# Monopsony Power and Firm Organization*

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**Abstract**

We develop a general equilibrium model where the wage dispersion between managers and production workers stems from heterogeneous wage markdowns and firm organizational decisions. Quantifying the model to Portuguese administrative data, we show that monopsony power reduces mean wage dispersion between occupations by 11.8 percent and causes welfare losses through distorting firms' managerial delegation choices. Raising the minimum wage lowers welfare and affects managers through worker reallocation and delegation decisions. However, designing an optimal occupation-based minimum wage leads to welfare gains of nearly 0.2 percent for both occupations.

**Keywords:** Monopsony power, firm organization, welfare, minimum wages.

**JEL:** D21, J21, J31, J42, O40

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# 1 Introduction

Recent studies emphasize the adverse economic implications of limited competition in the labor market (see, for instance Berger et al., 2022). The number of competing firms is a key factor for market competition, which is often assumed to be the same across occupations. However, the number of available firms for distinct worker types may differ due to firms' organizational decisions. For instance, managerial job markets tend to have fewer participant firms relative to the markets of production workers, as only a fraction of firms delegate decision-making to managers. Thus, wage disparities between both worker types may reflect not only productivity heterogeneity but also differences in competition. Simultaneously, firms are more likely to expand and delegate tasks to managers when they have fewer competitors, suggesting that labor market competition affects their organizational structure. This paper shows that understanding the interaction between firm organization and monopsony power helps us to explain wage dispersion across distinct types of workers, managerial delegation choices, and the design of policies that tackle monopsony power.

To that end, we develop a general equilibrium model where the distribution of employment and wages of production workers and managers stems from heterogeneous wage markdowns and firm organizational choices. Quantifying the model to Portuguese administrative data, we show that monopsony power reduces mean wage dispersion between both occupations by 11.8 percent and incentivizes managerial delegation in relatively less productive firms. We estimate consumption equivalent welfare losses of 5.7 and 23.1 percent for production workers and managers, respectively. Raising the minimum wage lowers welfare and affects managerial wages through firms' delegation choices and worker reallocation. However, designing an optimal occupation-based minimum wage would provide welfare gains for both occupations of about 0.20 percent.

To arrive at these conclusions, we first use data from an annual census that covers the universe of private firms in Portugal. We compute the Herfindahl-Hirschman Index (HHI) for each occupation-based local labor market, which increases when the total payroll in the market is concentrated in fewer firms. We document two stylized facts. First, we show that the average production worker and manager work in a market with an HHI equal to 0.19 and 0.27, respectively. One would observe a similar concentration level with five and three identical firms, respectively. Managers tend to work in more concentrated markets because the markets of production workers have about two times as many firms as the markets of managers and because a higher proportion of managers than production workers sort into markets with high concentration levels. Second, we document that highly concentrated local labor markets have a higher share of production workers who work at multi-layer firms, i.e., firms that add a managerial layer to their labor organization. In particular, an increase of 10 percentage points in the HHI is associated with an increase of 2.8 percentage points in the share of production workers at multi-layer firms. In summary, these facts suggest that firms' degree of monopsony power affects their internal organization, and the relationship between the two factors may affect wage dispersion between both worker types.

To quantify the distribution of wage markdowns across occupations and perform counterfactual simulations, we develop a general equilibrium model that incorporates oligopsony competition, minimum wages, and firm organizational decisions. The economy features a representative household for each occupation and a continuum of locations, each with a finite number of firms. Households choose consumption and the measure of workers to supply to each firm for their respective occupation. They view firms and locations as imperfect substitutes, where the degree of substitutability is exogenously specific to each occupation. Moreover, labor disutility costs are also exogenously heterogeneous across occupations. Firms exogenously differ in terms of productivity and the location they inhabit. The firm's organizational decision involves adopting a single- or multi-layer organizational structure. Single-layer firms decide how many production workers to hire. Multi-layer firms include an additional managerial layer and choose how many managers and production workers to hire. In the model, managers enable firms to direct a larger workforce, yet it comes at higher overhead costs, and thus, only the most productive firms adopt a multi-layer structure. Regarding monopsony power, imperfect firm substitutability and firm granularity imply that firms face upward-sloping labor supply curves and make employment choices under strategic competition, i.e., internalizing the employment policies of their competitors in the same location. If minimum wages do not bind, this environment leads to equilibrium wage markdowns that depend on (i) the exogenous occupation-based parameters that determine firm substitutability and (ii) the market payroll share of the firm, which endogenously depends on the organizational and employment choices of firms.

We estimate the model using the Simulated Method of Moments (SMM) to fit moments of firm organization, wages, and market concentration. We exploit within market-year correlation between employment and wages to estimate the within-market elasticities. Moreover, we adopt an indirect inference approach to estimate the across-market elasticities from plausibly exogenous labor demand changes at the municipality level, which we generate with a Bartik-type instrument that exploits national sector employment trends interacted with baseline exposure shares. The model reproduces the empirical distribution of wages across workers and the distribution of employment across markets for both occupations. Moreover, it fits average levels of market concentration, firm organization, as well as the positive relationship between market concentration and the share of production workers who work in multi-layer firms. In addition, we perform an event study analysis that quantifies the effect of mass-layoff shocks on employment and wages at the municipality level and shows that our model generates realistic outcomes. This shock is particularly interesting to our setting because it reflects labor market adjustments that depend on worker reallocation toward other firms, either in the same or a different local labor market. For each occupation, our model captures that mass layoffs have a small negative impact on the municipality's average wages and explains one-fourth of the negative change in the municipality's employment.

To quantify the effect of monopsony power on aggregate outcomes, we compare the benchmark equilibrium with a counterfactual efficient economy where wages are equal to the marginal product of labor. In the benchmark economy, we estimate that the average manager and production worker bear a wage markdown of 23.1 and 10.6 percent, respectively.

Firms generally exert wider wage markdowns on managers because managers (i) often work in markets with fewer competing firms, (ii) have lower across and within market elasticities, and (iii) the minimum wage is more likely to be binding for production workers. Comparing the benchmark and efficient economy, we show three main results. First, we estimate that dispersion in mean wages across occupations is 11.8 percent higher in the efficient economy. Second, monopsony power incentivizes managerial delegation in less productive firms because it enables them to hire a large workforce at relatively low wages. We find that the share of multi-layer firms decreases by 11.2 percent in the efficient economy due to the decrease of relatively less productive multi-layer firms. Conditional on low to medium productivity types, the share of multi-layer firms decreases by 12.6 to 44.4 percent. We show that accounting for this result is crucial in explaining the effect of monopsony power on market concentration and the reallocation of managers across firms. Third, we estimate a consumption-equivalent welfare gain of 5.7 percent for production workers and 23.1 percent for managers in the efficient economy, as both benefit from the efficiency gains and the redistribution of firm profits to labor income. We show that ignoring the endogenous decrease in managerial delegation contributes to overestimating the welfare gains of both worker types by 10 percent, as it neglects the reduction in the demand of managers and part of worker reallocation.

To assess the effectiveness of minimum wage policies in improving the welfare of households by limiting the monopsony power of firms, we start analyzing the Portuguese reforms that increased the real minimum wage by ten percent between 2016 and 2019. We estimate these reforms deteriorate production workers' welfare while maintaining managers' welfare. Moreover, we show that raising the minimum wage decreases the share of multi-layer firms and induces the reallocation of production workers toward more productive firms. As a result, it affects the employment and wage level of managers that typically earn salaries well above the minimum wage. Alternatively, we study whether occupation-based minimum wages improve upon these reforms and the benchmark economy. We show that the welfare gain of managers is hump-shaped relative to a policy that increases the minimum wage just for managers while keeping the baseline minimum wage for production workers. At most, this policy brings about a welfare gain for managers of about 0.5 percent when their minimum wage is 56 percent of their mean wage (900€). However, this policy often damages production workers because their welfare level is decreasing in the minimum wage of managers, as it reduces their employment level and increases their disutility of labor by inducing worker reallocation. Finally, we estimate the Pareto optimal combination of occupation-based minimum wages that provides welfare gains for both worker types. We estimate that setting the minimum wage of production workers at 63 percent of their mean wage (460€) and the one of managers at 50 percent of their mean wage (790€) increases their welfare level by 0.25 and 0.17 percent, respectively. Hence, we show that an optimal occupation-based minimum wage recovers between 1 to 4 percent of the corresponding welfare loss from monopsony power for each occupation.

**Literature.** This paper contributes to the literature on oligopsonistic labor markets and how this affects the overall economy (Bhaskar et al., 2002; MacKenzie, 2021; Berger et al., 2022, 2023a; Jarosch et al., 2023). Using models where labor market power arises from firm granularity and imperfect firm substitutability, they study the effect of labor market power on wages, efficiency, and welfare. Our main contribution to this literature is to study the effect of labor market power on these outcomes through the organization of work within firms. In our model, non-atomistic firms engage in organizational decisions that give rise to markdown heterogeneity for production workers and managers. Moreover, our production technology is not additively separable in labor, which allows studying the interplay between occupations in employment and wages.

We connect to the literature that studies the effect of minimum wage policies in models with imperfect labor market competition (Bamford, 2021; Ahlfeldt et al., 2022; Hurst et al., 2022; Karabarbounis et al., 2022; Drechsel-Grau, 2023). We build our framework on Berger et al. (2023b), which studies the effect of minimum wages on efficiency and welfare in an oligopsonistic environment with firm and worker heterogeneity. By considering firm organizational decisions, we add three contributions to this literature. First, we show that raising the minimum wage decreases the share of firms that delegate to managers and the managerial span of control. Second, we show that raising the minimum wage affects managers and production workers differently. Third, we show that adopting an occupation-based minimum wage can provide welfare gains.

This paper also contributes to the literature on production organization, which rationalizes organizations as an efficient device to use and communicate the knowledge required for production (Garicano and Rossi-Hansberg, 2006; Caliendo and Rossi-Hansberg, 2012). Several studies build on this model to analyze firm-size distortions (Garicano et al., 2016; Tamkoç, 2022), the adoption of information and technological capital (Mariscal, 2020), the misallocation of labor in developing countries (Grobovsek, 2020), and technological adoptions across urban areas (Santamaria, 2023). Contemporaneously to our work, Lawson et al. (2023) studies the impact of minimum wages on productivity through firm organization in a perfectly competitive framework. To our knowledge, we are the first to incorporate imperfect labor market competition in a general equilibrium model with endogenous managerial delegation choices to rationalize differences in monopsony power across worker types.

We also contribute to the literature that studies the misallocation of labor across firms (Hsieh and Klenow, 2009; Bartelsman et al., 2013; Davis et al., 2014; Garcia-Santana and Pijoan-Mas, 2014; Heise and Porzio, 2023). We show that large firms mainly restrict managerial employment relative to the efficient level in Portugal, which leads to an inefficiently high share of multi-layer firms and inefficiently high managerial span of control.

Lastly, we relate to the empirical literature on monopsony and labor market concentration (Martins, 2018; Azar et al., 2020; Benmelech et al., 2020; Rinz, 2022; Azar et al., 2022; Bassanini et al., 2023; Dodini et al., 2023). We bring two new stylized facts to this literature. First, we document that managerial markets display higher levels of market payroll concentration relative to the markets of production workers. Second, we highlight that this heterogeneity stems from managerial markets having fewer firms and because managers sort into more concentrated markets.

# 2 Stylized Facts

This section documents two stylized facts that motivates the relationship between firms' organizational decisions and labor market concentration. First, the average manager works in a local labor market with an HHI that is 8 percentage points greater than the market of the average production worker. Second, more concentrated local labor markets have a higher share of production workers that work in multi-layer establishments, i.e., establishments that add a managerial layer to their hierarchy.

## 2.1 Data

Our main data source is *Quadros de Pessoal* (QP), an annual census of private sector employees conducted by the Portuguese Ministry of Employment. This census provides matched employer-employee data with information on employment, monthly wages, occupation, industry, and municipality for all private firms based in Portugal with at least one worker. Our sample period covers from 2002 to 2016.

We classify labor markets based on three observable characteristics of the job: geography, industry, and occupation. This classification stems from the fact that workers are more attached to their current labor market because of the imperfect substitutability of skills across jobs and sectors, as well as imperfect geographical mobility (Neal, 1995; Kambourov and Manovskii, 2009; Sullivan, 2010; Kennan and Walker, 2011; Monte et al., 2018). In particular, we define two broad occupations: managers and production workers. For each occupation, we define a local labor market as the intersection of geography (municipality) and industry (2-digit NACE).

We assign workers to each occupation following a hierarchical classification similar to Caliendo et al. (2020). Particularly, we partition professional categories into two layers. We consider top executives, intermediary executives, supervisors, and team leaders as managers, while

Table 1: Market Concentration by Occupation

| | **Managers** | **Production Workers** |
|---|---|---|
| | Mean | Mean |
| Max $s_{ij}$ | 0.38 | 0.30 |
| $\text{HHI}_j$ | 0.27 | 0.19 |

Source: Elaboration based on Quadros de Pessoal.

Note: The first row reports the employment-weighted mean of the maximum payroll share across local labor markets. The second row of the Table reports the employment-weighted mean of the HHI across local labor markets.

we group the remaining categories as production workers.[1] In the data, the main difference between both occupations is that managers are responsible for the organizational policies of the firm and their adaptation, which require a high degree of qualification in terms of direction, guidance, and coordination of the firm fundamental activities.[2]

## 2.2 Payroll Concentration and Firm Organization

The level of market payroll concentration in a local labor market, which represents how much of the total market payroll belongs to a few firms, is a standard proxy for the degree of monopsony power that firms hold in such a market. We measure market payroll concentration in each local labor market using the HHI. This index equals a weighted average payroll share of firms within the market. Thus, an increase in the HHI reflects higher market concentration because fewer firms accumulate a greater share of the market payroll.

**Fact #1: Managers work in more concentrated markets.** In Table 1, we document that the average manager works in a market whose HHI is eight percentage points higher than the average production worker[3]. Specifically, the employment-weighted average HHI is 0.27

[1] Figure A.5 shows that most workers remain within the same broad category after changing to another firm.

[2] See Table A.1 for further information about the categories of the occupational classification, which is based on *Decreto-Lei nº. 121/78 de 2 de Junho, Ministério do Trabalho.*

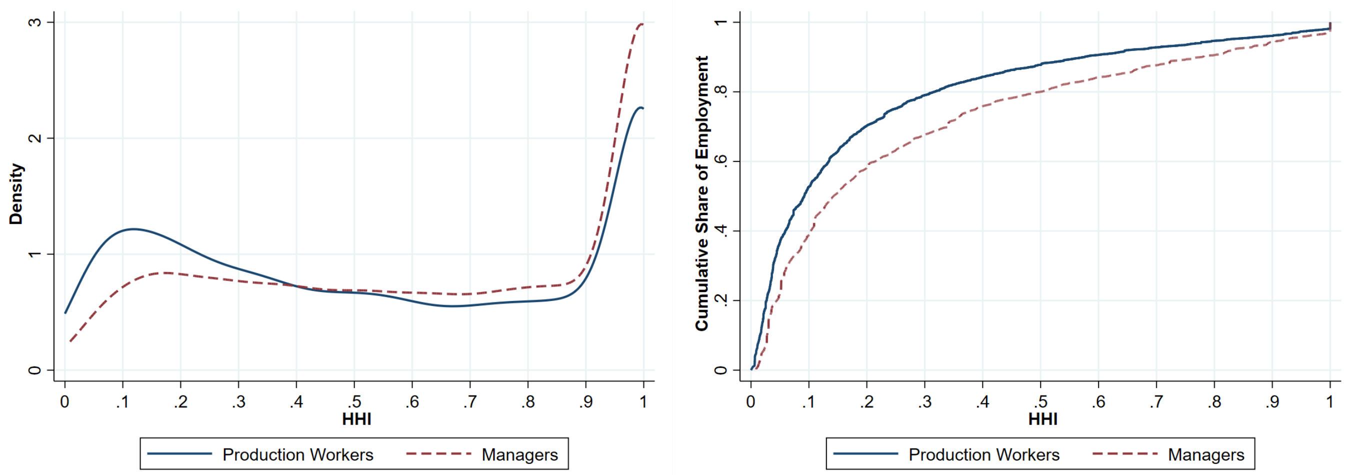
[3] This observation is robust to measuring HHI with the employment share rather the payroll share.

for managers and 0.19 for production workers. To provide context for these numbers, one would observe a similar concentration level with three and five equally-sized establishments, respectively. Table 1 also reports the employment-weighted average of the maximum payroll share across local labor markets. The average largest establishment in a local labor market accumulates about eight percentage points more market payroll in the market of managers than in the market of production workers.

Two mechanisms explain why managers tend to work in more concentrated markets than production workers. First, the heterogeneity in the distribution of payroll concentration across markets. Second, the heterogeneity in employment sorting across these market types. We display both channels in Figure 1, which plots the estimated kernel density of the market level HHI for each occupation and their respective cumulative share of employment. We find that managers work in more concentrated markets because (i) their markets are more likely to present higher payroll concentration (see Figure 1a) and because (ii) there is a higher share of managers working in such markets (see Figure 1b).

