage workers by firm in the Portuguese private sector and the nominal and real values of the minimum wage. To calculate the shares (in the bars and on the left-axis) we calculate the percentage of minimum wage workers for each firm and year, and then apply a yearly mean. We classify a MW considering the normal hours worked and using a €1 bandwidth around the MW. For that, we use data from QP restricted to dependent employment, excluding the primary and oil sector, and firms with less than 5 employees. The lines and the right-axis are the nominal national MW (in red) and the real national MW at 2010 prices (in yellow).

Analysing the Portuguese minimum wage poses the challenge of isolating its effect due to the yearly revisions. Because the impacts of a minimum wage increase may be felt two years afterward (Meer and West, 2016), the ordinary yearly increases of the minimum wage in Portugal will pose a threat to identification. To overcome this issue, we exploit a unique period during the financial crisis, between 2011 and 2015, when there was a single increase in the minimum wage in October 2014, visible in Figure 1. Because there is not a nominal increase between January 2011 and September 2014, the effects of 2014 are not contaminated. Moreover, because 2015 also has no increase, we can measure changes from 2013 to 2015 relative to a single minimum wage increase. The data is collected in October of each year, so the information for 2015 comes 13 months after the minimum wage increase. Figure 3 shows the evolution of the minimum wage in real and nominal terms over the period 2010-16, as well as the average percentage of minimum wage workers per firm by year.

In the period analysed in this paper, the minimum wage starts at 485€ in January 2011 and it's raised to 505€ in September 2014. It stays at 505€ until January 2016. The increase in 2014 is 4.12% in nominal terms and 4.41% in real terms. From 2013 to 2015, the real minimum wage increase was 1.04%. we can see in Figure 3 that the fact that the 2014 minimum wage increase came after a financial crisis made it quite binding, because of low wage spillovers effects, workers were dragged with the minimum wage.

## 3 Data

The analysis conducted uses three datasets:

### 3.1 Quadros de Pessoal

Quadros de Pessoal (QP) is a linked-employer-employee-dataset annually collected by the Ministry of Labour, Solidarity and Social Security (MTSSS), with a census on all private firms with at least one dependent employee in Portugal. QP assembles information at the establishment, firm and worker level, with a fictitious ID for each of them. Its legally mandatory nature ensures high response rates. Additionally, the Ministry's inspectors ensure adherence to the MW and collective agreements. Nowadays, QP collects information from more than 300 thousand firms and almost 3 million workers. QP includes year-by-year information on firm sector and location, and information on each worker's monthly wage, weekly hours worked, tenure, education, occupation, and gender. It has annual periodicity and refers to October of the respective year. See Table 1 for relevant descriptive statistics.

### 3.2 Sistema de Contas Integradas da Empresa

Sistema de Contas Integradas das Empresas (SCIE) is produced on an annual basis by INE, for all companies registered as societies. It provides a detailed income statement and a fictitious ID for the firm which is *crossable* with QP. The SCIE dataset includes information on key indicators used in the analysis, including the value of production, profits, labour costs, and expenses for materials, among others.

### 3.3 Comércio Internacional

Comércio Internacional (CI) is a dataset produced monthly by INE containing all the firms that exported or imported products. It contains the type of products and the value of the transaction. Because it contains a fictitious ID for the firm, we are able to cross CI with QP and SCIE. We use this information to control for yearly total exports of firms from October to October.

### 3.4 Main Sample

The main sample in this analysis is formed by all companies matched in QP, SCIE and CI that:

- Were operating in 2011, 2012 and 2013;
- Had 5 employees or more in 2013;
- Were not operating in the primary sector (for unreliability reasons) nor in the oil industry (the few firms in the sector would bias the sector fixed effect analysis);
- Were not operating solely on Madeira and Azores, because all establishment information from the Autonomous zones of Madeira and Azores is deleted due to a different minimum wage policy;

- Survive the data cleaning procedures.

The sample contains 46,243 firms from which 5,449 closed until 2015. The firm size variable used in this paper incorporates part-time workers by weighting employment with normal hours worked. A worker who works 40 hours a week is weighted as 1 and a part-time job of 20 hours a week is counted as 0.5. Wage was measured using total wage, which includes compensations, overtime payments and other irregular payments. The key independent variable in this analysis is firm exposure to an increase in the minimum wage (FA), measured by the weighted share of workers whose salaries are below next year's new minimum wage.

In Table 1 we report the descriptive statistics. Columns (1) and (2) report the mean and standard deviation of some firm characteristics for firm that are not in financial distress and (3) and (4) report the same for FDF. Column (5) evaluates whether there is a statistically significant difference between a FDF and Non-FDF. There are two noteworthy facts. The first is on the difference between full and intensive margin. Although firms decrease employment on average, that is driven by firm closures (the Non-FDF have more hirings than lay-offs). The second fact is the big difference between FDF and Non-FDF behaviour. FDF have lower wage growth and lower employment growth.

Table 1: Descriptive Statistics

	Not Financial Distress		Financial Distress		Difference (5) = (1) - (3)
	mean (1)	sd (2)	mean (3)	sd (4)	
Firm size	27.60	(177.07)	22.13	(54.49)	5.47
Firm exposure	0.22	(0.28)	0.24	(0.29)	0.02***
Change from 2013 to 2015					
Employment	-0.07	(0.44)	-0.30	(0.48)	0.23***
Percentage of Closing firms	0.11	(0.31)	0.24	(0.43)	-0.13***
Employment (Intensive)	0.04	(0.30)	-0.06	(0.27)	0.10***
Average Wage	-0.07	(0.35)	-0.22	(0.45)	0.15***
Average Wage (Intensive)	0.03	(0.14)	0.01	(0.12)	0.02***
Production (Intensive)	0.04	(0.15)	0.02	(0.14)	0.02***
Gross exploration surplus (Intensive)	0.03	(0.23)	0.14	(0.51)	-0.11***
Intermediary Consumption (Intensive)	0.04	(0.24)	-0.02	(0.31)	0.06***
Total Labour Costs (Intensive)	0.02	(0.12)	-0.05	(0.20)	0.07***
Observations	42250		3993		

This table reports descriptive statistics relevant to this study using data from Quadros de Pessôal. Columns (1) and (2) report the mean and standard deviation for firms not in financial distress, and columns (3) and (4) do the same for financially distressed firms. Column (5) shows the difference between columns (1) and (3), where \*\*\* means the p-value of the difference is  $< 0.001$ . Firm size is measured using weights considering the amount of normal hours worked. Firm exposure measures the fraction of workers affected by the minimum wage increase from 485€ in 2013 to 505€ in 2015. The changes from 2013 to 2015 at the intensive margin disregard firms that closed from 2013 to 2015. The data from Quadros de Pessôal excludes the primary sector, the oil sector, firms with less than 5 employees and only includes workers who are employed dependently.



# 4 Employment and Wage Effects of the Minimum Wage

## 4.1 Identification Strategy

We aim to estimate the effects of the minimum wage on employment and wages by comparing the outcomes in firms with many affected workers to firms with fewer affected workers. Firms with higher exposure to the minimum wage have to increase labour spending to maintain their production level. We adopt a well-established specification previously used by [Machin et al. \(2003\)](#), [Draca et al. \(2011\)](#) and [Harasztosi and Lindner \(2019\)](#). Furthermore, we follow [Alexandre et al. \(2022\)](#) and add interactions between the firm exposure variable ( $FA_i$ ) with an indicator of financial distress ( $FDF_i$ ), to allow the minimum wage to affect employment and wage differently between FDF and Non-FDF. Moreover, we study the effects at the intensive margin and extensive margin separately. The extensive margin measures the effects of the minimum wage on the probability of firm closures and the intensive margin measures the variation of wages and employment in firms that kept existing.