Regarding the first observation, we next use a standard decomposition that breaks the HHI into two elements to understand what makes managerial markets more likely to be concentrated (see Appendix B.4). The first element involves the *number of establishments* in each market. All else being constant, increasing the number of firms lowers the size of firms in the market. The second element entails the *dispersion level of payroll shares* across establishments relative to the case in which they hold identical shares. All else being constant, increasing the dispersion in payroll shares leads to a greater share of market payroll in fewer firms. Table 2 reports the results from decomposing the unweighted average of the HHI for both occupations. We do not weigh each market by employment size to isolate the decomposition from employment sorting. We find that the entire gap of nine percentage points stems from the fact that managerial markets have fewer firms. In particular, the markets of production workers tend to have almost two times as many establishments as the markets of managers (see Table A.6). This fact emphasizes the importance of modeling firms'

Figure 1: Distribution of HHI by Occupation




(a) Market Concentration

(b) Cumulative Employment

Source: Elaboration based on QP.

Note: The Graph plots the kernel density of the payroll HHI across local labor markets for managers (dashed line) and production workers (solid line). Moreover, the graph plots the cumulative share of employment with respect to the payroll HHI.

Table 2: Decomposition of the Average HHI across Occupations

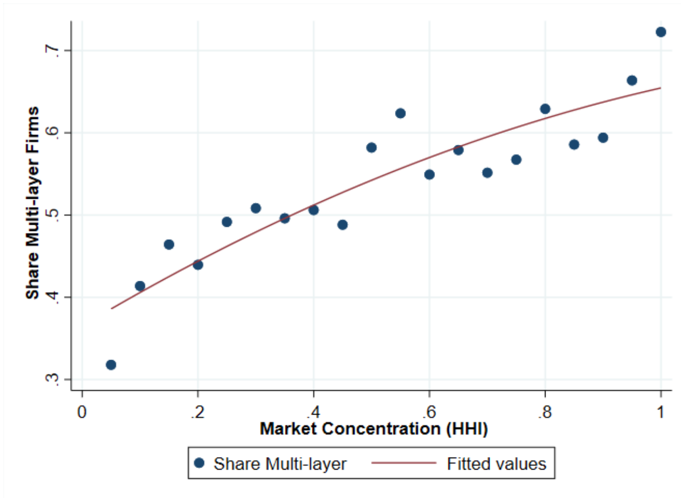
| | Component: Nº establishments | Component: Dispersion in shares | Mean HHI |
|---|---|---|---|
| (1) Managers | 0.57 | 0.08 | 0.65 |
| (2) Production Workers | 0.47 | 0.09 | 0.56 |
| (1)-(2) Gap | 0.10 | -0.01 | 0.09 |

Note: The Table reports the contribution of each channel to the unweighted average HHI level across local labor markets for each occupation. The first column reports the contribution of the number of establishments ($1/N$). In contrast, the second column shows the contribution of the dispersion in payroll shares relative to the symmetric case $\left(\sum_{i=1}^{N}\left(s_i - \frac{1}{N}\right)^2\right)$.

decision-making regarding managerial delegation, as only a proportion of establishments find it necessary to hire managers to organize their production.

The second observation emphasizes the need to model labor allocation across markets. Overall, most employees in both occupations work in a handful of markets with relatively low

Figure 2: Market Concentration and Multi-layer Firms




Source: Elaboration based on QP.
Note: The Figure plots the employment-weighted average share of multi-layer firms across local labor markets that differ in the level of HHI. In particular, we compute the share of multi-layer firms and the HHI for each local labor market of production workers. We split the distribution of the HHI into 20 cells of length 0.05. In each cell, we take the employment-weighted mean of the share of multi-layer firms across markets.

concentration levels. However, the proportion of managers in those markets is comparatively smaller. For instance, nearly 70 percent of production workers are in markets with an HHI below 0.20, whereas only 60 percent of managers work in such markets.

**Fact #2: More concentrated markets have a higher share of production workers in multi-layer firms**. Figure 2 displays the average share of multi-layer establishments, i.e., establishments that add a managerial layer to their hierarchy, across the markets of production workers where we rank these markets by their HHI. We weigh each establishment by its number of production workers to understand the contribution of multi-layer firms to markets' employment. When market concentration rises, the share of production workers who work in multi-layer firms increases. Rising the HHI by 10 percentage points is associated with an increase of 2.8 percentage points in the share of production workers who work in multi-layer firms. This suggests a tight relationship between the internal organization of firms and the level of payroll concentration in the labor markets where they operate. Two complementary stories, which have different economic implications, may explain this result. On the one hand, this relationship may reflect the tendency of high-productivity firms to adopt a multi-layer structure as they expand, consequently contributing to increased market concentration. On the other hand, it may reflect that small markets with low competition allow firms, even when their productivity is low, to easily attract workers and expand their organization because mobility and search frictions prevent production workers from relocating to other firms.

**Firm organization and monopsony power.** To sum up, the internal organization of firms is closely related to market concentration and, potentially, to monopsony power. We stand out two reasons to analyze this relationship through the lens of a general equilibrium model. First, the fact that managerial markets are more concentrated suggests that firms have greater monopsony power over managerial wages. Yet, these market categorizations do not capture the entire set of potential employers, as workers flow across industries and regions. Thus, to quantify monopsony power, it is necessary to measure the extent to which workers find it costly to switch firms both within the same and across different markets. Second, the fact that multi-layer firms contribute more to production workers' employment when their markets are more concentrated suggests that monopsony power affects managerial delegation choices. Modeling the relationship between both variables and performing counterfactual simulations solve the identification problem that arises from the confounding that delegation may also contribute to market concentration, as multi-layer firms are usually bigger.

# 3 Model

This section presents a general equilibrium model that incorporates managerial delegation, oligopsonistic labor markets, and minimum wages. The model considers two occupations, managers and production workers, each with exogenously heterogeneous labor disutility costs and firm substitutability parameters. For each occupation, there is a household that makes consumption choices and decides the labor supply to each firm. Firms are exogenously heterogeneous in productivity and the location they inhabit. Regarding their internal organization, firms choose whether to delegate production workers to managers. Conditional on the organization structure, they choose the number of workers in each occupation. Firms have monopsony power and face a minimum wage when making employment choices. The oligopsony structure implies that unconstrained firms exert occupation-based wage markdowns, which depend on their market payroll share and parameters determining firm substitutability from the worker perspective.

## 3.1 Environment

**Agents.** The economy is populated by two households, indexed by their occupation type $o \in \{w, m\}$, and a continuum of firms. Households are exogenously heterogeneous regarding how substitutable they view different firms, as well as in terms of disutility costs for each unit of work. Firms are exogenously heterogeneous in two dimensions. First, they belong to a continuum of locations $j \in [0, 1]$, where each location contains a finite number of firms indexed by $i \in \{1, \ldots, M_j\}$. Note that each location contains a local labor market for each occupation, i.e., the data counterpart of the location is the intersection between region and industry. Second, firms differ in productivity $z_{ij}$, drawn from a standard log-normal distribution with standard deviation $\sigma_z$.

**Goods and Technology.** Firms use labor to produce a tradable good in a perfectly competitive national market whose price we normalize to one. We assume that there are two types of labor: production workers and managers. Production workers are essential for production, while managers are optional. We assume each firm chooses between two types of organizations which vary in the number of layers, $\ell \in \{1, 2\}$.

The first type of firm organization is the single-layer firm ($\ell = 1$). Single-layer firms use $n_w$ units of labor of production workers to produce according to the following technology:

$$y(z, 1) = z\, \varphi_w\, n_w^{1-\alpha}. \tag{1}$$

The parameter $\varphi_w$ stands for the efficiency of labor of production workers. This technological specification includes the essential features of the production technology in the standard model of Lucas (1978). Namely, firms are heterogeneous in productivity and face diminishing returns to scale. The parameter $1-\alpha \in (0,1)$ determines the strength of diminishing returns and, thus, limits the number of production workers of single-layer firms.

Alternatively, firms may choose to be multi-layer organizations ($\ell = 2$) to manage a larger workforce. In this case, firms additionally include a managerial layer and use the labor of both managers $n_m$ and production workers $n_w$ to produce output. The technology of multi-layer firms is given by:

$$y(z,2) = z\,\varphi_m\, n_m^{(1-\alpha)\,\alpha} n_w^{1-\alpha}. \tag{2}$$

The parameter $\varphi_m$ reflects how much managers enhance the productivity of production workers relative to the single-layer organization. Under this technological specification, managerial delegation allows firms to increase their workforce by dampening the diminishing returns to labor of production workers. In addition, the parameter $\alpha$ embeds in a simple manner all the technical reasons that influence the span of control of managers, as it is the only technological parameter that is informative of the ratio of the marginal labor productivity between the two occupations.

Overall, this technological specification abstracts from the micro-foundations in the theory of firm organization, such as those of the knowledge-based hierarchy literature (Garicano, 2000; Garicano and Rossi-Hansberg, 2006). Nevertheless, it facilitates the quantification of the model and considers the main organizational trade-off. That is, adding a managerial layer permits the firm to manage a larger workforce, but it comes at the expense of higher costs.

**Households.** Each household type $o \in \{w, m\}$ chooses the measure of workers to supply to each firm $n_{ijo}$ and consumption of each good $c_{ijo}$ to maximize their utility:

$$\mathcal{U}_o = \max_{n_{ijo}, c_{ijo}} \quad \mathbf{C}_o \; - \; \phi_o \frac{\mathbf{N}_o^{1+\frac{1}{\gamma}}}{1+\frac{1}{\gamma}}, \tag{3}$$

subject to the household's budget constraint:

$$\mathbf{C}_o = \int_0^1 \sum_{i=1}^{M_j} w_{ijo} n_{ijo} \, dj, \tag{4}$$

where we define the aggregate consumption and labor supply indexes as

$$\mathbf{C}_o := \int_0^1 \sum_{i=1}^{M_j} c_{ijo} \, dj$$

$$\mathbf{N_o} := \left[ \int_0^1 \left( \frac{\mathbf{n_{jo}}}{B_{jo}} \right)^{\frac{\theta_o+1}{\theta_o}} dj \right]^{\frac{\theta_o}{\theta_o+1}} \quad \mathbf{n_{jo}} := \left[ \sum_{i=1}^{M_j} n_{ijo}^{\frac{\eta_o+1}{\eta_o}} \right]^{\frac{\eta_o}{\eta_o+1}}, \quad \eta_o > \theta_o > 0.$$

The parameter $\gamma$ stands for the aggregate Frisch elasticity of households, $\phi_o$ is a labor disutility shifter that is specific to each occupation, and $B_{jo}$ is a market amenity shifter. We follow closely the consumption and labor supply structure of Berger et al. (2022). That is, we assume that consumption goods are perfectly substitutable, but households view firms as imperfect substitutes in terms of non-wage characteristics. In particular, each firm faces an occupation-based upward-sloping labor supply curve with two elasticities of substitution $\theta_o > 0$ and $\eta_o > 0$. The parameter $\theta_o$ regulates the degree of substitutability of firms in distinct markets and, thus, captures the costs of moving across locations or idiosyncratic tastes for the location. If these costs decrease ($\theta_o \uparrow$), workers find it easier to substitute firms across locations and become more responsive to market wage differentials. The parameter $\eta_o$ regulates the degree of substitutability of firms within the same market, thus capturing features such as commuting costs, search costs, or idiosyncratic tastes for the firm. As these costs decrease ($\eta_o \uparrow$), workers find within-market, across-firm substitutability easier and become more responsive to wage differentials across firms in the same market. We refer to $\eta_o$ and $\theta_o$ as the within- and across-market firm substitutability parameters. Critical to the main conclusions of the theory, we impose the following assumption:

**Assumption 1.** Across-market mobility costs are higher than within-market mobility costs:

$$\eta_0 \geq \theta_0, \ \forall o \in \{0, 1\} \tag{5}$$

In other words, we assume that both household types find firms within the same market as closer substitutes than firms in different markets. Under this assumption, larger firms hinder the reallocation of their workers to other firms because their workers have fewer alternatives within the same market and, thus, need to move to other markets to find more potential employers. As a result, employees become less responsive to the wage policy of the firm, which in turn provides greater monopsony power to larger firms.

Linear utility in consumption implies that the aggregate disutility of labor supply in occupation $o$ is:

$$\mathbf{N}_o = \left(\frac{\mathbf{W}_o}{\phi_o}\right)^{\gamma}, \tag{6}$$

and the labor supply curve of occupation $o$ to firm $i$ in market $j$ is:

$$n_{ijo} = B_{jo}^{1+\theta_o} \left(\frac{w_{ijo}}{\mathbf{w}_{jo}}\right)^{\eta_o} \left(\frac{\mathbf{w}_{jo}}{\mathbf{W}_o}\right)^{\theta_o} \mathbf{N}_o \quad \longleftrightarrow \quad \underbrace{w_{ijo} = \left(\frac{1}{B_{jo}}\right)^{\frac{1+\theta_o}{\theta_o}} \left(\frac{n_{ijo}}{\mathbf{n}_{jo}}\right)^{\frac{1}{\eta_o}} \left(\frac{\mathbf{n}_{jo}}{\mathbf{N}_o}\right)^{\frac{1}{\theta_o}} \mathbf{W_o}}_{\text{Inverse labor supply curve } \forall ijo}, \tag{7}$$

where we define the market wage index $\mathbf{w}_{jo}$ and the aggregate wage index $\mathbf{W}_o$ as

$$\mathbf{w}_{jo} := \left[\sum_{i \in j} w_{ijo}^{1+\eta_o}\right]^{\frac{1}{1+\eta_o}} \qquad \mathbf{W_o} := \left[\int_0^1 \left(B_{jo}\mathbf{w_{jo}}\right)^{1+\theta_o} dj\right]^{\frac{1}{1+\theta_o}}. \tag{8}$$

We derive the labor supply system of equations given by (6) and (7) in Appendix C.1.

**Firms.** Firms choose the organizational structure to maximize profits, which consists of choosing whether to add a managerial layer:

$$\pi(z) = \max_{\ell} \, \{\pi(z, \ell)\}_{\ell=1}^{2}, \tag{9}$$

Conditional on the organizational structure, we assume firms make employment choices in an oligopsonistic framework where they face upward-sloping labor supply curves and internalize the effect of their decisions on local market outcomes. In addition, we assume there is a minimum wage. Infinitesimal with respect to the economy, firms take the aggregate disutility of labor supply $\mathbf{N}_o$ and aggregate wages $\mathbf{W}_o$ as given. However, non-atomistic with respect to the local market, each firm internalizes the impact of the employment decisions of all firms in the market, including itself, on the labor supply curve it faces.

Single-layer firms choose the measure of production workers $n_{ijw}$ to maximize profits, given the employment policies of their local competitors, $n^*_{-ijw}$. In particular, they solve:

$$\pi(z,1) \;=\; \max_{n_{ijw}} \quad y(z,1) \;-\; w_{ijw}\Big(n_{ijw}, n^*_{-ijw}, \mathbf{N}_w, \mathbf{W}_w\Big) n_{ijw}, \tag{10}$$

subject to the inverse labor supply curve of production workers and minimum wages:

$$w_{ijw}\Big(n_{ijw}, n^*_{-ijw}, \mathbf{N}_w, \mathbf{W}_w\Big) = \left(\frac{1}{B_{jo}}\right)^{\frac{1+\theta_o}{\theta_o}} \left(\frac{n_{ijw}}{\mathbf{n}_{jw}(n_{ijw}, n^*_{-ijw})}\right)^{\frac{1}{\eta_w}} \left(\frac{\mathbf{n}_{jw}(n_{ijw}, n^*_{-ijw})}{\mathbf{N}_w}\right)^{\frac{1}{\theta_w}} \mathbf{W}_w,$$

$$\mathbf{n}_{jw}(n_{ijw}, n^*_{-ijw}) = \left[ n_{ijw}^{\frac{1+\eta_w}{\eta_w}} + \sum_{k \neq i} n^{*\,\frac{1+\eta_w}{\eta_w}}_{kjw} \right]^{\frac{\eta_w}{1+\eta_w}}, ,$$

$$w_{ijw} \geq \underline{w}$$

Multi-layer firms choose the measure of production workers $n_{ijw}$ and managers $n_{ijm}$ to maximize profits, given the employment policies of their local competitors, $(n^*_{-ijw}, n^*_{-ijm})$. Their maximization problem is:

$$\pi(z,2) \;=\; \max_{n_{ijw}, n_{ijm}} \quad y(z,2) \;-\; \sum_{o \in \{w,m\}} w_{ijo}\Big(n_{ijo}, n^*_{-ijo}, \mathbf{N}_o, \mathbf{W}_o\Big) n_{ijo}, \tag{11}$$

subject to the inverse labor supply curve of both occupations:

$$w_{ijo}\Big(n_{ijo}, n^*_{-ijo}, \mathbf{N}_o, \mathbf{W}_o\Big) = \left(\frac{1}{B_{jo}}\right)^{\frac{1+\theta_o}{\theta_o}} \left(\frac{n_{ijo}}{\mathbf{n}_{jo}(n_{ijo}, n^*_{-ijo})}\right)^{\frac{1}{\eta_o}} \left(\frac{\mathbf{n}_{jo}(n_{ijo}, n^*_{-ijo})}{\mathbf{N}_o}\right)^{\frac{1}{\theta_o}} \mathbf{W}_o,$$

$$\mathbf{n}_{jo}(n_{ijo}, n^*_{-ijo}) = \left[n_{ijo}^{\frac{1+\eta_o}{\eta_o}} + \sum_{k\neq i} n^{*\,\frac{1+\eta_o}{\eta_o}}_{kjo}\right]^{\frac{\eta_o}{1+\eta_o}},$$

$$w_{ijw} \geq \underline{w}, \quad \forall o \in \{w, m\}.$$

Given the occupation $o \in \{w, m\}$ and the number of layers $\ell \in \{1, 2\}$, the solution to the firm's problem has three cases. First, the minimum wage is not binding. Second, the minimum wage is binding, and labor demand is on the labor supply curve. In the aforementioned two cases, labor demand equals labor supply. Third, the minimum wage is binding, and labor demand is off the labor supply curve. In this case, there is an excess of labor supply at the minimum wage because the optimal wage is above the efficient level. We summarize the system of first-order conditions for each case as follows.