The estimated model for the intensive margin is:

$$\frac{y_{i2015} - y_{i2013}}{y_{i2013}} = \beta_1 FA_i + \beta_2 FDF_i + \beta_3 FA_i \times FDF_i + \lambda X_i + \delta X_i^2 + \theta_{S(i)} + \epsilon_i, \quad (1)$$

and the estimated model for the extensive margin is the logit model:

$$\frac{Pr(c_i = 1 \mid \mathbf{Z}_i)}{Pr(c_i = 0 \mid \mathbf{Z}_i)} = \beta_1 FA_i + \beta_2 FDF_i + \beta_3 FA_i \times FDF_i + \lambda X_i + \theta_{S(i)} + \epsilon_i, \quad (2)$$

where the left-hand side of the equation is the percentage change in the outcome  $y$  (either employment or wages) for firm  $i$  between October 2013 and October 2015;  $c_i$  is 1 if the firm is closed in 2015 and 0 otherwise;  $FA_i$  is the fraction affected/firm exposure variable;  $FDF_i$  is a dummy variable which is 1 if the firm  $i$  is financial distress and 0 otherwise;  $X_i$  is a vector of controls and  $\theta_{S(i)}$  are two-digit sector fixed effects to control for sector constant heterogeneity within the sector  $S$  where firm  $i$  operates.  $\mathbf{Z}$  represents all independent variables. The controls include: the share of labour costs in total labour costs from 2013, the share of labour costs in total costs from 2013, the share of exports in total revenue from 2013, gross formation of fixed capital over 2011, 2012 and 2013, employment growth from 2012 to 2013 (to account for trends in downsizing, specially because of firms adaptation to the crisis), the share of college educated workers in 2013, share of men working in 2013 and average tenure in months in 2013. The education, tenure and sex controls are computed from worker-level data. Finally, we weight the regressions by the natural logarithm of firm size (employment) in order to value the changes of large firms more, whose decisions will affect more workers than small firms, by definition.

The main assumption of this identification strategy is that changes at firms with fewer exposition to MW hikes are a valid estimate of the counterfactual of firms with many affected workers. If we go even further, the key assumption is the stable unit treatment value assumption (STUVA). STUVA implies that workers and firms who aren't directly treated by the minimum wage cannot be affected by it. For example, if the minimum wage

caused loss of employment on firms without minimum wage workers, then the employment elasticity would be underestimated.

#### 4.1.1 Firm Exposure

Although the minimum wage increase was the same for every firm<sup>2</sup>, some firms are more affected than others. A firm in which, during 2013, all workers were earning a base wage higher than the minimum wage of 2014 is not legally binding to increase labour costs. However, a firm with minimum wage workers must increase their wages. To capture this difference in the impact of the minimum wage increase between firms, we build a firm exposure variable (or fraction affected, FA), following Machin et al. (2003); Draca et al. (2011); Harasztosi and Lindner (2019); Bossler and Gerner (2020); Drucker et al. (2021).

The FA variable measures the percentage of workers whose base wage is below the minimum wage of 2014, per firm. Not only the percentage below, but also the observations are also weighted by two factors: (1) the wage gap (Card and Krueger, 1994), with the goal of counting a minimum wage worker (earning €485 in 2013, who in late 2014 starts earning €505) as 1, and a worker earning €495 in 2013 as 0.5; (2) hours worked, to count full time workers as 1 and part-time workers of 20 hours weekly as 0.5. Furthermore, we follow Harasztosi and Lindner (2019) and use the average of FA over 2011, 2012 and 2013, to diminish the misclassification errors. This is a further advantage of choosing an isolated increase. Inflation does not matter because the FA compares between firms.

$$FA_i = \frac{1}{3} \sum_{t=2011}^{2013} FA_{it} \quad (3)$$

$$FA_{it} = \frac{\sum_w (\mathbb{1}[wage_{wt} < 505] \times \frac{505 - wage_{wt}}{20} \times \frac{weekly\ hours_{wt}}{40})}{firm\ size_{it}} \quad (4)$$

where  $i$  are firm,  $t$  are the years,  $w$  are workers,  $\mathbb{1}[\ ]$  is the indicator function, 505 is the minimum wage of 2014, 20 is the nominal difference between the minimum wage of 2014 and 2013, and 40 is the full-time weekly hours.

The objective of the FA's variable complexity is to be a proxy of the minimum wage effect on the firm's labour costs. In Figure 4 we can see that the higher the firm exposure, the smaller the average labour cost. That means we are correctly catching the firms that have more minimum wage workers, which are the ones who will have to bear the biggest cost. The efforts of averaging over 2011, 2012 and 2013 were also fruitful, as the FA variable is a smooth continuous variable 9.

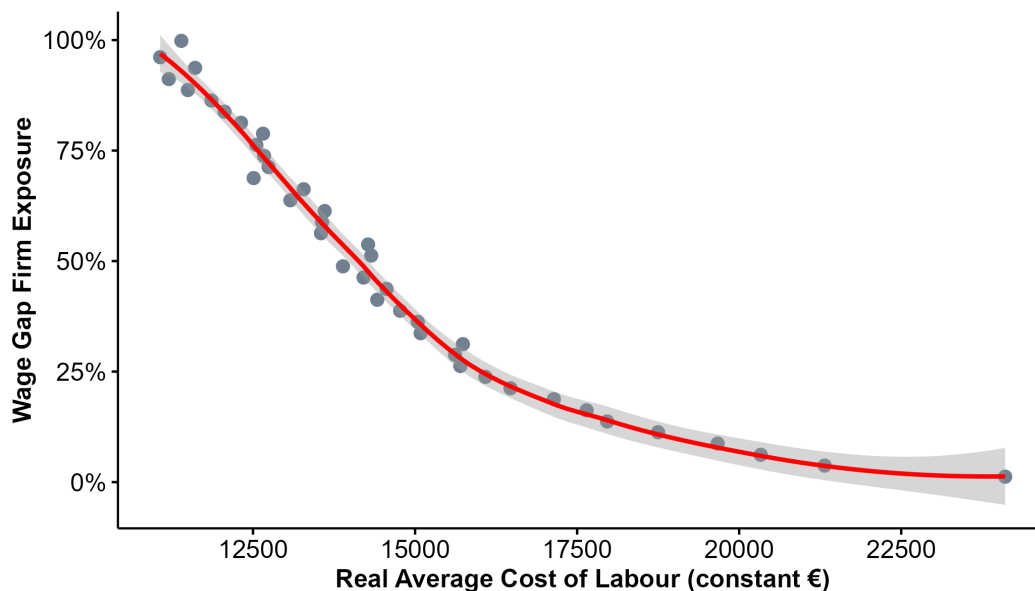
#### 4.1.2 Financially Distressed Firms

The minimum wage hike in October 2014 comes in the aftermath of a banking and financial crisis. This crisis affected a large number of Portuguese companies, significantly increasing private debt and the number of financially distressed firms (FDF). Alexandre et al. (2022) finds evidence for Portugal that the increase in the minimum wage increased closures, especially for FDF. We follow Alexandre et al. (2022) and include a dummy and an interaction of FDF. To classify a FDF, we use the OECD definition (McGowan et al., 2017), where a firm is in financial distress when the interest expenses are higher than the

<sup>2</sup>In fact the minimum wage policy has exceptions for certain occupations, sectors and geographical areas, which we took into considerations when building our sample.

EBITDA for 3 years in a row or the EBITDA is negative, in our case 2011, 2012 and 2013.

**Figure 4: Firm Exposure and the Average Cost of Labour**



**Sources:** Quadros de Pessoal and Sistema de Contas Integradas da Empresa

**Note:** This figure shows the relationship between firm exposure and the average cost of labour of private firms in Portugal. The Firm Exposure is computed by (1) determining the share, for each firm, of workers below the minimum wage of 2014 for 2011, 2012 and 2013; (2) averaging the 3 years; (3) weighting by the wage gap of each worker; (4) and weighting by the hours worked of each worker. The real average cost of labour includes normal wages plus all subsidies, overtime payments and compensations; and is also a 3-year-average for 2011, 2012 and 2013. The sample includes only dependent-employed and firms with 5 or more employees that existed in 2011, 2012 and 2013. The red line is a LOESS curve with a 95% CI in grey. The points are calculated by dividing the data into 40 percentiles of firm exposure and computing the means within each bin.

## 4.2 Methodology for the Elasticity

This section argues for a novel way to compute the elasticity of employment to own wage. Previous literature like [Machin et al. \(2003\)](#); [Draca et al. \(2011\)](#); [Harasztosi and Lindner \(2019\)](#); [Bossler and Gerner \(2020\)](#) estimate changes in employment using similar specifications to equation 1 for both the intensive and the extensive margin, considering firm closures as  $-100\%$  change in employment. Therefore, they would use the distribution represented in Figure 5, which is the distribution of the changes in employment from 2013 to 2015, as the dependent variable of equation 5. Instead, we'll be computing firm employment growth at intensive and extensive margins separately and bundling the estimates after, as shown in equation 6.