*Case I: The minimum wage is not binding.* Firms choose the level of employment in occupation $o \in \{w, m\}$ for which the marginal cost of labor equals its marginal product. Since the minimum wage is not binding, the optimal wage is above the minimum wage (see Figure A.1).

$$w^*_{ijo} \;=\; \mu_{ijo} \left.\frac{\partial y(z,\ell)}{\partial n_{ijo}}\right|_{n^*_{ijo}}, \qquad \mu_{ijo} \;=\; \frac{\varepsilon_{ijo}}{\varepsilon_{ijo}+1} \in (0,1), \qquad \varepsilon_{ijo} \;=\; \left[\frac{\partial \log w_{ijo}}{\partial \log n_{ijo}}\right]^{-1}. \tag{12}$$

Equation (12) determines that the marginal productivity of labor is higher than the wage payment for each occupation (see Appendix C.2 for complete derivations). As in the classical monopsony environment (Manning, 2013), the marginal cost of labor is equal to both the wage and the additional cost of increasing wages because firms internalize upward-sloping labor supply curves. This results in a wedge between wages and the marginal product of labor $\mu_{ijo} < 1$. In addition, firm granularity within each local labor market implies that wage markdowns and the labor supply elasticity are heterogeneous across firms because these internalize the impact of their relative market size on the labor supply curve they face. In particular, the structural labor supply elasticity has a closed-form solution and is given by:

$$\varepsilon_{ijo}(s_{ijo}) \;=\; \left[\frac{1}{\eta_o} + \left(\frac{1}{\theta_o} - \frac{1}{\eta_o}\right)\frac{\partial \log \mathbf{n}_{jo}}{\partial \log n_{ijo}}\right]^{-1} \;=\; \left[\frac{1}{\eta_o} + \left(\frac{1}{\theta_o} - \frac{1}{\eta_o}\right)s_{ijo}\right]^{-1}, \qquad (13)$$

where $s_{ijo}$ stands for the payroll share of firm $i$ in market $j$:

$$s_{ijo} := \frac{w_{ijo}n_{ijo}}{\sum_{i\in j} w_{ijo}n_{ijo}}. \qquad (14)$$

Note that firms face an elasticity that is a function of their payroll share for each occupation. Since we assume $\eta_0 \geq \theta_0$, larger firms face lower labor supply elasticities and exert wider markdowns. On the one hand, consider the monopsony case with only one firm in the market, i.e., $s_{ijo} = 1$. If a monopsonist makes an additional hire, it understands that it has to attract workers from other markets. Hence, it faces the across-market labor supply elasticity $\theta_{ijo}$. On the other hand, consider an atomistic firm ($s_{ijo} \simeq 0$). This firm internalizes that a marginal hire attracts workers from the same market, as its decision has a negligible effect on market employment. Therefore, it faces the within-market labor supply elasticity $\eta_{ijo}$.

It is worth stressing that the model explicitly tells apart the forces shaping wage dispersion across occupations when the minimum wage is not binding. The first source of dispersion comes from differences in marginal productivity, which depends on organizational choices. The second source of dispersion comes from differences in markdowns. Firms have occupational-based monopsony power because they may have different sizes in each local labor market ($s_{ijo}$) and because firm substitutability may differ across occupations ($\eta_o, \theta_o$).

*Case II: The minimum wage is binding, and the firm is on the labor supply curve.* The minimum wage is binding and is below the efficient wage level. In this case, firms pay the minimum wage, the markdown is the ratio between the minimum wage and the marginal product, and the level of employment is given by the labor supply curve evaluated at the minimum wage (see Figure A.2).

$$w^*_{ijo} \;=\; \underline{w}, \qquad \mu_{ijo} \;=\; \frac{\underline{w}}{\frac{\partial y(z,\ell)}{\partial n_{ijo}}\Big|_{n^*_{ijo}}}, \qquad n^*_{ijo} = \left(\frac{\underline{w}}{\mathbf{w}_{jo}}\right)^{\eta_o}\left(\frac{\mathbf{w}_{jo}}{\mathbf{W}_o}\right)^{\theta_o}\mathbf{N}_o. \tag{15}$$

In this region, firms pay higher wages and hire more workers than they had done without the minimum wage.

*Case III: The minimum wage is binding, and the firm is off the labor supply curve.* The minimum wage is binding and is above the efficient wage level where the labor supply curve equals the marginal product of labor. In this case, firms pay a wage that is equal to both the minimum wage and marginal product, the employment level is given by the marginal product, and firms face an excess of labor supply (see Figure A.3).

$$w^*_{ijo} \;=\; \underline{w} \;=\; \frac{\partial y(z,\ell)}{\partial n_{ijo}}\bigg|_{n^*_{ijo}}, \qquad \mu_{ijo} \;=\; 1, \qquad n^*_{ijo} < \left(\frac{\underline{w}}{\mathbf{w}_{jo}}\right)^{\eta_o}\left(\frac{\mathbf{w}_{jo}}{\mathbf{W}_o}\right)^{\theta_o}\mathbf{N}_o. \tag{16}$$

In this region, firms pay higher wages and hire fewer workers than they had done without the minimum wage.

**Equilibrium.** Given a minimum wage $\underline{w}$, the general equilibrium of this economy is a set of organizational structures $\{\ell^*_{ij}\}$, aggregate disutilities of labor supply $(N^*_w, N^*_m)$, and employment levels $\{n^*_{ijw}, n^*_{ijm}\}$ such that:

1. *Labor supply*: Households choose aggregate disutility $N^*_o$ and labor supply to each firm $\{n^*_{ijo}\}$ to maximize utility. That is, Equation (6) and Equation (7) hold $\forall o \in \{w, m\}$.

2. *Firm organization*: Firms optimally choose the organizational structure: $\ell^*_{ij}$. That is, Equation (9) holds $\forall j \in [0,1],\ \forall i = \{1, \ldots, M_j\}$.

3. *Labor Demand*: Firms optimally choose employment $(n^*_{ijw}, n^*_{ijm})$. That is, Equations (12)-(16) hold $\forall j \in [0,1],\ \forall i = \{1, \ldots, M_j\}$.

4. *Labor Market*: Labor supply and demand are equal for firms in Cases I and II. For firms in Case III, excess of labor supply is given by Equation (16).

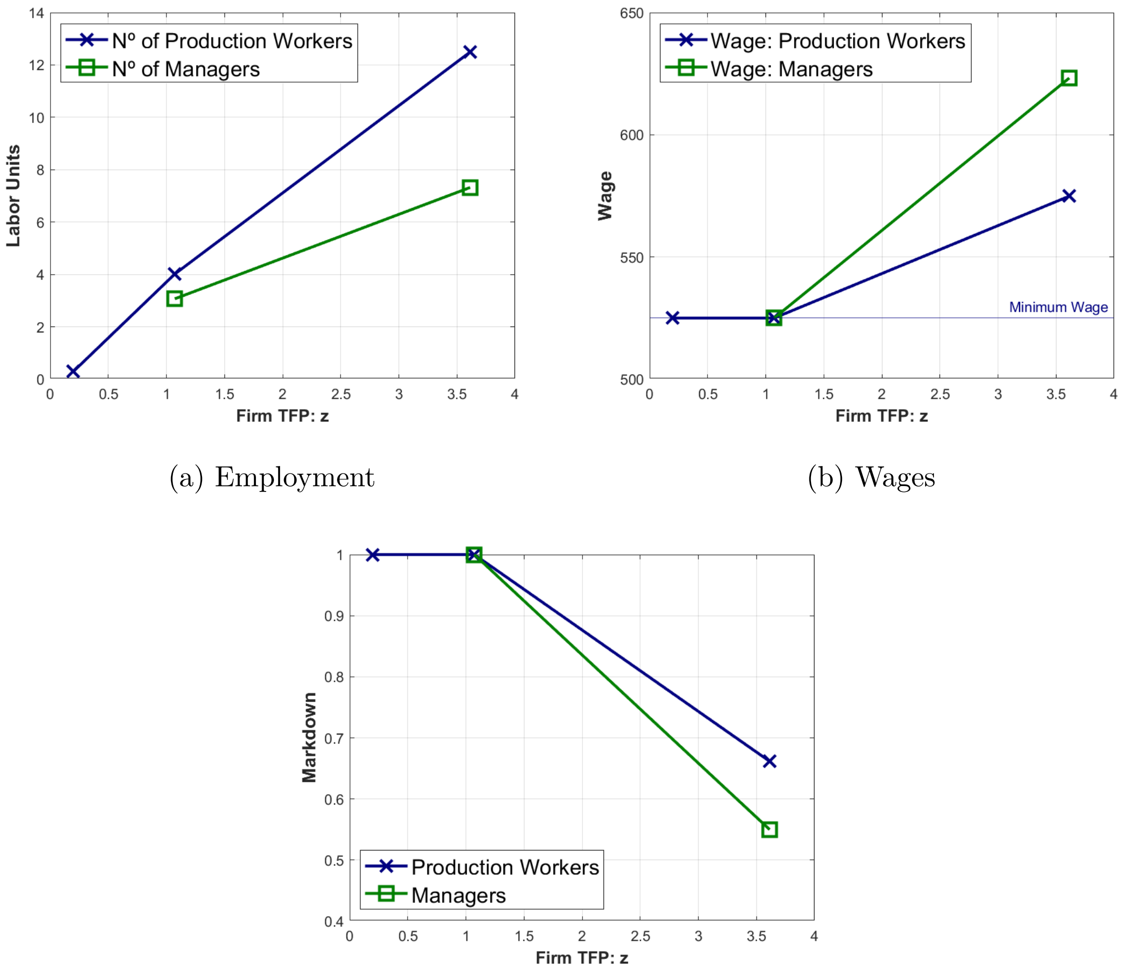
## 3.2 Market Characterization

Before presenting the quantification of model parameters, we show the interaction between firm organization, market concentration, and wage markdowns in equilibrium. Figure 3 plots the equilibrium level of employment, wages, and wage markdowns in a market with three firms. The numerical example displays the equilibrium in the model under the benchmark quantification of parameters.

Consider first the top left panel, which displays the employment level of production workers (blue) and managers (green) across firms. All firms hire production workers, as they are essential for production. However, only relatively high-productivity firms find it optimal to hire managers. These firms have more incentives to produce at large scales because of the technological complementarities between a firm's TFP and managerial labor. As a result, they use managerial delegation to dampen the diminishing marginal returns to the labor of production workers. The top right panel shows the wage level across firms for each occupation. Both managers and production workers earn wages close to the minimum wage when they work at low-productivity firms. If the minimum wage is not binding, managers earn substantially higher wages than production workers. This occurs because the ratio of production workers to managers is sufficiently high, which drives up the marginal productivity of the latter with respect to that of the former. Moreover, the model captures the fact that wage dispersion between both occupations increases with firm size. This result stems from the fact that the ratio of managerial to production worker employment increases with firm size and, therefore, also the ratio of their marginal productivity.

Lastly, the bottom panel of Figure 3 plots wage markdowns across firms as the ratio between wages and the marginal product of labor for each occupation. Overall, wage markdowns are wider for managers than for production workers for three reasons. First, minimum wages are

Figure 3: Oligopsonistic Market with Firm Organization




(a) Employment

(b) Wages

(c) Markdown

Note: Figures constructed from the model under the estimated parameters in Table 3.

more likely to be binding for production workers. Second, managers have a lower degree of firm-substitutability. If firms had the same payroll share in both markets, they would exert a wider markdown over managerial wages because they would internalize that managers bear higher across-firm mobility costs, which makes them less responsive to labor demand changes. Third, market payroll concentration is also higher for managers. If both occupations had the same degree of firm-substitutability, firms would exert a wider markdown over managerial wages because the labor supply elasticity of managers that firms face would be closer to the across-market elasticity than that of production workers.

# 4 Quantification of the Model

The quantification of the model parameters proceeds in two steps. First, we exogenously calibrate the aggregate Frisch elasticity of labor supply. Secondly, we estimate the remaining model parameters using the Simulated Method of Moments (SMM) approach. The quantification of the parameters targets moments of the firm organization, such as the average firm size or span of control. Together these moments determine the characteristics of the average firm across markets. Then, we target observed market differences in wages, employment, number of firms, and payroll concentration. Moreover, we estimate the within-market elasticity parameters from the correlation between wages and employment, and we use an indirect inference approach to estimate the across-market elasticity from plausibly exogenous changes in firms' labor demand. Finally, we compare the model simulated moments and their data counterparts to assess the model predictions, and we exploit mass-layoff shocks to analyze the performance of the model equilibrium responses.

## 4.1 Estimation

Table 3 summarizes the quantification of model parameters. We calibrate outside the model the aggregate Frisch elasticity. We follow Berger et al. (2022) by setting $\gamma = 0.5$, which is within the range that the Congressional Budget Office considers for policy evaluation. We estimate the remaining parameters by the SMM approach. In particular, we set the parameter values to minimize the percentage difference with equal weighting between the vector of model moments and its data counterpart. Next, we describe each parameter and its most informative moment in detail.[4]

**Labor disutility shifter ($\phi_w, \phi_m$).** We set the labor disutility shifter of production workers

[4]See Table A.4 for their model fit.

$\phi_w$ to match the average firm size in terms of production workers. In the data, the average firm hires 5.3 production workers. In addition, we choose the labor disutility shifter of managers $\phi_m$ to match the economy-wide share of managers over total employment of 0.19.

**Span of control** ($\alpha$)**.** The ratio of production workers to managers partially depends on the span of control parameter. When this parameter increases, the technology converges towards a production function with constant marginal returns to labor, thus decreasing the incentives for managerial delegation. We calibrate this parameter to target that the median multi-layer firm has 3.1 workers per manager.

**Efficiency of labor** ($\varphi_w, \varphi_m$)**.** We use the efficiency of labor of each occupation to target wages in the data, as these parameters are informative of the marginal product of labor. We use the efficiency of labor of production workers $\varphi_w$ to match a mean monthly wage of 717€ for production workers. Then, we set the efficiency of labor of managers $\varphi_m$ to match that the wage gap in mean wages between managers and production workers is equal to 0.73 log points.

**Dispersion in firm productivity** ($\sigma_z$)**.** The level of productivity dispersion across firms within a market affects the level of market payroll concentration. We use the standard deviation of firm productivity to target the employment-weighted average HHI across local labor markets of production workers, which equals 0.19.

**Market Amenities** ($B_{ijw}$)**.** Regarding market amenities, we note that only 12 percent of production workers belong to markets with less than ten firms, despite these markets representing nearly 65 percent of the total. We set a common market amenity for production workers in markets with less than ten firms, $B_{ijw}$ such that $M_j \leq 10$, to target the share of production workers in those markets. The rationale for using amenities rather than productivity differences is that we would require too low productivity in small locations, which would highly overestimate the share of minimum wage earners in such places.

**Firm Distribution** ($G$)**.** To estimate the distribution of the number of firms across markets,

Table 3: Parameterization

| Parameter Value | Description | Value | Moment |
|---|---|---|---|
| ***Panel I: Exogenous Calibration*** | | | |
| $\gamma$ | Aggregate Frisch elasticity | 0.50 | Berger et al. (2022) |
| ***Panel II: SMM Estimation*** | | | |
| *A: Preferences* | | | |
| $\phi_w$ | Labor disutility shifter: workers | $1.67 \times 10^{-4}$ | Average firm size |
| $\phi_m$ | Labor disutility shifter: managers | 0.13 | Share managers |
| *B: Firm Organization* | | | |
| $\alpha$ | Span of control | 0.76 | Median span of control |
| $\varphi_w$ | Worker efficiency | 4,356 | Mean wage of prod. workers |
| $\varphi_m/\varphi_w$ | Managerial efficiency | 1.13 | Wage gap managers and prod. workers |
| $\sigma_z$ | Std. Dev. firm TFP | 1.11 | Weighted Mean HHI prod. workers |
| *C: Market Characteristics* | | | |
| $B_{ijw}$ | Amenities in small markets | 0.46 | Share workers in markets $M_j \leq 10$ |
| $G(\cdot)$ | Firm distribution | | Mean, variance, and mass single-firm |
| *D: Firm Substitutability* | | | |
| $(\theta_w, \theta_m)$ | Across-market firm substitutability | (1.52 , 0.95) | Across-municipality labor supply elasticity |
| $(\eta_w, \eta_m)$ | Within-market firm substitutability | (19.97 , 6.10) | Within-market labor supply elasticity |

Source: The Table reports the quantification of model parameters. Panel I reports the parameters that we calibrate outside the model. Panel II reports the estimated parameters using the SMM approach.