The approach of the literature of estimating full margin employment assumes that the relationship between firm exposure and change in employment is linear through the distribution of employment change from 2013 to 2015. However, we argue that closing a firm is a different, slower, and more intricate phenomenon than downsizing. Thus, counting a firm closure as a downsizing of  $-100\%$  would be joining two different processes together and OLS will produce a pseudo-average between them that may describe neither. The highly plausible scenario that the effect of the minimum wage is different on downsizings and firm closures is illustrated in Figure 5, where we can view

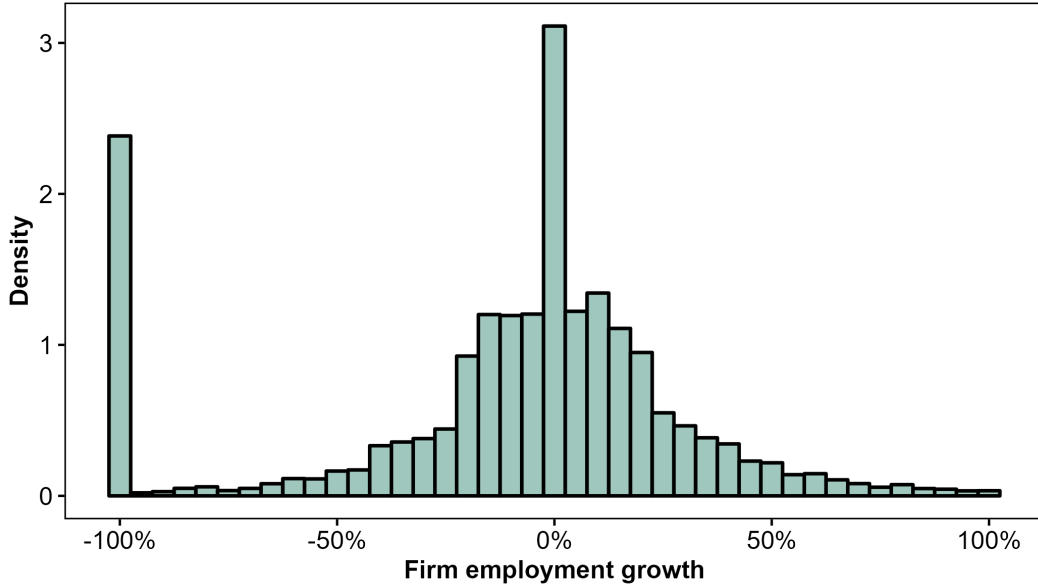
two different processes.

Equation 6 shows how we compute our full margin estimates for the computation of the employment to own-wage elasticity. For comparison, the literature would add to equation 5 a point estimate of full employment change directly.

$$OWE = \frac{\Delta\% emp.}{\Delta\% wage} = \frac{\Delta\% \text{ Full Margin Employment}}{\Delta\% \text{ Intensive Margin Wage}} \quad (5)$$

$$OWE = \frac{\overbrace{\Delta\% emp. \text{ intensive} \times \% \text{ open firms}}^{\text{Effect at the intensive margin weighted by active firms}} - \overbrace{1 \times \% \text{ close firms} \times \Delta Pr(\text{closure})}^{\text{Percentage of firms that closed counting as } -100\% \text{ employment change weighted by closures share}}}{\Delta\% wage \text{ intensive}} \quad (6)$$

**Figure 5: Employment Change by Firm from 2013 to 2015**



**Source:** Quadros de Pessôal

**Note:** This figure shows the distribution of the change in firm size/employment of private firms in Portugal. Firm size is computed by doing a full-time equivalence, where workers are weighted by normal hours worked and full-time jobs count as 1. The sample only includes dependent-employed and firms with 5 or more employees that existed in 2011, 2012 and 2013.

We use employment to own-wage elasticity because it's the most accurate way to measure the employment effects of the minimum wage and also describes the trade-off between employment and wage growth for workers. To measure the effect of the minimum wage on employment, researchers don't just report the change in employment, they report the elasticity of employment to the minimum wage. This makes it more comparable from study to study, because some minimum wage increases are larger than others. However, (Dube, 2019) argues that this is not enough, as many others. The effect of a minimum wage increase on employment is also dependent on the amount of people it affects. If the minimum wage coverage is higher, it's normal that more effects are felt. To tackle this issue, many researchers report the elasticity of employment to own wage, because a

higher coverage will make the wage increase more. Moreover, the employment to own-wage elasticity also makes obvious the trade-off, i.e., the cost for workers of the minimum wage policy, between employment and wages. The employment to own-wage elasticity cannot be computed using the wages at the full margin (Harasztosi and Lindner, 2019), because the goal is to see how much the average wage of the economy rose due to the minimum wage.

Finally, to get the final effects of the minimum wage we won't estimate (1) and (2) without the interaction  $\beta_3 FA_i \times FDF_i$ , because that would create another pseudo-average between the two distinct effects. Because our setting of crisis demands a separations of financially distressed firms and not financially distressed, we calculate the total effect of the minimum wage using an average probability effect (Wooldridge, 2010) on (1) and (2):

$$\sum_{i=1}^N \frac{\partial Pr(c_i = 1 | \mathbf{Z}_i)}{\partial FA_i} / N = \frac{\sum_{i=1}^N f(\mathbf{Z}_i \boldsymbol{\beta}) (\beta_1 + \beta_3 FDF_i)}{N} \quad (7)$$

### 4.3 Estimation

To estimate model (1) we use the Weighted Least Squares Within estimator based on Gaure (2013) procedure. All dependent variables are winsorized at the 99<sup>th</sup> percentile and the independent variables are winsorized at the 1<sup>st</sup> and 99<sup>th</sup> percentiles. The regression is weighted using the natural logarithm of firm size. To estimate the fixed effect logit model (2), with the same winsorization, we use Stammann (2018) procedure.

In order to estimate the effect of the logit model on the probability of closure, we use the same formula 7 for the total effects, and restrict the sample conditionally on the FDF state of the firm and use the same formula to estimate the other APE's.

We further correct for the Rare Event Problem. Because firm closures are consistently below a 50% rate (see Table 1) and logit models perform worse whilst facing this Rare Event Problem. To tackle this issue we employ the posterior rare event bias correction developed by King and Zeng (2001). We use equation 8 to find the bias that we later subtract to the  $\hat{\boldsymbol{\beta}}$ s. Because of the FE, equation 8 is computationally heavy, so we re-use Gaure (2013) method to estimate a high-dimensional linear weighted least-squares with worker and firm FE, with  $\varsigma$  as the dependent variable.

$$bias(\hat{\boldsymbol{\beta}}) = (X^T W X)^{-1} X^T W \varsigma, \quad (8)$$

where  $\hat{\boldsymbol{\beta}}$  are the coefficients from equation 2;  $\varsigma = 0.5 \hat{p}_{it} Q_{vv}$ ;  $Q_{vv}$  are the diagonal elements of  $Q = X(X^T W X)^{-1} X^T$ ;  $W = diag\{\hat{p}_{it}(1 - \hat{p}_{it})\}$ ; and  $\hat{p}_{it}$  the predicted probabilities.

To get the exact Logit interaction term we use (Ai and Norton, 2003) formula:

$$\begin{aligned} \frac{\Delta \frac{\partial F(\cdot)}{\partial FA_i}}{\Delta FDF_i} &= \frac{\Delta[(\beta_1 + \beta_3 FDF_i) f(\cdot)]}{\Delta FDF_i} \\ &= (\beta_1 + \beta_3) f[(\beta_1 + \beta_3) FA_i + \beta_2 + X_i \beta] - \beta_1 f(\beta_1 FA_i + X_i \beta) \end{aligned} \quad (9)$$

Lastly, for proper statistical inference, we use Huber-White Heteroskedastic robust standard errors for the coefficients of the regressions and we bootstrap the confidence intervals for the elasticities using the formulas found in in Chapter 5 of Davison and Hinkley (1997). We also follow Abadie et al. (2017) and don't cluster the standard errors.

## 4.4 Results of the Minimum Wage Burden on Workers

Table 7 reports computations from models 1 and 2. Panel A reports results of employment and panel B wages. Column (1) shows full margin estimates from running equation 1 with  $-100\%$  for a firm closure (the procedure used by the literature). Column (2) presents estimates for model 1 for firms that did not perform extensive margin adjustments (i.e. firms that did not close doors) as result of the shock, respectively. In Column (3) we can find the estimates for the minimum wage effect on the probability of firm closure (using the logit model 2 APEs, calculated with equation 7). Finally, in Column (4) are our preferred estimates, which join both estimates using equation 6.