$M_j \sim G(\cdot)$, we combine a discrete mass at $m_j = 1$ with a Pareto distribution to target the mass of markets with a single firm, the mean, and the standard deviation of the distribution of firms. In particular, we target that 29 percent of markets have just one firm, the average market has 17.4 firms, and the standard deviation in the number of firms equals 59.9.

**Within-market substitutability ($\eta_w, \eta_m$).** The within-market elasticity parameters are informative of the relationship between firms' productivity and wages for the sub-sample of unconstrained firms in each market. In particular, the inverse labor supply curve in Equation 7 delivers the following equilibrium relationship between (log) wages and (log) employment:

$$\log(w^*_{ijo}) \;=\; \frac{1}{\eta_o}\log(n^*_{ijo}) \;+\; \underbrace{\underbrace{\left(\frac{1}{\theta_o} - \frac{1}{\eta_o}\right)\log\Big(\mathbf{n_{jo}}(n^*_{ijo}, n^*_{-ijo})\Big)}_{\text{Effect of payroll share on wages stems from } \mathbf{n_{jo}}} + \frac{1}{\theta_o}\log(\mathbf{N_o}) \;+\; \log(\mathbf{W_o})}_{\text{Common across firms in a market } jo}.$$

Note that, conditional on common market features, all firms face the same labor supply elasticity $\eta_o$ for each occupation. This occurs because the effect of the payroll share on the labor supply elasticity shuts down when we control for market employment. We use this insight to obtain a theory-consistent estimate of the within-market elasticity for each occupation. In particular, the previous equation implies the following empirical reduced-form relationship for the inverse labor supply curve:

$$\log(w_{ijo,t}) \;=\; \beta_o \log(n_{ijo,t}) \;+ \mu_{jo,t} \;+\; \nu_{ijo,t}, \tag{17}$$

where $\mu_{jo,t}$ stands for the market-year fixed effects that empirically control for common labor demand and supply shocks across firms in the same market year. Our coefficient of interest is $\beta_o$. In the model, conditional on the sub-sample of unconstrained firms, the OLS regression of Equation 17 separately for each occupation identifies the within-market elasticity as $\hat{\eta}_o = 1/\hat{\beta}_o$. This regression exploits the cross-sectional variation in employment and wages that uniquely stems from labor demand differences across firms in the same market while keeping their labor supply curve fixed. The intuition is as follows. Firms pay different wages and hire a different number of workers because they are heterogeneous in productivity. Higher productivity, either because firms adopt a multi-layer organization or have a higher

TFP, has two equilibrium effects. First, the labor demand curve shifts to the right because the marginal productivity rises. Second, the labor supply curve shifts to the right because the strategic complementarities from Cournot's competition imply that competitors restrict employment. The coefficient $\beta_o$ absorbs the first effect while market-fixed effects absorb the second effect.

In our baseline specification, we separately estimate Equation 17 by OLS for each occupation. Regarding the sample selection, we restrict to firms paying wages at least one percent higher than the minimum wage each year. This regression implies a within-market labor supply elasticity of 19.9 for production workers and 6.1 for managers (see Table C.1). In addition, since the error may capture firm-specific labor supply considerations that threat identification, we also provide the results from an IV regression that uses a traditional Bartik instrument to predict firms' employment from national sector employment trends and initial shares (see Appendix C.4). This alternative specification provides similar results. Overall, we estimate that production workers are three times as responsive to changes in labor demand as managers.

**Across-market substitutability ($\theta_w, \theta_m$).** The across-market firm substitutability parameters govern how greater market productivity translates into higher wages. When firm substitutability is high, total employment in a particular market is highly responsive to increased market productivity. We use an indirect-inference approach for each occupation to match the reduced-form inverse labor supply elasticity from a municipality-level regression. We estimate the following equation:

$$\text{Log}\, w_{m,o,t} = \gamma \,\text{Log}\, L_{m,o,t} + \alpha_{m,o} + e_{m,o,t}, \tag{18}$$

where $w_{m,o,t}$ is the mean wage in municipality $m$ for occupation $o$ in period $t$, $L_{m,o,t}$ is total employment in that municipality, and $\alpha_{m,o}$ are municipality fixed effects. In the model, the municipality is a collection of local labor markets. We use a municipality-level regression, instead of a market-level regression, to use the standard formulation of the shift-share instrument for employment (Blanchard et al., 1992):

$$\hat{L}_{m,o,t} = \sum_s \Bigg( \underbrace{\frac{L_{i,m,s,o,2007}}{\sum_i L_{i,m,s,o,2007}}}_{\text{Industry-Municipality Share}} \times \underbrace{\sum_i L_{i,s,o,t}}_{\text{National Employment in Sector } s} \Bigg). \tag{19}$$

This instrument predicts employment in each municipality as the exposure-weighted average of national sector employment, where the weights are the employment shares of each sector in the municipality in the initial period. With this approach, we estimate the coefficient $\gamma$ from within-municipality, across-time variation in wages and employment that arises from national sector employment shocks and the municipality's initial exposure to them, which plausibly represent exogenous changes in the municipality's labor demand. We also restrict the sample to municipalities with a mean wage higher than 25 percent of the minimum wage in the reference year. We impose this restriction to exclude municipalities where a high share of firms pay wages close to the minimum wage, as the labor supply elasticity of these firms is not informative of the across-market elasticity because they may pay the minimum wage either before or after the labor demand shock. Table C.2 reports the IV results for each occupation. The implied coefficients are 1.5 for production workers and 0.92 for managers.

To replicate this regression in the model, we randomly assign markets to each municipality to approximate the number of markets that the average municipality has in the data while keeping a reasonable sample size of municipalities. Then, we simulate two periods, where the second period involves random productivity shocks at the municipality level from a standard log-normal distribution with $\sigma = 0.05$. Finally, we choose $(\theta_w, \theta_m)$ to target the inverse labor supply elasticity $\gamma$ that results from estimating the regression in Equation (18) with the simulated sample. We infer an across-market elasticity of 1.5 for production workers and 0.95 for managers.

## 4.2 Discussion on the Estimation of Labor Supply Elasticities

Given the importance of the firm-substitutability parameters in estimating wage markdowns, we provide additional evidence on mobility measures that support our findings and compare our estimates with the literature.

The main finding from our estimates is that production workers are significantly more responsive to changes in labor demand than managers. Panel A of Table A.3 shows that production workers have two relevant characteristics, which suggest that they face lower mobility costs and search frictions. This result is consistent with their higher labor supply elasticity. First, young workers are significantly more likely to migrate (Molloy et al., 2011; Kennan and Walker, 2011) and make greater job search efforts (Faberman et al., 2022). About 13 percent of production workers are younger than 25, while only 4 percent of managers are below that age. Second, workers in temporary contracts search harder than workers in permanent contracts (Kahn, 2012). Notably, the share of production workers with temporary contracts is 31 percent, twice that of managers with temporary contracts. In addition, since the labor supply elasticity of production workers is higher, one would expect that they are also more mobile across markets and firms. Panel B of Table A.3 reports that production workers are more likely to change firm, municipality, and sector relative to managers.

Comparing our estimates with the literature, we focus on the estimates from three papers that also estimate the firm-substitutability parameters using a general equilibrium model of oligopsony. Berger et al. (2022) estimate the firm-substitutability parameters using an indirect inference approach to replicate size-dependent labor supply elasticities at the firm level, which they estimate using U.S. microdata and exploiting changes in state corporate taxes. Abstracting from different occupations, they define the local labor market as the combination of a three-digit industry and a commuting zone. They estimate $\theta = 0.42$ and $\eta = 10.85$. Shubhdeep et al. (2023) also estimates the firm substitutability parameters from U.S. microdata and exploits changes in state corporate taxes. However, they estimate skill-specific parameters and use a stochastic market definition that is a subset of 6-digit industries. For low-skilled workers, they estimate $\theta_L = 1.85$ and $\eta_L = 2.42$, and for high-skilled workers, they find $\theta_H = 2.02$ and $\eta_H = 2.53$. Using French data, Azkarate-Askasua and Zerecero (2023) define a local labor market as the intersection between a commuting zone, three-digit industry, and occupation. Nonetheless, they assume the firm-substitutability parameters to be common across occupations. They find an across-market elasticity $\theta = 0.42$ and industry-specific within-market elasticities that range within $\eta \in \{1.22, 4.05\}$. Despite using a different methodology, we find our estimates reasonably close to their results. Our estimates of the within-market elasticities are within the range of their results for managers but somewhat higher for production workers. We attribute this to Portuguese-specific factors such as the high rate of temporary contracts. Our estimates of the across-market elasticities are also within the range of their results. They are higher than Berger et al. (2022) and Azkarate-Askasua and Zerecero (2023), but we find this result consistent with Portuguese municipalities being smaller than U.S. and French commuting zones.[5]

## 4.3 Model Fit

Before turning to the counterfactual analysis, we discuss how the model captures untargeted moments of employment, wages, firm organization, and market concentration. In addition, we exploit large mass-layoff shocks to assess the model's generated employment and wage responses relative to the ones in the data.

**Simulating mass-layoff shocks.** Mass-layoff shocks involve a sudden, sizable, and enduring reduction in the employment size of a prominent plant within the regional economy. As a result, these events potentially affect regional wages and employment due to the initial shock and its spillover effects on the local economy.

Mass-layoff shocks are relevant to assess the performance of employment and wage equilibrium responses in the model, as there is an initial firm-specific labor demand shock that affects households' labor supply decisions and other firms' labor demand decisions. Furthermore, the model incorporates two main channels through which areas adjust to this shock:

[5] Comparing mobility rates, nearly 10 percent of workers change municipality in Portugal yearly. Instead, the yearly migration rate across U.S. counties, subsets of commuting zones, ranges between 3 to 6 percent in the same period (Molloy et al., 2011).

(i) outflows to non-employment and (ii) worker reallocation to other firms, either in the same or a different area. These shocks are helpful for this setting because the empirical evidence suggests that most of the impact of mass-layoff shocks on regional employment depends on the degree of worker reallocation across regions (Foote et al., 2019; Gathmann et al., 2020).[6] Therefore, we use this simulation as a validation exercise of the across- and within-market firm substitutability estimates, which are the key drivers of the allocation of workers across and within markets.

To identify mass layoffs in the Portuguese data, we use sharp and sizeable drops in the employment of an establishment. More precisely, a drop of 100 workers in any establishment for two consecutive years between 2004 to 2016 is a mass layoff.[7] All mass layoff events are aggregated at the municipal level to construct the treatment. So, we define the treated municipalities from the first time they experience a mass layoff in our sample period, and those who never have one belong to the control group. Next, to quantify the impact on local employment and wages, we use an event-study specification that compares the changes in employment and wages of treated and control municipalities for managers and production workers following a mass layoff. Because the treated municipalities have different characteristics relative to the control ones, we also use covariates in the pre-shock period that capture the size and structure of the local economy for a cleaner comparison between groups. These variables are the log of regional employment, the share of manufacturing employment, the share of highly educated workers, the share of male workers, and the share of young workers. Hence, the main assumption needed in this setup is the conditional parallel trends assumption, stating that in the absence of mass layoffs, treated and control groups would evolve similarly; in the Appendix C.5, we show that pre-treatment coefficients are not statistically

[6] These papers find that geographic mobility accounts for most of the regional employment change. For instance, Gathmann et al. (2020) finds that outflows to non-employment account for only 20 percent of the overall employment decline in German regions following a mass layoff. They also find that geographic mobility protects workers below 50 from suffering employment losses.

[7] We further restrict establishments with more than 1 percent of local employment in the baseline period, and we do not take into account plant closures to define mass layoffs.

Table 4: Estimates of Mass Layoff Shocks on Municipalities

| | **Production Workers** | | **Managers** | |
|---|---|---|---|---|
| | Model | Data | Model | Data |
| *Panel A: Log Wages* | | | | |
| Event Region | -0.006*** | -0.007 | -0.012*** | -0.006 |
| | (0.001) | (0.005) | (0.003) | (0.010) |
| *Panel B: Log Employment* | | | | |
| Event Region | -0.017*** | -0.061*** | -0.011** | -0.040** |
| | (0.001) | (0.013) | (0.005) | (0.019) |
| Observations | 200 | 3,084 | 200 | 3,084 |

Note: The Table reports the empirical (Data) and simulated (Model) results from exploiting mass-layoff shocks. For the Data, we show the average treatment effect of mass-layoff shocks on average municipality wages (Panel A) and total municipality employment (Panel B). The dependent variable is the log municipality's employment and wages. Standard errors are in parentheses.

different from zero, suggesting that this assumption holds.[8]

In the model, we randomly assign across all the areas a large productivity shock to firms that fulfill three characteristics that are informative of the firm's importance within the municipality and the size of the shock. First, we restrict the shock to multi-layer firms, as more than 95 percent of plants experiencing mass layoffs hire managers and production workers. Second, we exploit that the average firm carrying out a mass layoff had an average municipality employment share of 4.4 percent one year before the mass layoff. Thus, we condition the random shock on the sub-sample of firms whose municipality employment share falls within a specific range to match the same average size of shocked firms. Third, we choose the magnitude of the productivity shock to target that the average firm undergoing a mass layoff reduces its workforce by nearly 50 percent.

Table 4 reports the empirical and simulated results of the impact of mass-layoff shocks on

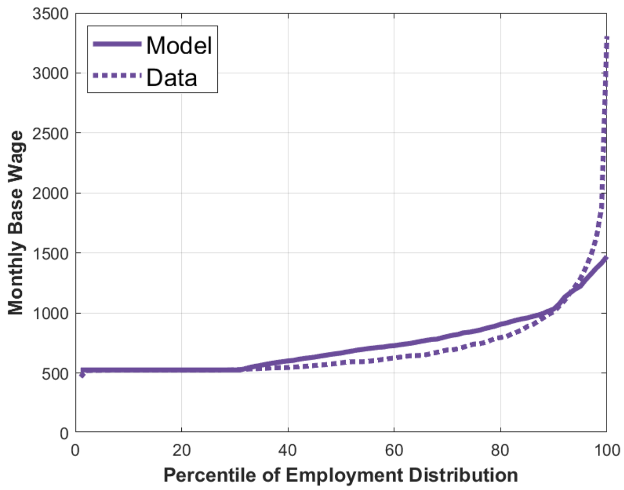
[8]Appendix C.5 explains the empirical specification in more detail.

average municipality wages and total municipality employment. Our empirical results show that municipalities with at least one mass-layoff event experience an average decrease of 6.1 percent in the local employment of production workers and 4 percent in the local employment of managers compared to municipalities without mass layoffs. We do not find a significant impact of mass layoffs on average municipality wages. These results align with Gathmann et al. (2020) for Germany, which find a drop of 3.7 percent in local employment and an insignificant response in wages following a mass layoff.

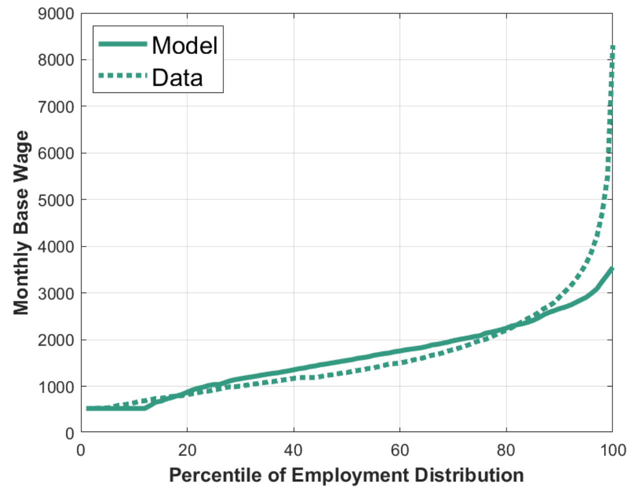
Regarding the results in the simulated data, the model reproduces that mass layoffs have a small effect on average municipality wages for production workers. For managers, the point estimate is twice more negative in the model, but it is in the range of the confidence interval of the data. In the model, wages decrease for two reasons. First, the shocked firm becomes less productive. Second, the non-affected firms also decrease wages because their employment share increase. At the same time, wages do not fall much due to the downward rigidity in wages stemming from minimum wages. In terms of employment, the model accounts for nearly one-fourth of the decrease in employment of managers and production workers. Overall, we argue that the model explains a substantial portion of the observed employment decline and attribute the residual to the lack of factors such as agglomeration economies, input-output linkages, or firm exit.