### *Employment Effects*

Column (4) shows our main employment results, combining extensive and intensive margins. The point estimates in column (4) indicate that on average and *ceteris paribus* the minimum wage increase of 2014 decreased employment by 2.27% more at firms where 100 percent of the workforce is directly affected by the minimum wage relative to firms where there are no exposed workers. The effect on employment change was higher in financially distressed firms ( $-3.33\%$ ) and smaller in the remaining firms ( $-1.84\%$ ). Column (4) is a combination of column (2) and Column (3), which report intensive margin and extensive margin estimates, respectively. We can see that the minimum wage had both an effect on lay-offs, decreasing employment in firms that stayed open by 1.98% and in closure probability, increasing the probability of closure by 4.45 percentage points. There is a difference between financially distressed firms and the remainders both at the intensive and extensive margin. However, the difference is greater in the probability of closure, because it increased 4.25 percentage points more for financially distressed firms. That is what drives the enormous difference between the two estimates in column (1), which is the change in employment from running both margins in equation 1, as the literature estimates them.

In column (1) Here we see that all estimates are overestimated compared to column (4). We can see that the bigger the probability of closure, the worst the fit. Furthermore, even the confidence intervals reflect the bad fit, given that the variance is much bigger in column (1) than in column (2). The confidence intervals are so small at the intensive margin that they can barely be seen in Figure 6, the figure which graphically illustrates column (2). Column (3) is illustrated in Figure 7.

### *Wage Effects*

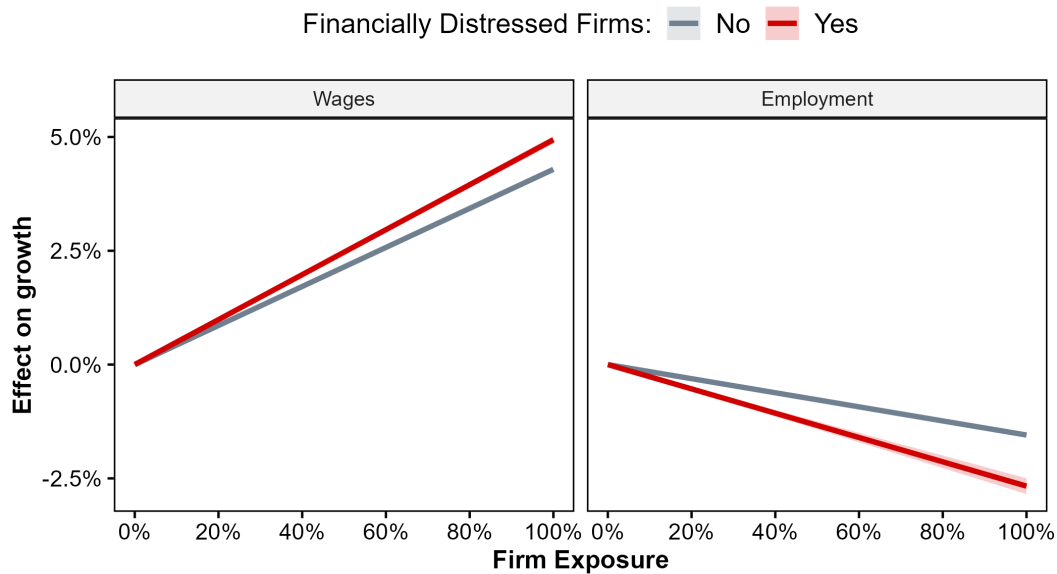
From Column (2) we can see that the minimum wage increase of 2014 increased wages by 4.55% more at firms where 100 percent of the workforce is directly affected by the minimum wage relative to firms where there are no exposed workers. As expected, this number is extremely similar between FDF and not FDF. We can also see that estimating it at full margin, seen in column (1), leads to an underestimation of the effect on average wages. This is due to the large variance of the parameter by the fact that there is a cluster of firms that have shut down, registering an employment variation of  $-100\%$ . Figure 6 reports the estimates throughout the distribution of FA.

Table 2: The Impact of the Minimum Wage on Wage and Employment

	Effect of Firm Exposure from 2013 to 2015 at			
	Full Margin	Intensive Margin	Extensive Margin	Weighted Full Margin
	Change (1)	Change (2)	$Pr(\text{closure})$ (3)	Change (4)
<b>Panel A: Employment</b>				
Total	-0.0290* [-0.0466; -0.0115]	-0.0198* [-0.0332; -0.0065]	0.0445* [0.0332; 0.0558]	<b>-0.0227</b> [-0.0331; -0.0123]
Not FDF	-0.0187* [-0.0918; -0.0004]	-0.0154* [-0.0159; -0.0150]	0.0408* [0.0295; 0.0521]	<b>-0.0184</b> [-0.0193; -0.0175]
FDF	-0.0674 [-0.1410; 0.0115]	-0.0266* [-0.0284; -0.0249]	0.0833 [0.0399; 0.1267]	<b>-0.0333</b> [-0.0369; -0.0297]
<b>Panel B: Wages</b>				
Total	0.0285* [0.0142; 0.0429]	<b>0.0455*</b> [0.0392; 0.0519]		
Not FDF	0.0339* [0.0185; 0.0493]	<b>0.0428*</b> [0.0426; 0.0431]		
FDF	-0.0147* [-0.07; 0.0413]	<b>0.0493</b> [0.0485; 0.0502]		
Controls	Yes	Yes	Yes	-
$Controls^2$	Yes	Yes	No	-
Sector FE	Yes	Yes	Yes	-
Num. obs.	46243	40794	46243	-
Num. sectors	23	23	23	-

This table shows the employment and wage impacts of the minimum wage increase in September 2014. \* denotes that the null hypothesis value is outside the confidence intervals at the 95% level, shown in square brackets. The confidence intervals are computed from Eicker-Huber-White Heteroskedastic robust standard errors for every column but (4), where the confidence intervals were bootstrapped. Panel A measures the effect of the MW on firm size from 2013 to 2015. The firm-size variable is weighted by the number of normal working hours of every worker. Panel B reports effects on average total wages. In each panel, FDF refers to firms that are in financial distress, which is a firm that both in 2011, 2012 and 2013 had a negative EBITDA or a positive EBITDA that is smaller than its expending with interests. The row Non-FDF is the parameter  $\beta_1$ , FDF is  $\beta_1 + \beta_3$  and total is the average partial effects of the firm exposure variable. The firm exposure variable is a 3-year-average from 2011, 2012 and 2013 of workers below the MW of 2015, weighted by the wage gap, and normal working hours. Column (1) shows the effects of the MW from the OLS regression 1, assigning closures a  $-100\%$  employment change and weighted by the  $\log(\text{firm size})$ . Column (2) shows the effects of the MW from the OLS regression 1 while excluding firm which closed and weighted by the  $\log(\text{firm size})$ . Column 3 are the computed average partial effects from the logit model 2 to assess the MW effect on the probability of closure. Column (4) has the weighted full margin from a combination of columns (2) and (3). The controls are: the lagged intensive margin employment variation from 2012 to 2013, the total investment in fixed capital a firm made from 2011 to 2013, the share of total wage on total labour costs, the share of exports share on total revenue, the share of labour costs of total costs, the share of men, the average tenure and the percentage of college educated workers and sector fixed effects. Data is from QP, SCIE and CI. The data is restricted to firms that existed in 2011, 2012 and 2013 and to a firm size higher or equal to 5. The primary and oil sectors are removed. We don't account for workers employed at Azores or Madeira because they have a different MW policy. Wage and firm-size variables are winsorized at the 99<sup>th</sup> percentile and the continuous control are windorized variables at the 1<sup>st</sup> and 99<sup>th</sup> percentiles.