**Untargeted moments.** We start analyzing the wage distribution, which is crucial to quantifying wage dispersion and the repercussions of minimum wage policies. Figure 4 displays the occupation wage distribution in the model and data. The model fits most of the wage distribution for both occupations. Importantly, it replicates the wage distribution at the bottom deciles. This is key for two reasons. First, minimum wage policies have the most substantial employment and wage effects on workers close to the minimum wage. Second, conditional on the occupation, relatively low-paid employees are the most susceptible to monopsony power because they primarily work in small markets. The model underestimates wages in the upper deciles, as we assume that workers are homogeneous in talent within

Figure 4: Wage Distribution across Occupations




(a) Production workers




(b) Managers

Note: The Figures show the wage distribution in the model and data for production workers (left) and managers (right).

occupations. In contrast, high-wage workers typically work in markets with many firms, where firms have low monopsony power, and their wages are well above the minimum wage.

Panel A in Table 5 displays how the model fits moments related to the share of workers whose wages are close to the minimum wage. The model somewhat overvalues the share of minimum wage earners for both occupations, but it captures that managers are much less likely to earn the minimum wage. Moreover, the model gets right the share of workers in each occupation conditional on being a minimum wage earner. Notably, the model matches that more than 90 percent of employees are production workers. Furthermore, the model matches that most production workers earn less than 30 percent of the minimum wage (700€), whereas this proportion falls to around 15 percent for managers. These facts show that the model can explain that minimum wage policies mainly affect production workers.

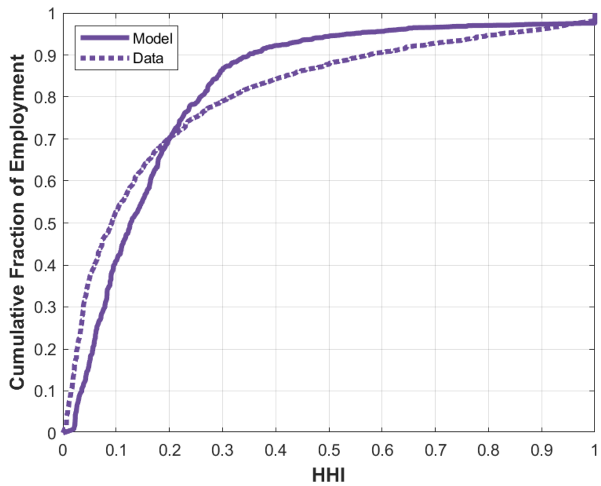
The distribution of firm wages, the degree of firm substitutability, and local amenities determine the firm size distribution in the model. This distribution is important to understand

Table 5: Untargeted Moments

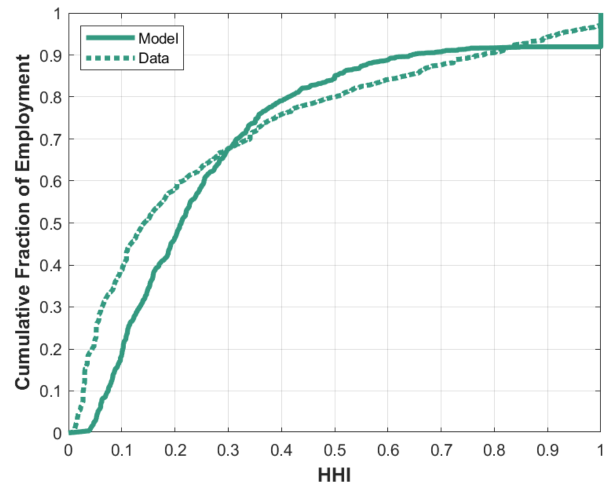
| | **Production Workers** | | **Managers** | |
|---|---|---|---|---|
| | **Model** | **Data** | **Model** | **Data** |
| *Panel A: Minimum Wage* | | | | |
| Share minimum wage earners | 0.31 | 0.22 | 0.12 | 0.04 |
| Share \| Minimum wage earner | 0.91 | 0.96 | 0.09 | 0.04 |
| Share wage $\leq$ 700 | 0.55 | 0.69 | 0.15 | 0.12 |
| *Panel B: Firm Size Distribution* | | | | |
| P25 | 1 | 1 | 2 | 1 |
| P50 | 2 | 2 | 3 | 1 |
| P90 | 14 | 9 | 9 | 5 |
| P99 | 52 | 59 | 15 | 34 |
| *Panel C: Firm Organization* | | | | |
| Share multi-layer | 0.33 | 0.33 | | |
| Share workers in multi-layer | 0.36 | 0.43 | | |
| Share workers in multi-layer \| $\text{HHI}_j \leq 0.20$ | 0.31 | 0.37 | | |
| Share workers in multi-layer \| $\text{HHI}_j > 0.20$ | 0.49 | 0.55 | | |
| *Panel D: Market Concentration* | | | | |
| Weighted mean HHI | | | 0.29 | 0.27 |
| Weighted mean Max $s_{ij}$ | 0.28 | 0.30 | 0.38 | 0.38 |

Note: The Table reports untargeted moments of the distributions of wages, firm size, firm organization, and market payroll concentration. For each occupation, we report the statistic from the data and baseline model.

Figure 5: Distribution of Employment across Markets




(a) Production workers




(b) Managers

Note: The Figures show the cumulative fraction of employment across local labor markets ranked by their level of concentration in the model and data for production workers (left) and managers (right).

the misallocation of labor across firms that results from high-productivity firms exerting wider markdowns. Panel B in Table 5 shows that the distribution in the model is somewhat similar to that of the data for production workers. Both in the model and data, most firms are small and hire less than two employees. Moreover, the model captures that a few firms are relatively large and hire more than 60 workers.

The share of firms that delegate tasks to managers is key for explaining the differences in market concentration in the markets of production workers and managers, as it determines the relative number of competing firms across these markets. Panel C shows that one-third of firms hire managers in both the model and data. Moreover, the model also approximates that these firms hire nearly 40 percent of production workers, which is also relevant because multi-layer firms are on average bigger and increase market concentration. Finally, the model can explain our motivational fact that more concentrated markets display a higher share of production workers that work at multi-layer firms. In particular, the share of production workers employed in multi-layer firms is about 20 pp higher in relatively high-concentrated local labor markets. The model rationalizes this fact because the few firms that usually compete in these markets are able to attract many production workers and managers at relatively low wages due to the low degree of substitutability across markets. As a result, they find managerial delegation profitable because they produce at large scales.

Next, consider the distribution of employment across markets that differ in the level of payroll concentration, which is endogenous in the model due to the agents' labor demand and supply decisions. This distribution is fundamental to measuring the wage markdown of the average employee, as it describes the level of market concentration in which individuals work. Figure 5 shows that the model closely matches the distribution of employment across markets that differ in terms of the HHI. Two features stand out. First, the model rationalizes that most workers sort into a handful of relatively low-concentrated labor markets. These markets attract most workers because they have many firms that pay higher wages due to the relatively high degree of competition. These markets are also more attractive for production workers because they have relatively higher local amenities. Second, managers are more likely to belong to a market with higher levels of concentration relative to production workers. This heterogeneity occurs because there is a higher proportion of managerial markets with higher concentration levels, and managers face higher across-market mobility costs, discouraging them from leaving markets that pay relatively low wages.

Lastly, consider how the model fits two key statistics of market payroll concentration. Panel C in Table 5 shows that the model closely approximates the employment-weighted average of the HHI for managers. Both in the model and data, the average manager works in a market with an HHI of around one-third; the same one would observe with three equally sized firms. In addition to aggregate concentration measures, the model establishes a direct relationship between a wage markdown and the firm's market payroll share. As a result, it is key for the model to predict realistic payroll shares for the biggest firms. The last row in Panel D of Table 5 shows that the model closely fits the average maximum payroll share across markets, where we weigh each market by its employment level. So, the model captures that the average production worker works for a firm with nearly one-third of the market payroll, whereas the average manager works for a firm with about 40 percent of the market payroll.

# 5 Quantitative Results for Monopsony Power

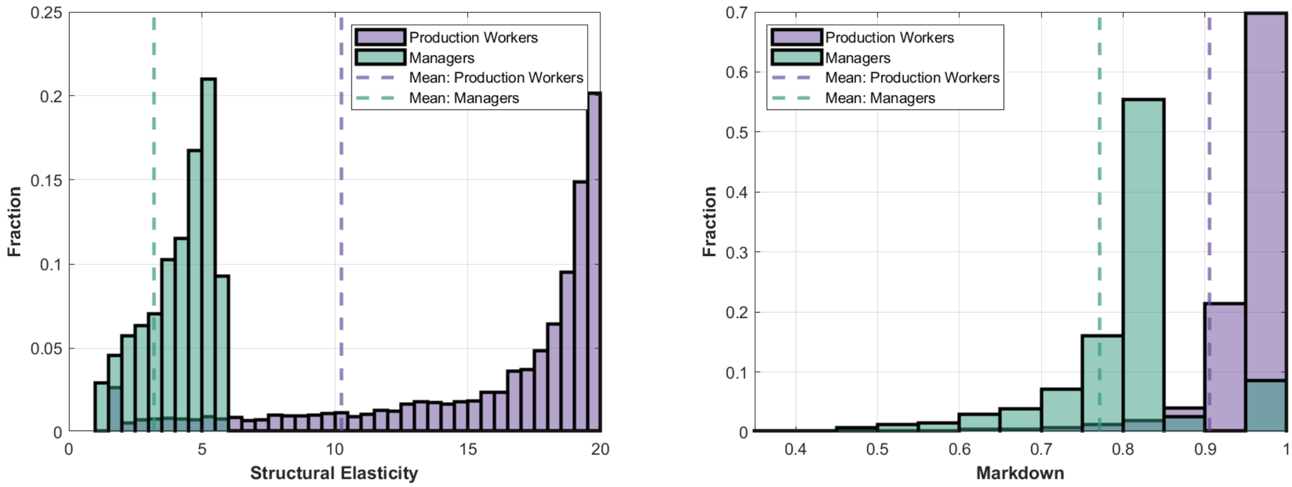
In this section, we quantify the distribution of wage markdowns for both occupations and the effect of monopsony power on firm organization and welfare. We estimate a markdown of 10.4 percent for the average production worker and 23.1 percent for the average manager. Relative to the benchmark economy, monopsony power reduces wage dispersion across occupations by 11.8 percent and increases the share of multi-layer firms by 11.3 percent because it incentivizes less productive firms to delegate tasks to managers. Overall, monopsony power leads to a welfare loss of 5.7 and 23.1 percent for production workers and managers, respectively. We show that considering firms' managerial delegation choices is crucial to explain worker reallocation and accounts for 10 percent of the welfare change and between 10 to 30 percent of the change in average market concentration.

## 5.1 Quantification of Monopsony Power

This section shows the distribution of wage markdowns across firms for production workers and managers. In the benchmark economy, wage markdowns are below one due to imperfect firm substitutability and firm granularity, implying that wages are below the marginal revenue product of labor. This wedge represents the efficiency loss from monopsony power, as workers would earn the entire marginal product in an efficient economy.

The left panel in Figure 10 shows the distribution of the structural labor supply elasticity firms face for both occupations. This is the welfare-relevant notion of labor supply elasticity because it determines the wage markdown. We estimate that the employment-weighted mean structural elasticity equals 3.2 for managers and 10.3 for production workers. Moreover, the Figure shows that most firms face substantially lower labor supply elasticities to managers

Figure 6: Quantification of Monopsony Power




(a) Structural Labor Supply Elasticity ($\varepsilon_{ij}$) (b) Wage Markdowns ($\mu_{ij}$)

Note: The left Figure displays the distribution of the structural labor supply elasticity faced by firms for production workers and managers. That is the welfare-relevant labor supply elasticity that determines wage markdowns. The right Figure plots the distribution of wage markdowns across firms for production workers and managers. The wage markdown is the wedge between the wage and the marginal productivity of labor. Dashed lines display the weighted mean of each variable, where the weight of each firm is its employment size.

than to production workers. There are three reasons for this fact. First, both the upper ($\eta_o$) and lower bounds ($\theta_o$) of the structural elasticities are lower for managers. That is, we estimate that managers bear greater mobility costs of moving to a firm in another region or industry and greater mobility costs of changing firms within the same region-industry. Second, firms tend to have higher managers' payroll shares than production workers. Thus, the labor supply elasticity of managers is closer to the across-market elasticity than that of production workers. In other words, managers find it harder to reallocate toward other firms because more of their alternatives are outside of their current local market. Third, minimum wages constrain low-productivity firms from exercising monopsony power. Since most of these firms only hire production workers, the minimum wage does not usually affect the wage markdowns of managers, whose wages are typically well above the minimum wage.

The distribution of the structural elasticities determines wage markdowns, which we show in the right panel of Figure 10. Lower structural elasticities translate into wider wage markdowns for managers than for production workers. That is, firms exert greater monopsony power on managerial than production worker wages. In particular, we estimate an employment-weighted markdown of 10.4 percent over the wage of the average production worker and a markdown of 23.1 percent over the wage of the average manager. Therefore, the interaction between monopsony power and firm organization reduces the wage dispersion between both occupations. Relative to the efficient economy, this heterogeneity in wage markdowns implies a higher distortion in the allocation of managers across firms than production workers. For policy evaluation, this suggests that additional policies targeting the reduction of monopsony power among low-wage workers, such as an increase in the minimum wage, may not effectively mitigate the welfare losses from monopsony power.

## 5.2 Welfare and Efficiency Losses from Monopsony Power

We now study the effect of monopsony power on firm organization, wage dispersion, efficiency, and welfare. Moreover, we estimate the extent to which the impact of monopsony power on these outcomes is attributable to the endogenous organizational choices of firms.

**Quantifying the impact of Monopsony Power.** We compute the efficient allocation by setting wage markdowns to one, i.e., equalizing wages to the marginal product of labor for all firms. The left column in Table 6 summarizes the results by comparing the aggregate outcomes in the efficient relative to the benchmark economy.

Panel A in Table 6 shows the change in employment across occupations. When firms have monopsony power, they internalize that a higher level of employment also involves higher wages, i.e., they internalize an upward-sloping labor supply curve. Then, firms find it optimal to restrict employment relative to the efficient allocation to reduce labor costs. We find that employment would rise by 5.6 and 9.3 percent for production workers and managers in an efficient economy, respectively. Managers' employment response is higher because firms exert

Table 6: Change in Counterfactual Relative to Benchmark

| | **Efficient Economy** | **Minimum Wage Reform** |
|---|---|---|
| **Panel A: Employment & Output** | % Change | % Change |
| Production workers | 5.57 | -1.28 |
| Managers | 9.29 | -0.99 |
| Aggregate Employment | 6.33 | -1.21 |
| Output | 3.25 | -0.04 |
| **Panel B: Wages** | | |
| Mean: Production workers | 10.04 | 2.06 |
| Mean: Managers | 23.02 | 0.94 |
| Ratio | 11.79 | -0.87 |
| **Panel C: Firm Organization** | | |
| Share multi-layer firms | -11.27 | -0.56 |
| Median span of control | -3.64 | -0.48 |
| Mean HHI: Production Workers | 5.00 | 0.63 |
| Mean HHI: Managers | 7.95 | 0.07 |
| **Panel D: Welfare** | | |
| Welfare: Production workers | 5.73 | -0.72 |
| Welfare: Managers | 23.13 | -0.01 |

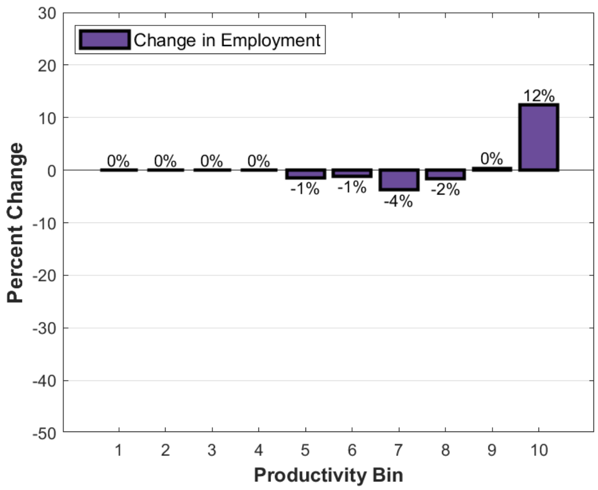
Note: The Table reports the percent change in aggregate outcomes in the counterfactual relative to the benchmark economy. In the first column, the counterfactual consists of an efficient economy where wage markdowns equal one. In the second column, the counterfactual consists of an economy with a ten percent higher minimum wage than the benchmark economy.

wider markdowns over their wages. Besides changes in aggregate employment, monopsony power also distorts labor allocation across firms because high-productivity firms restrict employment the most, as they set the widest markdowns. The top panels in Figure 7 show the reallocation of employees from less to more productive firms. We observe that firms in the top decile of productivity raise the number of production workers and managers by about 12 and 21 percent, respectively. The increase in employment and the reallocation of workers leads to an increase of 3.3 percent in aggregate output.

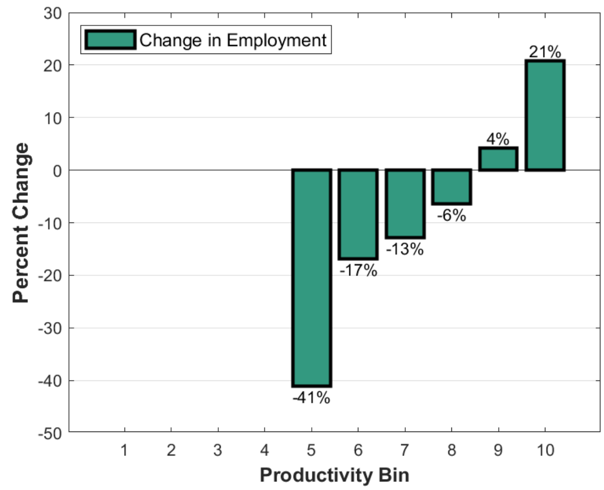
Regarding the impact of monopsony power on wages, the top panels in Figure 8 show how mean wages change across the firm productivity distribution. In an efficient economy, wages especially increase at high-productivity firms, which exert the widest markdowns. As a result, wage dispersion within occupations also increases. Since managers bear wider markdowns, the wage increase is greater for managers. In particular, Panel B shows that the mean wage of production workers and managers increase by 10 and 23 percent, respectively. As a result, dispersion in mean wages across occupations rises by 11.8 percent.

To understand why managerial employment and wages drop at middle-productivity firms, we need to analyze the effect of monopsony power on the internal organization of firms. Panel C shows, in line with the empirical evidence, that more firms adopt a multi-layer structure when they have monopsony power. In particular, we estimate that the proportion of firms that delegate to managers falls by 11.3 percent, from 33 to 29 percent of all firms. Furthermore, the share of multi-layer firms especially decreases at medium-productivity firms, as we observe in Figure 9. The reason is that monopsony power enables medium-productivity firms to attract employees at relatively low wages, incentivizing them to be multi-layer organizations. This result implies that managers at medium-productivity firms experience the most substantial decline in employment and even a decrease in wages. Notably, when we get rid of the effect of multi-layer firm exit on these outcomes, i.e., we analyze what happens to employment and wages in a counterfactual efficient economy where firms exogenously choose the benchmark organizational structure, we observe that managers at middle-productivity

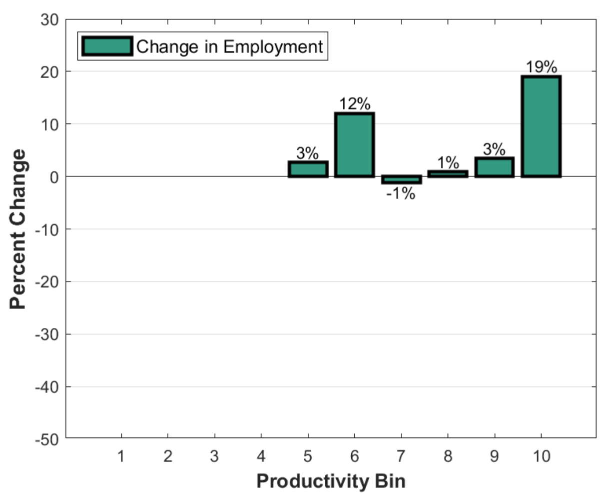
Figure 7: Effect of Monopsony Power on Employment Reallocation




(a) Production Workers



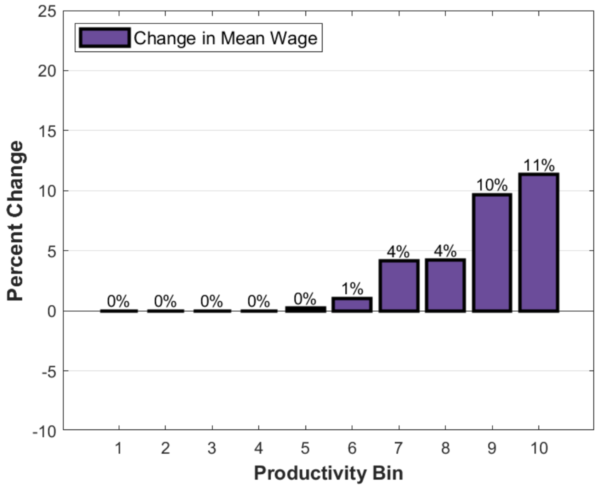

(b) Managers



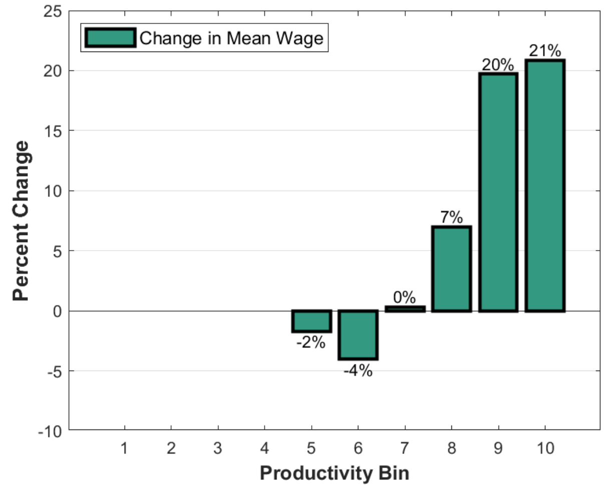

(c) Managers: Exogenous Delegation Choice

Note: The top panels in the Figure plot the percent change in employment of production workers (left) and managers (right) across firms in the efficient relative to the benchmark economy. The bottom panel shows the reallocation of managers in an efficient economy where firms exogenously keep the organizational structure of the benchmark economy. Both counterfactual simulations represent an efficient economy where wages are equal to the marginal product of labor. We classify firms into ten bins according to their productivity, where a higher bin implies higher productivity.

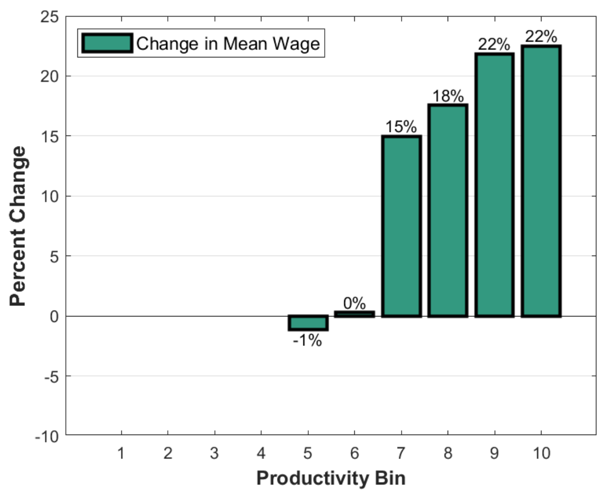
Figure 8: Effect of Monopsony Power on Wages




(a) Production Workers



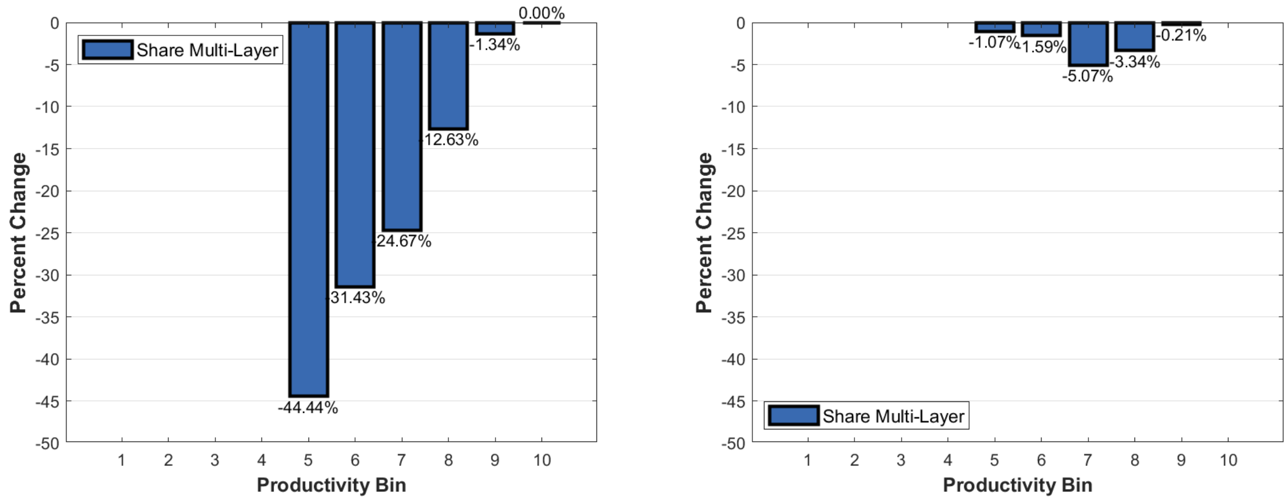

(b) Managers




(c) Managers: Exogenous Delegation Choice

Note: The top panels of the Figure plot the percent change in mean wages relative to the benchmark for production workers (left top) and managers (right top). The bottom panel shows the change in mean wages of managers in an efficient economy where firms exogenously keep the organizational structure of the benchmark economy. Both counterfactual simulations represent an efficient economy where wages are equal to the marginal product of labor. We classify firms into ten bins according to their productivity, where a higher bin implies higher productivity.

Figure 9: Effect of Monopsony Power on the Share of Multi-layer Firms




(a) Over Total Firms in Productivity Bin

(b) Over Total Firms

Note: The Figure plots the percent change in the share of multi-layer firms, where we express the change as a fraction over the total number of firms (right) and over the total number of firms in the same productivity bin (left). The counterfactual simulation represents an efficient economy where wages are equal to the marginal product of labor. We classify firms into ten bins according to their productivity, where a higher bin implies higher productivity.

firms would get employment and wage gains due to the reallocation of production workers (see the bottom panels of Figure 7 and Figure 8). Regarding managers' span of control, we estimate that it decreases by almost 3.6 percent because firms increase their managerial workforce. We also find that the average HHI in the market of production workers and managers increases by 5 and 7.9 percent, respectively, due to the reallocation of labor towards high-productivity firms and the decrease in the number of firms that hire managers.

Panel D reports the welfare losses from monopsony power. The efficiency gains translate into much higher welfare gains because, in addition to the output gain, there is a redistribution channel that increases labor income at the expense of profits. Measuring welfare as the consumption equivalent that would make households indifferent between the efficient and benchmark economy, we estimate that welfare increases by 5.7 and 23.1 percent for production workers and managers, respectively.

Figure 10: Firm Organization Channel


(a) Production Workers

(b) Managers

Note: The Figures display how much the firm organization channel, i.e., the endogenous firms' choice of layers, accounts for the percent change between the efficient and benchmark economies in several outcomes of production workers (left) and managers (right). For instance, the endogenous organizational choice of firms explains about 30 percent of the change in the average level of payroll concentration in managerial markets between the efficient and benchmark economy.

**Firm organization channel**. Our structural model allows us to quantify the extent to which changes in economic outcomes in the efficient economy stem from the endogenous organizational choices of firms. In the model, the main organizational choice of firms is to determine the number of layers. To isolate this channel, we simulate a counterfactual efficient economy where firms exogenously keep the same number of layers they choose in the benchmark economy. Then, we compute the change in each economic outcome between this counterfactual and the benchmark economy. This change is attributable to all the mechanisms included in the model except for the firm organization channel. Hence, we attribute to firm organizational choices the difference in the changes between the efficient counterfactual economy, where the layer structure is endogenous, and the efficient counterfactual economy, where this choice is exogenous.

Figure 10 shows how much firm organization accounts for changes in the market structure and welfare of production workers and managers. Two results stand out. Firstly, the firm organization channel explains about 30 percent of the change in the average concentration level of managerial markets. In particular, the average HHI of managerial markets increases by 7.7 percent in the efficient economy. Out of this increase, 2.3 percentage points are attributable to delegation decisions. The reason is that the number of multi-layer firms decreases when firm organization is endogenous, further contributing to increased market concentration because fewer firms participate in managerial markets.

Moreover, the firm organization channel also explains nearly 10 percent of the change in the average concentration level in production worker markets. This result stems from the technological reciprocity between worker types, which implies that organizational decisions also affect the distribution of production workers across firms. Hence, considering firm organizational choices is relevant to capture the impact of monopsony power on the market structure.

Secondly, ignoring firm organization contributes to overestimating the welfare gains of both worker types by about 9.1 percent. Regarding the welfare of managers, we overestimate it by about 2 pp when the organization of firms is exogenous (25.2%) relative to endogenous (23.1%). That is, the endogenous organizational response of firms in an efficient economy reduces the welfare of managers. Since fewer firms adopt a multi-layer structure in an efficient economy, the demand for managers falls, and so does their consumption level. Moreover, their disutility of labor decreases because their aggregate labor supply falls. Regarding the welfare of production workers, we overestimate it by 0.6 percentage points when the organization of firms is exogenous (6.3%) relative to endogenous (5.7%). In this case, almost the entire negative effect of firm organization on production workers' welfare stems from an increase in their disutility of labor supply, as the decrease in the share of multi-layer firms also induces the reallocation of some production workers.

**Summary**. To sum up, we show the impact of monopsony power on firm organization, efficiency, and welfare in the Portuguese economy. Regarding the importance of the firm organization channel, we emphasize that it is informative of the impact of monopsony power on employment at middle-productivity firms, welfare, and the market structure. Regarding the policies that aim to reduce the welfare losses from monopsony power, our results point out that the success of these policies especially relies on their ability to reduce the misallocation of managerial employment across firms. In the following section, we assess the effectiveness of Portuguese minimum wage policies in reducing the monopsony power of firms.

# 6 Minimum Wage Policies

Minimum wage policies aim to improve the well-being of low-income workers and tackle the wage-setting power of firms. We estimate that recent Portuguese minimum wage reforms deteriorated production workers' welfare and do not improve managers' welfare. Despite typically earning high wages, the reform affects managers through worker reallocation and delegation decisions. We assess occupation-based minimum wages as an alternative to the benchmark. Increasing the minimum wage for managers gives them up to a 0.5 percent welfare gain but slightly decreases production workers' welfare. Furthermore, we find a Pareto optimal combination of occupation-based minimum wages that brings about a welfare gain of 0.25 and 0.17 for production workers and managers, respectively. Thus, this optimal policy recovers 0.7 and 5 percent of their welfare losses from monopsony power.

## 6.1 Minimum Wage Reforms Implemented in Portugal

We start quantifying the welfare and efficiency effects of Portuguese reforms that raised the real minimum wage by ten percent between 2016 and 2019.[9] We focus on this period because it involves a meaningful and permanent minimum wage increase, and it coincides right after our calibration period and before the COVID-19 crisis. The rightmost column in Table 6 reports the percent change in aggregate outcomes in the minimum wage counterfactual relative

[9]In nominal terms, the Portuguese minimum wage increased from 530€ to 600€. Adjusting for the CPI, where we set the base year to 2010, it implies an increase of 10 percent from 525€ to 578€. See https://www.dgert.gov.pt/evolucao-da-remuneracao-minima-mensal-garantida-rmmg.

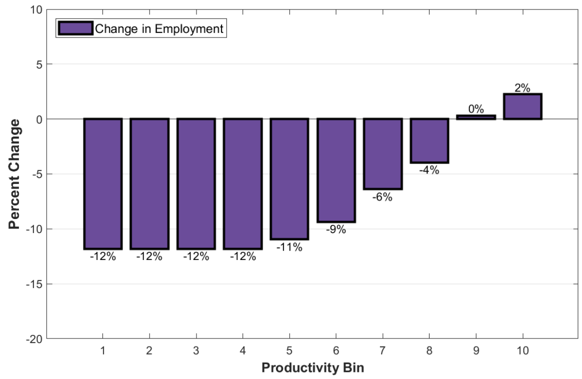
to the benchmark economy.

Before presenting the results, we describe our model's four channels through which minimum wages alter wages and employment. First, minimum wages directly change employment and wages at constrained firms. The minimum wage may positively or negatively affect employment, depending on the firm's productivity level. Second, spillover effects exist in unconstrained firms, which increase wages because their competitors pay higher wages. Third, there is a reallocation effect because the rise in the minimum wage leads to employment losses at unproductive firms, part of which relocates to more productive firms. The channels mentioned above are also included in Berger et al. (2023b). Fourth, our model includes a novel channel that considers how the minimum wage affects the internal organization of firms. As a result, minimum wage policies that affect one worker type also affect the other worker type within the organization due to our technological specification, as changing the employment of one worker type affects the marginal productivity of the other type.