Figure 6: Effect of the Minimum Wage at the Intensive Margin



Source: QP, SCIE and CI;

Note: This figure shows the impact of the minimum wage hike in 2014 on employment and wages at the intensive margin, excluding firm closures. The lines show the relationship between firm exposure to the minimum wage and the change in employment/wages between 2013 and 2015. The confidence intervals are computed using robust standard errors. The blue line refers to firms that aren't in financial distress and the red line are financially distressed firms, which are firms that both in 2011, 2012 and 2013 had a negative EBITDA or a positive EBITDA that is smaller than its expending with interests. The lines are calculated from model (1), where non-FDF is the parameter  $\beta_1$ , FDF is  $\beta_1 + \beta_3$ . The firm exposure variable is a 3-year-average from 2011, 2012 and 2013 of workers below the MW of 2015, weighted by the wage gap, and normal working hours. The controls are: the lagged intensive margin employment variation from 2012 to 2013, the total investment in fixed capital a firm made from 2011 to 2013, the share of total wage on total labour costs, the share of exports share on total revenue, the share of labour costs of total costs, the share of men, the average tenure and percentage of college educated workers and sector fixed effects. The data is restricted to firms which existed in 2011, 2012 and 2013 and to a firm-size higher or equal to 5. The primary and oil sectors are removed. We don't account for workers employed at Azores or Madeira because they have a different MW policy. Wage and firm-size variables are winsorized at the 99<sup>th</sup> percentile and the continuous control are windorized variables at the 1<sup>st</sup> and 99<sup>th</sup> percentiles.

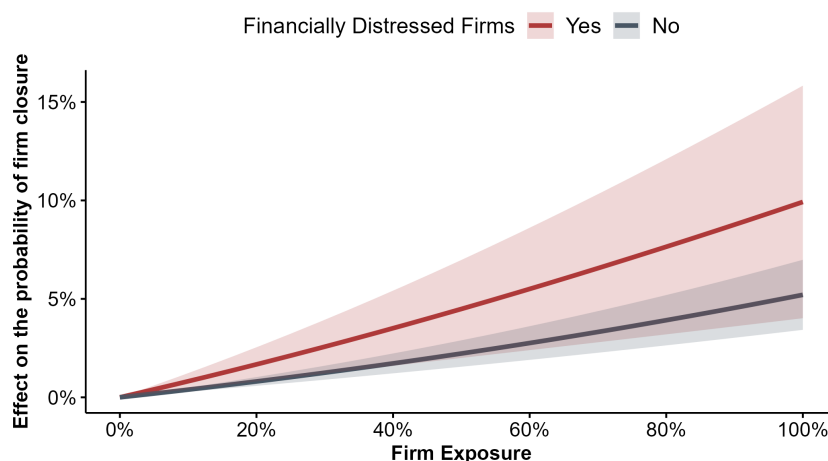
### Elasticity

To relate the estimates obtained with those from the literature, we computed the own-wage employment elasticity, which is shown in Table 3. Column "Total" reports estimates for all firms using average partial effects; column "Not Financially Distressed" reports estimates just for firms which weren't in financial distress and "Financially Distressed Firm" reports estimates for firms in financial distress.

Our preferred estimate for the own-wage employment is in row (1). It used the weighted employment estimates (from Panel A column (4) of Table 7) and the intensive wage (from Panel B column (2) of Table 7). The elasticity in global terms was  $-0.4994$  (significant at the 5% level), meaning that the effects on employment were negative and about half of the positive effects on average workers' wages. As one could expect, on average, the own-wage elasticity is greater in absolute value for the FDF, since for these the probability of closure was higher.



**Figure 7: Effect of the Minimum Wage on Firm Closures**



**Sources:** QP, SCIE and CI;

**Note:** This figure shows the impact of the minimum wage hike in 2014 on the probability of firm closure. The lines show the relationship between firm exposure to the minimum wage hike of 2014 and the increase of the probability of being closed in 2015, in percentage points. The confidence intervals are computed using robust standard errors. The firm exposure variable is a 3-year-average from 2011, 2012 and 2013 of workers below the MW of 2015, weighted by the wage gap, and normal working hours. The blue line refers to firms that aren't in financial distress and the red line are financially distressed firms, which are firms that both in 2011, 2012 and 2013 had a negative EBITDA or a positive EBITDA that is smaller than its expending with interests. The lines are calculated by taking the average partial effects of model (2) of firm exposure conditionally on being financially distressed or not. The controls are: the lagged intensive margin employment variation from 2012 to 2013, total investment in fixed capital a firm made from 2011 to 2013, share of total wage on total labour costs, share of exports share on total revenue, share of labour costs of total costs, share of men, average tenure and percentage of college educated workers and sector fixed effects. The data is restricted to firms which existed in 2011, 2012 and 2013 and to a firm-size higher or equal to 5. The primary and oil sectors are removed. We don't account for workers employed at Azores or Madeira because they have a different MW policy.

**Table 3: Employment Elasticities of the Minimum Wage**

	Total	Not Financially Distressed	Financially Distressed Firm
(1) $\frac{\Delta\% \text{ Weighted Margin Employment}}{\Delta\% \text{ Intensive Margin Wage}}$	<b>-0.4994</b> [-0.8471; -0.2003]	<b>-0.4303</b> [-0.4662; -0.4063]	<b>-0.6757</b> [-0.7793; -0.6054]
(2) $\frac{\Delta\% \text{ Full Margin Employment}}{\Delta\% \text{ Intensive Margin Wage}}$	-0.6383 [-1.1909; -0.1321]	-0.4377 [-0.8882; -0.0589]	-1.3673 [-2.8133; 0.0024]
(3) $\frac{\Delta\% \text{ Full Margin Employment}}{\Delta\% \text{ Minimum Wage}}$	-0.7033 [-1.1310; -0.2791]	-0.4535 [-2.2281; -0.0009]	-1.6345 [-3.422; -0.2791]
(4) $\frac{\Delta\% \text{ Full Margin Employment}}{\Delta\% \text{ Full Margin Wage}}$	-1.0179 [-3.2956; 0.0958]	-0.5530 [-2.0422; 0.8540]	4.5994 [1.9256; 14.6743]

*Note:* This table shows several computations of the employment to own-wage elasticity. \* denotes that the null hypothesis value is outside the confidence intervals at the 95% level, shown in square brackets. Standard errors are bootstrapped. In each panel, FDF refers to firms that were in financial distress, which is a firm that both in 2011, 2012 and 2013 had a negative EBITDA or a positive EBITDA that is smaller than its expending with interests. The column Non-FDF is the parameter  $\beta_1$ , FDF is  $\beta_1 + \beta_3$  and Total are the average partial effects of the firm exposure variable. Row (1) (our preferred estimates) computes the employment change by weighting the intensive and extensive margins. Row (2) estimates extensive and intensive margin together, counting closures as a  $-100\%$  reduction in wages. Column (3) shows the estimate if computed with the minimum wage change and not the actual wage change. Column (4) shows the elasticities if computed considering a wage change of  $-100\%$  in the case of a firm closure.

Column (2) reports estimates as the literature would. Instead of using weighted full estimates for employment, it uses simple full (from Panel A column (1) of Table 7). This leads to a clear overestimation of the unemployment effects of the minimum wage, an overestimation which is larger if a firm is in financial distress because firm closures are more relevant and distort OLS more.

Column (3) reports estimates not for the elasticity of employment to own-wage but of employment to minimum wage variation. These estimates are less comparable with another studies because they don't take into account the minimum wage coverage.

Column (4) exemplifies why can't the full margin of wages be used (from Panel B column (1) of Table 7). Because financially distressed firms have more firm closures, the full wage estimates are negative and this leads to an uninterpretable elasticity of 4.5.

## 5 Incidence of the Minimum Wage

Until now, we have evaluated the burden of the minimum wage on workers. However, laying off workers (in Portugal is normal for the firm to pay compensations to lay-off workers) and increasing wages is very likely to increase labour costs, even considering the amount of people laid-off because of the minimum wage (the elasticity of  $-0.4994$  of table 3 suggests that the total spending on wages increased). That increase must be paid somehow. Thus, this section studies how the increased labour costs are distributed amongst firms and consumers. We reserve this part of the analysis to the intensive margin because there is no meaning in dividing the burden for closed firms. We further restrict our sample to the manufacturing sector. The share of the cost that each agent bears depends on the combination of the various factors at play, and it will be reflected in changes in the following accounting identity:

$$\text{Labour Costs}_i \equiv \text{Output}_i - \underbrace{CI_i - \text{Profits}_i - \text{Invest}_i - \text{Misc}_i}_{\text{Gross Operating Surplus}} \quad (10)$$

Where  $CI$  is intermediary consumption (external services and materials), investment is just gross formation of fixed capital and misc are the other costs. Table 5 describes the variables and what they include. Rearranging, we get:

$$\frac{\Delta \text{Labour Costs}_i}{\text{Output}_i} = \underbrace{\frac{\Delta \text{Output}_i}{\text{Output}_i} - \frac{\Delta CI_i}{\text{Output}_i}}_{\text{Consumers Pay}} - \underbrace{\frac{\Delta \text{Profits}_i}{\text{Output}_i} - \frac{\Delta \text{Invest}_i}{\text{Output}_i} - \frac{\Delta \text{Misc}_i}{\text{Output}_i}}_{\text{Firm Owners Pay}} \quad (11)$$

In accordance with equation 11, a positive change in the wage bill stemming from an increase in the minimum wage will manifest itself in a change in the firm's production, intermediary costs, investment, profits and/or miscellaneous costs. Moreover, firms more exposed to minimum wage increases are subject to greater adjustments of this type.