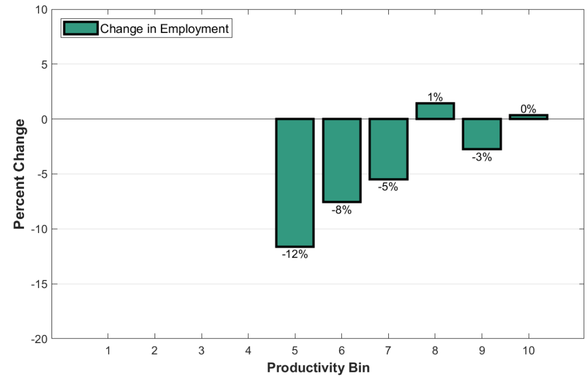
Panel A in Table 6 shows that the increase in the minimum wage reduces aggregate employment by about 1.3 percent. Although employment falls for both occupations, the employment decline is higher for production workers, who are likelier to work at firms that exert narrow markdowns and pay low wages. The negative effect on employment does not generate large efficiency losses, as output almost remains unchanged. The reason is that the minimum wage reform also induces workers to relocate to high-productivity firms, reducing the misallocation of labor. Figure 11 shows the reallocation of both worker types towards high-productivity firms. Note that even a slight employment increase at high-productivity firms crowds out most of the employment drop at low-productivity firms, as high-productivity firms account for most of aggregate employment (see Figure A.7).

Regarding the impact of the minimum wage reform on wages, Figure 12 shows that the reform increases wages at low-productivity firms, which have to pay higher wages. In contrast, when labor relocates towards high-productivity firms, it increases labor supply in those firms, leading to downward pressure on wages. As a result, wage dispersion decreases within

Figure 11: Effect the of Minimum Wage Reform on Employment Reallocation




(a) Production Workers




(b) Managers

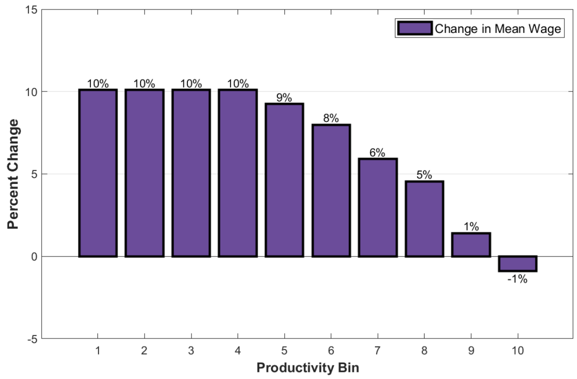
Note: The Figure plots the percent change in employment of production workers (left) and managers (right) across firms in the minimum wage counterfactual relative to the benchmark economy. In the counterfactual economy, the minimum wage is ten percent higher than in the benchmark. We classify firms into ten bins according to their productivity, where a higher bin implies higher productivity.

occupations. Since the wage change is more intense for production workers, wage dispersion also decreases across occupations. In particular, Panel B shows that the minimum wage reform reduces mean wage dispersion across occupations by 0.9 percent. Lastly, we estimate the own-wage employment elasticity by occupations to find that for production workers, it is -0.62, and for managers, it is -1.05.[10] The managers' elasticity indicates that the wage gains from the minimum wage cancel out with the job losses, while for production workers, the wage gains are larger than the job losses. These elasticities are in the range of other estimates from the minimum wage literature (Dube, 2019).

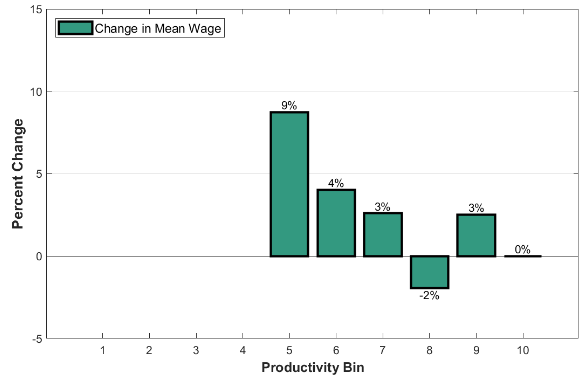
Next, Panel C reports the effect of the reform on firm organization. We estimate a decrease of almost 0.6 percent in the share of multi-layer firms. Figure 13 shows that this happens at medium productivity bins, even though managers in these firms earn wages well above the baseline minimum wage (see Figure A.8). The reform makes their production workers, who

[10] We estimate the elasticity as $OWE_o = \frac{\%\Delta Employment_o}{\%\Delta MinimumWage} * \frac{\%\Delta MeanWage_o}{\%\Delta MinimumWage}^{-1}$.

Figure 12: Effect of the Minimum Wage Reform on Wages




(a) Production Workers



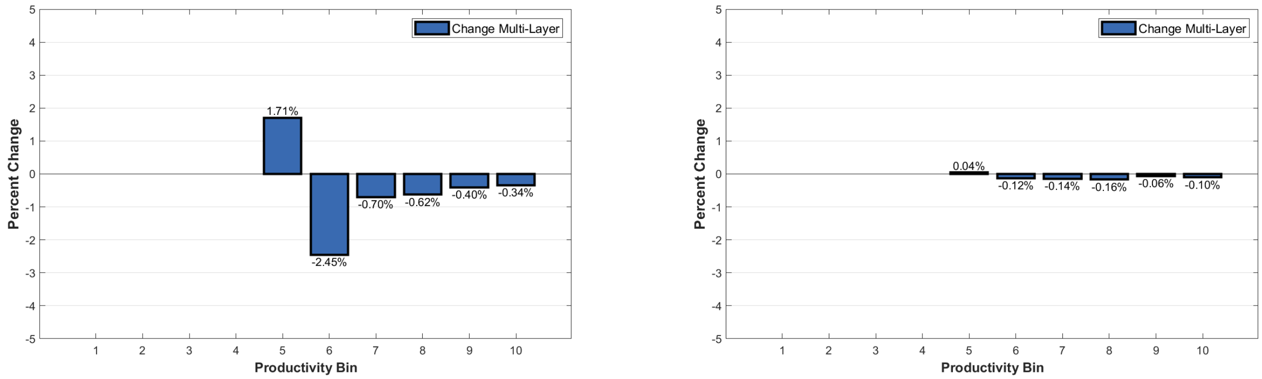

(b) Managers

Note: The Figure plots the percent change in mean wages of production workers (left) and managers (right) across firms in the minimum wage counterfactual relative to the benchmark economy. In the counterfactual economy, the minimum wage is ten percent higher than in the benchmark. We classify firms into ten bins according to their productivity, where a higher bin implies higher productivity.

earn wages close to the minimum wage, more expensive. Therefore, they have incentives to reduce their workforce and, consequently, the number of layers because a multi-layer organization especially provides advantages when producing at large scales. The median span of control of managers decreases by 0.48 percent because production workers become more expensive than managers. Regarding the effect on the market structure, we find that the reform induces an increase in market concentration for both occupations due to the reallocation effect and the drop of the second layer of firms.

Lastly, consider the effect of the minimum wage reform on welfare in Panel D. The reform reduces the welfare of production workers by 0.7 percent. Despite a slight increase in consumption, welfare decreases because the reform induces a reallocation of labor across firms that significantly raises their disutility of labor supply. We interpret this last finding as a situation wherein the reallocation of labor across firms involves substantial search costs, increases commuting costs, and diminishes the idiosyncratic taste of production workers toward firms, all in an effort for workers to remain employed. The reform has a negligible effect

Figure 13: Effect of the Minimum Wage Reform on the Share of Multi-layer Firms




(a) Over Total Firms in Productivity Bin

(b) Over Total Firms

Note: The Figure plots the percent change in the share of multi-layer firms, where we compare the change over the total number of firms (right) and the total number of firms in the same productivity bin (left).

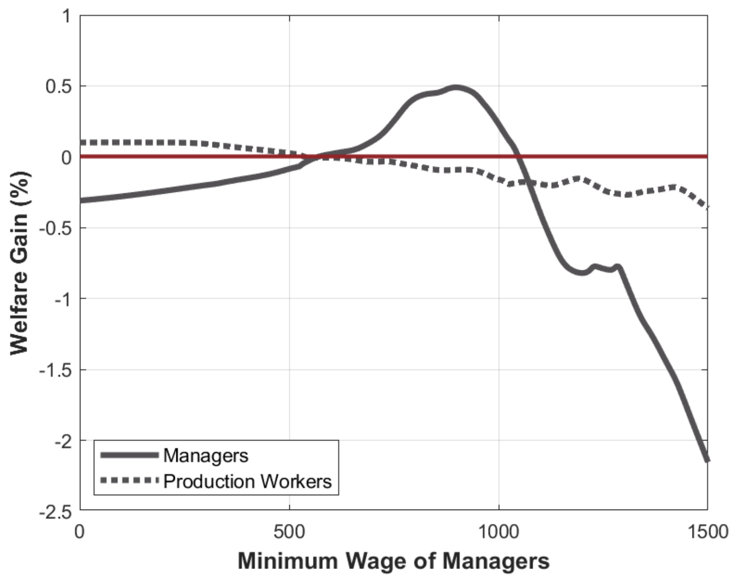
on the welfare of managers, as their wages and employment levels change less prominently.

**Summary.** To sum up, the minimum wage reform has small effects on aggregate employment and output, and it fails to address the welfare losses from monopsony power. Despite typically earning salaries well above the minimum wage, the reform decreases the employment of managers and increases managers' wages through delegation choices and worker reallocation. Moreover, the reform makes production workers worse off on average, even though they presumably constitute the main target of the policy. Two factors contribute to this finding: A high baseline minimum wage, already binding on about one out of five production workers, and the lower monopsony power of firms employing low-wage workers.

## 6.2 Occupation-based Minimum Wage

The heterogeneity in the distribution of wage markdowns across occupations suggests that designing a minimum wage for each occupation would be more effective at tackling the welfare losses from monopsony power. It is natural to ask whether a different minimum wage for managers would improve upon the implemented Portuguese minimum wage reforms, as

Figure 14: Welfare Effect of Occupation-based Minimum Wage




Note: The Figure plots the percent change in the welfare of both managers and production workers in the counterfactual where the minimum wage of managers changes relative to the benchmark economy. We keep the benchmark minimum wage for production workers.

managers tend to earn wages above the minimum wage and bear wider markdowns than production workers. For this reason, we simulate different scenarios where we set a specific minimum wage for managers while keeping the benchmark minimum wage for production workers. Figure 14 depicts the welfare change of production workers and managers in each counterfactual relative to the benchmark.

Designing an occupation-based minimum wage improves welfare relative to the implemented Portuguese minimum wage reforms. In particular, the welfare change of both worker types is higher when the minimum wage of managers ranges between approximately 43 percent (695€) and 64 percent (1025€) of their mean wage. As expected, the welfare of managers is hump-shaped relative to their minimum wage. We calculate that the welfare gain of managers attains its maximum at 0.5 percent when their minimum wage equals 56 percent of the mean managerial wage (900€). It is worth noting that even a specific minimum wage for managers does not recover more than 2 percent of their total welfare loss from monopsony power.

Regarding production workers, their welfare level is decreasing in the minimum wage of managers due to a consumption drop. Raising the minimum wage of managers diminishes the consumption level of production workers, as firing managers decreases the marginal productivity of the incumbent production workers and incentivizes firms to fire production workers. Hence, occupation-based minimum wages raise welfare inequality between occupations. Nonetheless, the total effect of this policy on the welfare level of production workers is close to zero.

Lastly, we estimate the Pareto optimal combination of occupation-based minimum wages that provides welfare gains for both worker types relative to the benchmark economy. We find that this combination of occupation-based minimum wages provides a welfare gain relative to the benchmark of 0.25 percent for production workers and 0.17 percent for managers when the minimum wage of production workers is about 63 percent of their mean wage (460€) and the minimum wage of managers is about 50 percent of their mean wage (790€). Therefore, our results show that there exist reforms that make both worker types better off in comparison to the current situation. Moreover, our findings indicate that an optimal occupation-based minimum wage policies mitigates between 0.7 and 4.3 percent of the welfare loss from monopsony power of managers and production workers, respectively.

# 7 Conclusion

The main result of this paper shows that markdown heterogeneity and the organization of work within firms generate wage dispersion between managers and production workers, leading to economic implications in terms of wage dispersion, misallocation, and the design of policies that address monopsony power. We find that firms exert wider monopsony power over managers than production workers. As a result, the managerial wage gap would increase by 11.8 percent in an efficient economy where firms do not exert monopsony power.

Moreover, monopsony power incentivizes managerial delegation in less productive firms, as it distorts the allocation of managers and production workers across firms. The efficient economy provides substantial welfare gains for both occupations, which stem from efficiency gains and redistribution of firm profits to labor income. In particular, we estimate a consumption equivalent gain of 5.7 and 23.1 percent for production workers and managers, respectively. Lastly, we study whether minimum wage policies address the welfare losses from monopsony power. We find that recent Portuguese reforms that increase the minimum wage by ten percent lowers production workers' welfare and maintain managers' welfare. Designing occupation-based minimum wages recovers less than 5 percent of the welfare losses from monopsony power, but provides welfare gains for both occupations relative to the benchmark.

We consider two valuable extensions for future research. Empirically, we think that market concentration and mobility costs may also show a systematic relationship with other important market characteristics. For instance, the skill level required in the job, the age of workers, or whether the market is formal or not in developing countries. Theoretically, future model extensions may consider worker heterogeneity in productivity and across-occupation mobility to improve the results.

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# Online Appendix

# A Additional Figures and Tables

Table A.1: Classification of Occupations

| **Level** | **Tasks** | **Skills** |
|---|---|---|
| Top Management | Definition of the firm general policy or consulting on the organization of the firm; strategic planning; creation or adaptation of technical, scientific and administrative methods or processes | Knowledge of management and coordination of firms fundamental activities; knowledge of management and coordination of the fundamental activities in the field to which the individual is assigned and that requires the study and research of high responsibility and technical level problems |
| Middle Management | Organization and adaptation of the guidelines established by the superiors and directly linked with the executive work | Technical and professional qualifications directed to executive, research, and management work |
| Supervisors | Orientation of teams, as directed by the superiors, but requiring the knowledge of action processes | Complete professional qualification with a specialization |
| Higher-skilled Professionals | Tasks requiring a high technical value and defined in general terms by the superiors | Complete professional qualification with a specialization adding to theoretical and applied knowledge |
| Skilled Professionals | Complex or delicate tasks, usually not repetitive, and defined by the superiors | Complete professional qualification implying theoretical and applied knowledge |
| Semi-skilled Professionals | Well defined tasks, mainly manual or mechanical (no intellectual work) with low complexity, usually routine and sometimes repetitive | Professional qualification in a limited field or practical and elementary professional knowledge |
| Non-skilled Professionals | Simple tasks and totally determined | Practical knowledge and easily acquired in a short time |

Sources: (i) *Decreto-Lei nº. 121/78 de 2 de Junho, Ministério do Trabalho*, (ii) Caliendo et al. (2020).

Table A.2: Share of Occupations

| **Level** | **Share (%)** | **Share Hierarchy (%)** | **Mean Wage** | **Std. dev. Wage** |
|---|---|---|---|---|
| **Managers** | 19.19 | 100 | 1,850 | 1,398 |
| *Top Management* | 7.97 | 41.55 | 2,226 | 1,778 |
| *Middle Management* | 5.96 | 31.08 | 1,658 | 1,033 |
| *Supervisors and Team Leaders* | 5.25 | 27.37 | 1,498 | 862 |
| **Workers** | 80.81 | 100 | 808 | 842 |
| *Higher-skilled Professionals* | 8.07 | 9.98 | 1,367 | 2,318 |
| *Skilled Professionals* | 40.44 | 50.04 | 841 | 443 |
| *Semi-skilled Professionals* | 21.48 | 26.58 | 661 | 281 |
| *Non-skilled Professionals* | 10.83 | 13.40 | 565 | 241 |

Source: Elaboration based on Quadros de Pessoal.

Table A.3: Mobility and Sample Characteristics

| | (1) **Production Workers** | (2) **Managers** |
|---|---|---|
| | Mean | Mean |
| Share Age≤25 | 0.13 | 0.04 |
| Share Age≤30 | 0.28 | 0.19 |
| Share Temporary | 0.31 | 0.16 |
| Share Change Firm | 0.24 | 0.20 |
| Share Change Municipality | 0.11 | 0.10 |
| Share Change Sector | 0.20 | 0.17 |
| Observations | 24,362,091 | 5,128,131 |

Source: Elaboration based on QP.