The channels of adjustment may be wrapped in two burdens. The first is to consumers, through prices. Because we don't have prices in our data, we restrict our sample to the manufacturing sector we assume that output and intermediary consumption have a

constant ratio. The key underlying assumption of this approach is that external services and the cost of materials are jointly sound proxies for the quantity produced.

The second channel of adjustment is to firm owners. If the firm responds by reducing profits, investment or cutting other costs that might reduce production in the long run, the burden falls upon the firm.

We estimate the effects of exposure to minimum wage increases on the variation in labour costs, revenues, materials and profits relative to revenues earned in 2013 using a specification akin to equation 1, as follows:

$$\frac{y_{i2015} - y_{i2013}}{\text{Output}_{i2013}} = \beta_1 FA_i + \beta_2 FDF_i + \beta_3 FA_i \times FDF_i + \lambda X_i + \delta X_i^2 + \theta_{S(i)} + \epsilon_i \quad (12)$$

## 5.1 Results of the Minimum Wage Incidence

Table 4 reports estimates from equation 12 for various dependent variables further restricted to the manufacturing sector. Column (1) reports the estimates for firms that are not in financial distress, captured by parameter  $\beta_1$ . Column (2) reports the estimates for firms in financial distress, which is  $\beta_1 + \beta_3$ .

Table 4: Incidence of the Minimum Wage in Manufacturing

	Change for Non-Financially Distressed	Change for Financially Distressed
	$\beta_1$	$\beta_1 + \beta_3$
	(1)	(2)
Change in total labor costs	0.0148	0.0417
Incidence on consumers ( $\Delta Prices = \Delta Output - \Delta IC$ )	0.0117**	0.0201*
Percentage change in output ( $\Delta Output$ )	0.0462**	0.1089**
Change in IC relative to output ( $\Delta IC$ )	0.0345**	0.0888*
Incidence on firm owners ( $\Delta GOS = \Delta Profits + \Delta Invest + \Delta Misc$ )	-0.0031	-0.0216
Change in profits relative to output ( $\Delta Profits$ )	-0.0108***	0.0187**
Change in investment relative to output ( $\Delta Invest$ )	0.0060*	0.0024*
Change in miscellaneous costs relative to output ( $\Delta Misc$ )	0.0015 <sup>+</sup>	-0.0167*
Fraction paid by consumers	78.6%	48.2%
Fraction paid by firm owners	21.4%	51.8%

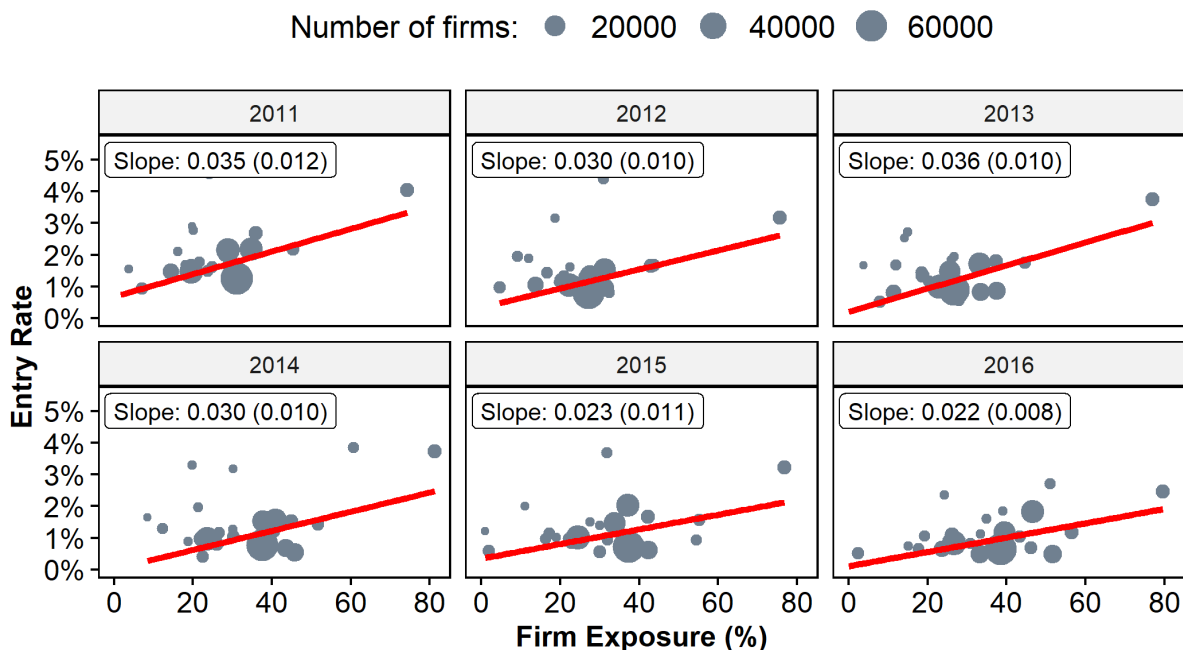
+  $p < 0.1$ , \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ . This table provides estimates for the incidence of the minimum wage increase. Using equation 12, we estimate the relationship between the incidence indicator and the evolution of various balance sheet items, controlling for the fixed heterogeneity of each firm, as for a number of other characteristics. Through these relations, we estimate the *Incidence on consumers*, which is given by the margin between the value of output and intermediate costs. Additionally, the *Incidence on firm owner* is estimated, which is given by the symmetric of the gross operating surplus (a detailed definition of this variable can be found in Table 5). The *Fraction paid by consumers* is given by the ratio between *Incidence on consumers* and the *Change in total labor cost*. The *Fraction paid by firm owners* is given by the ratio between the *Incidence on firm owners* and the *Change in total labor cost*. Column 1 displays the change between 2013 and 2015 for Non-financially distressed firms and column 2 shows the change between 2013 and 201 for financially distressed firms. All regressions are weighted by the  $\log(\text{firm size})$ .

In Column (1) we see that, for financially distressed firms, total labour costs rose 1.48% more at firms where 100 percent of the workforce is directly affected by the minimum

wage relative to firms where there are no exposed workers. This increase was paid in 78.6% by consumers and 21.4% by firm owners. Prices rose 1.17% more at firms where 100 percent of the workforce is directly affected by the minimum wage relative to firms where there are no exposed workers. Firm owners decreased profits ( $-1.08\%$ ), and had very small adaptations on other costs and investments.

Interestingly, the margins of adjustment changed in column (2), for financially distressed firms. We must note that the fact that this is at intensive margin means that we are analysing the financially distressed firms which managed to survive. We find that firm owners take a higher share of the burden (51.8%). This implies that firms in financial distress could not raise prices even more, because revenues would decrease too. But they couldn't decrease profits either (they actually increase them). Thus, much of the adjustment is made through the decrease of other miscellaneous costs, which are likely to have long-term impacts on the firm, but decrease the current high risk of firm closure that these firms face.

**Figure 8: Firm Entry and Firm Exposure at Sector Level**



**Source:** Quadros de Pessôal

**Note:** This figure shows the relationship between exposure to the minimum wage and firm entry at two-digit industry level from 2011 to 2015. Each scatterplot reports the entry rate in a two-digit sector to the average firm-level fraction of affected workers in that sector. In each graph, the fitted regression line is the outcome from a corresponding OLS regression of firm exposure on entry rate weighted by the number of firms in the sector. The regression slope along with the standard errors are indicated in the top left corner. Firm size is restricted to 5 workers (measures with full-time equivalence), the primary and oil sectors are excluded. The exposure to the minimum wage is relative to the year in question, not to the following year. A minimum wage worker is classified using hourly wages.

## 6 Entry Rate Robustness

One possible limitation of our firm-level estimates is that we can only characterize the exposure to the minimum wage for firms that existed prior to the minimum wage

increase. As a result, we excluded new firms from the sample. Therefore, if the minimum wage changed the entry of firms, our employment estimates would be biased. In Figure 8 we test the hypothesis of the minimum wage having increased/decreased entries. We find no indication of a shift in firm entry due to the minimum wage, given that there is no statistical difference between the slopes in Figure 8.

## 7 Conclusion

Using a rich combination of linked employer-employee administrative data for Portugal, we conclude that the minimum wage hike of 2014 in Portugal had an employment to own-wage elasticity of  $-0.50$ . We compute the elasticity in a novel way, estimating the effect of the minimum wage on closures and lay-offs separately, and then joining them into a single elasticity estimate.

Our analysis has some limitations. We don't uncover any workers dynamics within and between firms. The minimum wage doesn't bite equally on every worker, and we are bundling all workers together and disregarding any substitution effect. This hypothesis further limits our analysis because we assume that untreated firms and workers are unaffected by the minimum wage (the stable unit treatment value assumption).

Furthermore, we identify who pays for the increase in labour costs and find that consumers pay 78.6% and firm owners pay 21.4%.

## References

- Abadie, Alberto, Susan Athey, Guido W Imbens, and Jeffrey Wooldridge**, “When Should You Adjust Standard Errors for Clustering?,” Working Paper 24003, National Bureau of Economic Research November 2017. (Cited on page(s) 13)
- Ai, Chunrong and Edward C Norton**, “Interaction terms in logit and probit models,” *Economics letters*, 2003, 80 (1), 123–129. (Cited on page(s) 13)
- Alexandre, Fernando, Pedro Bação, João Cerejeira, Hélder Costa, and Miguel Portela**, “Minimum wage and financially distressed firms: Another one bites the dust,” *Labour Economics*, 2022, 74 (C). (Cited on page(s) 5, 9, 10)
- Allegretto, Sylvia A., Arindrajit Dube, and Michael Reich**, “Do Minimum Wages Really Reduce Teen Employment? Accounting for Heterogeneity and Selectivity in State Panel Data,” *Industrial Relations: A Journal of Economy and Society*, April 2011, 50 (2), 205–240. (Cited on page(s) 5)
- Bailey, Martha J., John DiNardo, and Bryan A. Stuart**, “The Economic Impact of a High National Minimum Wage: Evidence from the 1966 Fair Labor Standards Act,” *Journal of Labor Economics*, 2021, 39 (S2), S329–S367. (Cited on page(s) 5)
- Belman, Dale and Paul J. Wolfson**, *What Does the Minimum Wage Do?* Books from Upjohn Press, W.E. Upjohn Institute for Employment Research, July 2014. (Cited on page(s) 4)
- Bossler, Mario and Hans-Dieter Gerner**, “Employment effects of the new German minimum wage: Evidence from establishment-level microdata,” *ILR review*, 2020, 73 (5), 1070–1094. (Cited on page(s) 3, 4, 5, 10, 11)
- Burkhauser, Richard V., Kenneth A. Couch, and David C. Wittenburg**, “A Reassessment of the New Economics of the Minimum Wage Literature with Monthly Data from the Current Population Survey,” *Journal of Labor Economics*, 2000, 18 (4), 653–680. (Cited on page(s) 5)
- Card, David and Alan B Krueger**, “Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania,” *American Economic Review*, September 1994, 84 (4), 772–793. (Cited on page(s) 4, 10)
- Cengiz, Doruk, Arindrajit Dube, Attila Lindner, and Ben Zipperer**, “The Effect of Minimum Wages on Low-Wage Jobs,” *The Quarterly Journal of Economics*, 2019, 134 (3), 1405–1454. (Cited on page(s) 4, 5)
- , –, –, and **David Zentler-Munro**, “Seeing beyond the Trees: Using Machine Learning to Estimate the Impact of Minimum Wages on Labor Market Outcomes,” *Journal of Labor Economics*, 2022, 40 (S1), S203–S247. (Cited on page(s) 5)
- Centeno, Mário, Cláudia Duarte, and Álvaro Novo**, “The Impact of the Minimum Wage on Low-Wage Earners,” *Economic Bulletin and Financial Stability Report Articles and Banco de Portugal Economic Studies*, 2011. (Cited on page(s) 4, 5)

- Clemens, Jeffrey and Michael Wither**, “The minimum wage and the Great Recession: Evidence of effects on the employment and income trajectories of low-skilled workers,” *Journal of Public Economics*, 2019, 170, 53–67. (Cited on page(s) 5)
- Davison, Anthony Christopher and David Victor Hinkley**, *Bootstrap methods and their application* number 1, Cambridge university press, 1997. (Cited on page(s) 13)
- Derenoncourt, Ellora and Claire Montialoux**, “Minimum Wages and Racial Inequality,” *The Quarterly Journal of Economics*, 09 2020, 136 (1), 169–228. (Cited on page(s) 5)
- Draca, Mirko, Stephen Machin, and John Van Reenen**, “Minimum Wages and Firm Profitability,” *American Economic Journal: Applied Economics*, January 2011, 3 (1), 129–51. (Cited on page(s) 4, 9, 10, 11)
- Drucker, Lev, Katya Mazirov, and David Neumark**, “Who pays for and who benefits from minimum wage increases? Evidence from Israeli tax data on business owners and workers,” *Journal of Public Economics*, 2021, 199, 104423. (Cited on page(s) 4, 5, 10)
- Dube, Arindrajit**, “Impacts of minimum wages: review of the international evidence,” *Independent Report. UK Government Publication*, 2019, pp. 268–304. (Cited on page(s) 4, 12)
- , **T. William Lester, and Michael Reich**, “Minimum Wage Effects Across State Borders: Estimates Using Contiguous Counties,” *The Review of Economics and Statistics*, 2010, 92 (4), 945–964. (Cited on page(s) 5)
- Dustmann, Christian, Attila Lindner, Uta Schönberg, Matthias Umkehrer, and Philipp Vom Berge**, “Reallocation effects of the minimum wage,” *The Quarterly Journal of Economics*, 2022, 137 (1), 267–328. (Cited on page(s) 5)
- Gaure, S.**, “OLS with Multiple High Dimensional Category Variables.,” *Computational Statistics and Data Analysis*, 2013, 66, 8–18. (Cited on page(s) 13)
- Gopalan, Radhakrishnan, Barton H. Hamilton, Ankit Kalda, and David Sovich**, “State Minimum Wages, Employment, and Wage Spillovers: Evidence from Administrative Payroll Data,” *Journal of Labor Economics*, 2021, 39 (3), 673 – 707. (Cited on page(s) 4)
- Harasztosi, Peter and Attila Lindner**, “Who Pays for the Minimum Wage?,” *American Economic Review*, August 2019, 109 (8), 2693–2727. (Cited on page(s) 3, 4, 5, 9, 10, 11, 13)
- Jardim, Ekaterina, Mark C. Long, Robert Plotnick, Emma van Inwegen, Jacob Vigdor, and Hilary Wething**, “Minimum Wage Increases and Individual Employment Trajectories,” NBER Working Papers 25182, National Bureau of Economic Research, Inc October 2018. (Cited on page(s) 4)
- King, Gary and Langche Zeng**, “Logistic Regression in Rare Events Data,” *Political Analysis*, Spring 2001, 9. (Cited on page(s) 13)

- Luca, Dara Lee and Michael Luca**, “Survival of the Fittest: The Impact of the Minimum Wage on Firm Exit,” Working Paper 25806, National Bureau of Economic Research May 2019. (Cited on page(s) 4)
- Machin, Stephen, Alan Manning, and Lupin Rahman**, “Where the minimum wage bites hard: Introduction of minimum wages to a low wage sector,” *Journal of the European Economic Association*, 2003, 1 (1), 154–180. (Cited on page(s) 4, 5, 9, 10, 11)
- MaCurdy, Thomas**, “How Effective Is the Minimum Wage at Supporting the Poor?,” *Journal of Political Economy*, 2015, 123 (2), 497–545. (Cited on page(s) 3, 5)
- Mayneris, Florian, Sandra Poncet, and Tao Zhang**, “Improving or disappearing: Firm-level adjustments to minimum wages in China,” *Journal of Development Economics*, 2018, 135 (C), 20–42. (Cited on page(s) 5)
- McGowan, Müge Adalet, Dan Andrews, and Valentine Millot**, “Insolvency regimes, zombie firms and capital reallocation,” OECD Economics Department Working Papers 1399, OECD Publishing June 2017. (Cited on page(s) 10)
- Meer, Jonathan and Jeremy West**, “Effects of the Minimum Wage on Employment Dynamics,” *The Journal of Human Resources*, 2016, 51 (2), 500–522. (Cited on page(s) 6)
- Monras, Joan**, “Minimum Wages and Spatial Equilibrium: Theory and Evidence,” *Journal of Labor Economics*, 2019, 37 (3), 853–904. (Cited on page(s) 5)
- Neumark, David and Peter Shirley**, “Myth or measurement: What does the new minimum wage research say about minimum wages and job loss in the United States?,” *Industrial Relations: A Journal of Economy and Society*, 2022, 0 (0), 1–34. (Cited on page(s) 4)
- **and William L. Wascher**, “Minimum Wages and Employment,” *Foundations and Trends in Microeconomics*, 2007, 3 (1–2), 1–182. (Cited on page(s) 3)
- Pereira, Sónia C.**, “The impact of minimum wages on youth employment in Portugal,” *European Economic Review*, April 2003, 47 (2), 229–244. (Cited on page(s) 4, 5)
- Shapiro, Carl and Joseph E. Stiglitz**, “Equilibrium Unemployment as a Worker Discipline Device,” *The American Economic Review*, 1984, 74 (3), 433–444. (Cited on page(s) 4)
- Silva, João Cerejeira**, “Young Employment, Job-Skill Composition and Minimum Wages: Evidence from a ‘Natural Experiment’,” Working Paper, NIPE - Universidade do Minho 2008. (Cited on page(s) 4, 5)
- Stammann, Amrei**, “Fast and Feasible Estimation of Generalized Linear Models with High-Dimensional k-way Fixed Effects,” 2018. (Cited on page(s) 13)
- Stigler, George J.**, “The Economics of Minimum Wage Legislation,” *The American Economic Review*, 1946, 36 (3), 358–365. (Cited on page(s) 4)
- Wooldridge, J. M.**, *Econometric Analysis of Cross Section and Panel Data*, 2 ed., MIT Press, 2010. (Cited on page(s) 13)

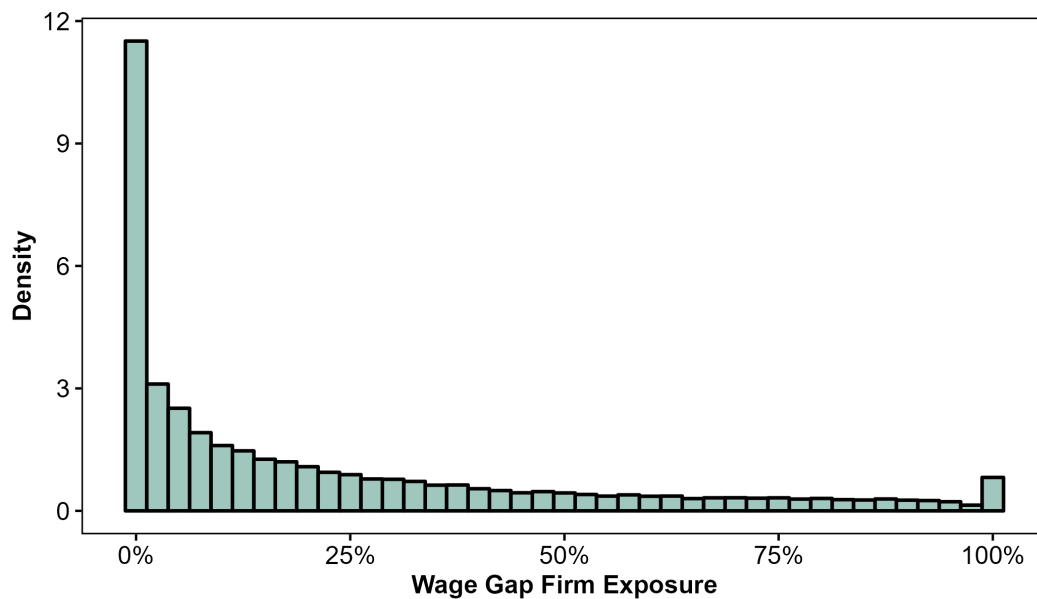


## A Additional Figures and Tables

Table 5: Description of Variables used for Incidence Evaluation

Variable Name	Level	Unit	Formula
Gross Operating Surplus (GOS)	Firm	Euro	GVA - Labor Costs - NetTax
Gross Value Added at market prices (GVA)	Firm	Euro	Output - Intermediate Costs
Intermediate Costs (IC)	Firm	Euro	Cost of Materials + Cost of biological assets + External Services + Quotizations + Other non-specified Costs
Net Taxes (NetTax)	Firm	Euro	Taxes - Operating Subsidies
Output	Firm	Euro	Revenue - Cost of Materials +Inventories Variation + Own Work Capitalized + Supplementary Income + Other non-specified costs

Figure 9: Distribution of Firm Exposure to the Minimum Wage



Sources: Quadros de Pessoa

Note: This figure shows the distribution of Firm Exposure. Firm Exposure measures the percentage of workers below the minimum wage of 2014, by firms. It is a 3-year-average from 2011, 2012 and 2013 of workers below the MW of 2014, weighted by the wage gap, and normal working hours.

Table 6: Wage and Employment Coefficients at the Intensive and Full Margin

	Change from 2013 to 2015 in:			
	Employment		Wages	
	Full Margin (1)	Intensive Margin (2)	Full Margin (3)	Intensive Margin (4)
FA	-0.0153 [-0.0345; 0.0038]	-0.0129 [-0.0275; 0.0018]	0.0353* [0.0200; 0.0507]	0.0433* [0.0366; 0.0500]
FDF	-0.1675* [-0.1858; -0.1493]	-0.0714* [-0.0861; -0.0567]	-0.1194* [-0.1340; -0.1048]	-0.0097* [-0.0164; -0.0029]
$FA \times FDF$	-0.0639* [-0.1139; -0.0140]	-0.0287 [-0.0702; 0.0128]	-0.0499* [-0.0899; -0.0099]	0.0054 [-0.0136; 0.0244]
Controls	Yes	Yes	Yes	Yes
Controls <sup>2</sup>	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes
R <sup>2</sup>	0.0560	0.0560	0.0555	0.0713
Adj. R <sup>2</sup>	0.0552	0.0551	0.0547	0.0704
Num. obs.	47197	41599	47197	41599

\*\*\* $p < 0.001$ ; \*\* $p < 0.01$ ; \* $p < 0.05$ . Coefficients and statistics from equation 1. Column (1) reports numbers for employment at the full margin, column (2) reports numbers for employment at the intensive margin, column (3) reports numbers for wages at the full margin and column (4) reports numbers for wages at the intensive margin. The controls are: the lagged intensive margin employment variation from 2012 to 2013, total investment in fixed capital a firm made from 2011 to 2013, share of total wage on total labour costs, share of exports share on total revenue, share of labour costs of total costs, share of men, average tenure and percentage of college educated workers and sector fixed effects. Data is from QP, SCIE and CI. The data is restricted to firms which existed in 2011, 2012 and 2013 and to a firm-size higher or equal to 5. The primary and oil sectors are removed. We don't account for workers employed at Azores nor Madeira because they have a different MW policy.

Table 7: Logit Model for Firm Closures

Dependent variable: Firm being closed in 2015	
$FA$	0.43*** (0.06)
$FDF$	0.94*** (0.05)
$FA \times FDF$	0.04 (0.14)
Controls	Yes
Sector FE	Yes
AIC	32702.36
BIC	32964.61
Log Likelihood	-16321.18
Deviance	32642.36
Num. obs.	46243

\*\*\* $p < 0.001$ ; \*\* $p < 0.01$ ; \* $p < 0.05$ . Coefficients and statistics from equation 2. The controls are: the lagged intensive margin employment variation from 2012 to 2013, total investment in fixed capital a firm made from 2011 to 2013, share of total wage on total labour costs, share of exports share on total revenue, share of labour costs of total costs, share of men, average tenure and percentage of college educated workers and sector fixed effects. Data is from QP, SCIE and CI. The data is restricted to firms which existed in 2011, 2012 and 2013 and to a firm-size higher or equal to 5. The primary and oil sectors are removed. We don't account for workers employed at Azores nor Madeira because they have a different MW policy.