Table A.4: Targeted Moments

| Parameter Value | Description | Moment | Model | Data |
|---|---|---|---|---|
| *A: Preferences* | | | | |
| $\phi_m$ | Labor disutility shifter: production workers | Average firm size | 5.59 | 5.28 |
| $\phi_w$ | Labor disutility shifter: managers | Ratio managers to workers | 0.20 | 0.19 |
| *B: Firm Organization* | | | | |
| $\alpha$ | Span of control | Median span of control | 3.41 | 3.14 |
| $\varphi_w$ | Worker efficiency | Mean wage of workers (€) | 729 | 718 |
| $\varphi_m$ | Managerial efficiency | Wage gap managers and workers | 0.79 | 0.73 |
| $\sigma_z$ | Std. Dev. firm TFP | Weighted mean HHI workers | 0.18 | 0.19 |
| *C: Market Characteristics* | | | | |
| $B_{ijw}$ | Amenities in small markets | Share workers in markets $M_j \leq 10$ | 0.12 | 0.12 |
| Mass $m_j = 1$ | Share single-firm markets | Mass single-firm markets | 0.29 | 0.29 |
| $\zeta_0$ | Scale Pareto distribution | Mean Nº firms | 17.87 | 17.63 |
| $\zeta_1$ | Shape Pareto distribution | Std. Dev. Nº firms | 72.65 | 68.25 |
| *D: Firm Substitutability* | | | | |
| $(\theta_w, \theta_m)$ | Across-market firm substitutability | Across-municipality LS elasticity | (1.52 , 0.92) | (1.46 , 0.92) |
| $(\eta_w, \eta_m)$ | Within-market firm substitutability | Within-market LS elasticity | (19.97 , 6.10) | (19.97 , 6.10) |

Note: The Table reports the vector of parameters estimated using the SMM approach and the calibrated firm distribution with their respective moment description and fit.

Figure A.1: Unbinding Minimum Wage in Partial Equilibrium Analysis

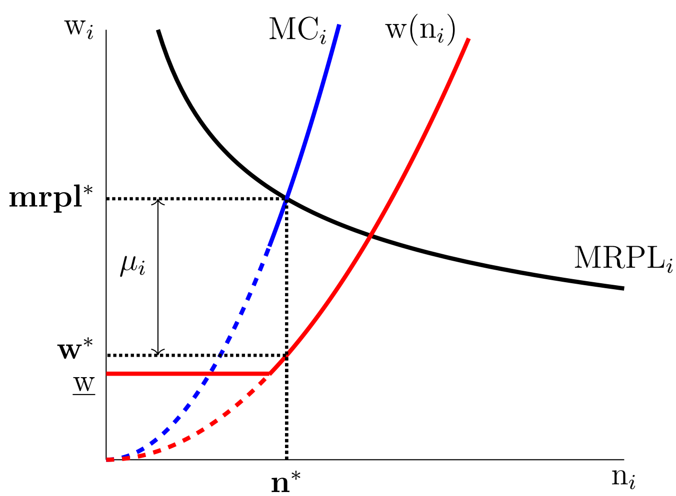


Figure A.2: Binding Minimum Wage on the Labor Supply Curve

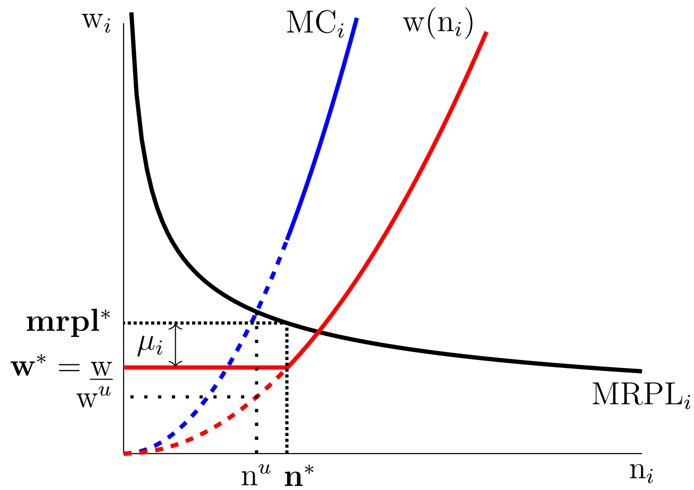



Figure A.3: Binding Minimum Wage off the Labor Supply Curve

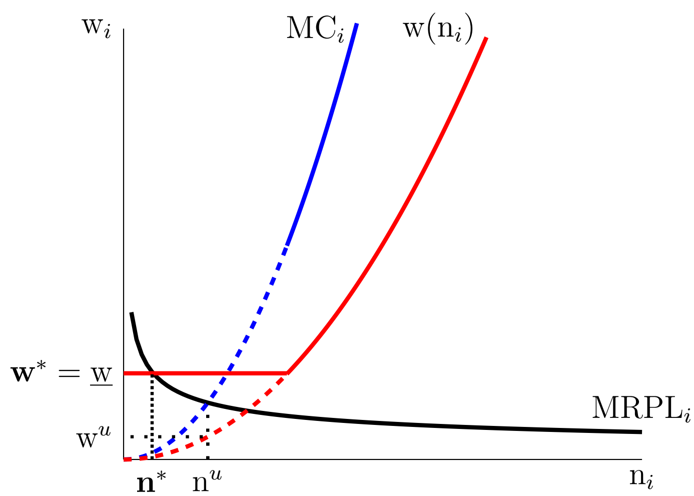
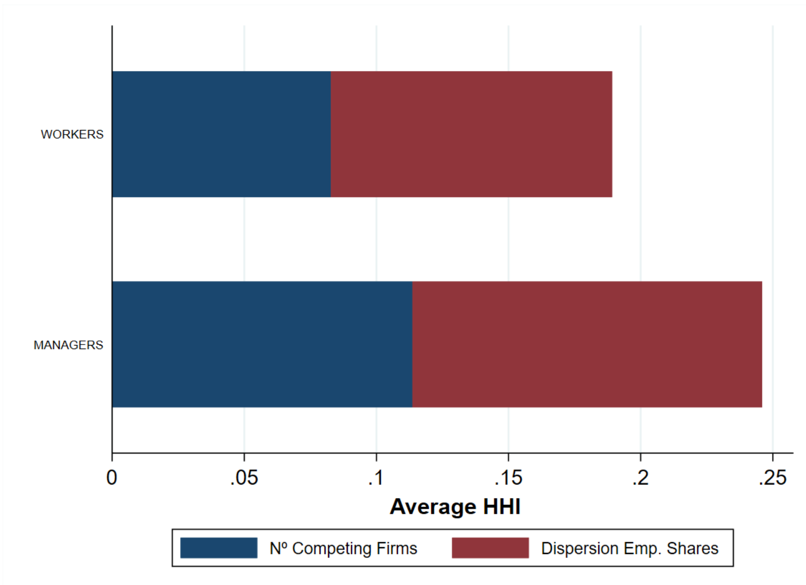


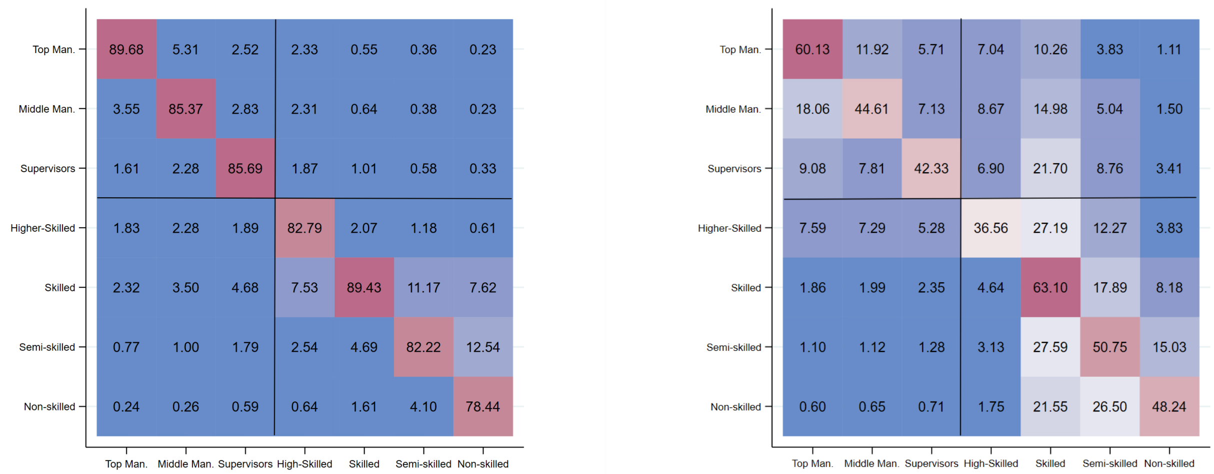
Figure A.4: Decomposition Average HHI




Source: Elaboration based on QP.

Note:

Figure A.5: Transition Probabilities

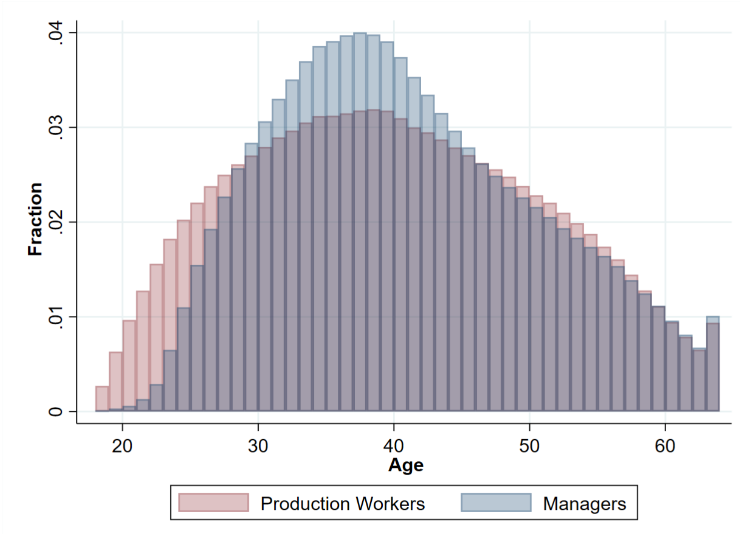



(a) Unconditional

(b) Conditional

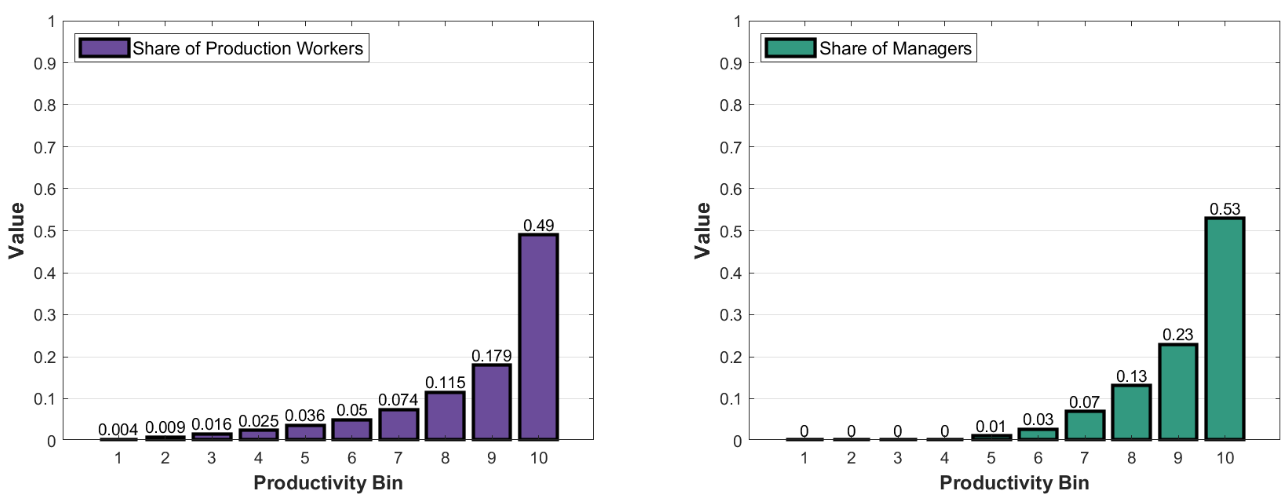
Note: The Figures display the transition probabilities of changing sub-occupation. The left panel shows the unconditional transition probability, whereas the right panel shows the transition probability conditional on changing firms. The black lines delimit the quadrants of moving across or within the two broad occupation categories (managers and production workers), where the top left and right bottom quadrants represent within-occupation transitions. The vertical axis represents the sub-occupation before the transition, and the horizontal axis the sub-occupation afterward.

Figure A.6: Age Distribution across Occupations




Note: The Figures display the age distribution across occupations.

Figure A.7: Employment Share in the Benchmark Economy

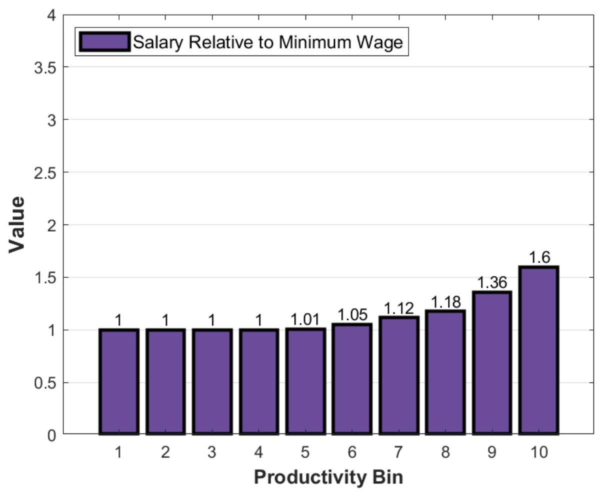



(a) Production Workers

(b) Managers

Note: The Figure plots the employment share of production workers (left) and managers (right) across firms in the benchmark economy. We classify firms into ten bins according to their productivity, where a higher bin implies higher productivity.

Figure A.8: Mean Wages in the Benchmark Economy




(a) Production Workers


(b) Managers

Note: The Figure plots the employment-weighted mean wage of production workers (left) and managers (right) across firms in the benchmark economy. We classify firms into ten bins according to their productivity, where a higher bin implies higher productivity.

# B Data

This section provides a detailed description of the data, the market definition, and the methodology to measure market concentration using the Herfindahl-Hirschman Index (HHI).

## B.1 Quadros de Pessoal

Our primary data source is *Quadros de Pessoal* (QP), an annual census of private sector employees conducted by the Portuguese Ministry of Employment. This census provides matched employer-employee data on all firms based in Portugal with at least one worker.[11] The database incorporates unique time-invariant identifiers for each firm, establishment, and worker entering the report, which allows tracking them over time. In particular, we cover the period from 2010 to 2016.

The worker-level data contains information on each firm's employees as of the October reference week. The variables include age, occupation, monthly earnings, and hours worked. At the firm level, we have information on the industry, the headquarters location, and all its establishments.

Regarding the sample selection, we exclude workers younger than 18 or older than 64, those working outside of continental Portugal, and those working in agriculture, forestry, fishing, or mining industries. We also exclude apprentices, workers with missing information on earnings or occupation, and workers with misreported identifiers.[12] Finally, we drop chief executive officers because their market is not local, which is a core feature of the theory in this paper. This selection results in 3,492,148 workers and 13,036,426 worker-year observations.

[11] The census excludes public administration and non-market services.

[12] Most workers with missing earnings include unpaid family members and owners of the firm. In addition, workers with misreported identifiers (e.g., duplicated) account for about 2% of the sample.

## B.2 Market Definition

We classify labor markets based on three observable characteristics of the job: geography, industry, and occupation. This classification stems from the fact that workers are more attached to their current labor market because of imperfect substitutability of skills across jobs and sectors and imperfect geographical mobility (Neal, 1995; Kambourov and Manovskii, 2009; Sullivan, 2010; Monte et al., 2018). In particular, we define two broad occupations, i.e., managers and production workers, and define a local labor market for each occupation as the intersection of the geography (Municipality) and industry (2-digit NACE). This selection results in 13,890 and 11,765 local labor markets for workers and managers, respectively.

The geographical dimension reflects that workers likely stay in their current labor market due to geographical mobility costs. We use the municipality or *concelho* administrative division as the benchmark geographic unit, which splits the country into 278 areas of an average of 320 square kilometers. Within each geography, workers are more likely to stay in firms of the same sector due to the imperfect substitutability of human capital across sectors. We use the 2-digit NACE classification of industries as a baseline measure. This includes 78 different economic sectors such as *Manufacture of food products* or *Accommodation and food service activities.* Given that our model does not distinguish between across-industry and across-region mobility, we use these baseline definitions because worker transitions are similar in both cases. In particular, the unconditional across-municipality and across-industry annual transition probabilities are 9.8 percent.

Regarding the occupational definition, the Portuguese law obliges firms to assign their workers to an occupational category based on tasks performed and skills required so that each category considers the level of the worker within the firm's hierarchy in terms of increasing responsibility and task complexity. We follow a hierarchical classification similar to (Caliendo et al., 2020). In particular, we partition professional categories into two layers. We assign top executives, intermediary executives, and supervisors, and team leaders to the management layer. In addition, we assign higher-skilled professionals, skilled professionals,

Table A.5: Summary Statistics at the Establishment Level

| | Mean | P10 | P25 | P50 | P75 | P90 |
|---|---|---|---|---|---|---|
| **Production Workers** | | | | | | |
| Monthly Wage | 718 | 518 | 588 | 756 | 1,082 | 2,159 |
| **Managers** | | | | | | |
| Monthly Wage | 1,698 | 937 | 1,346 | 2,059 | 3,065 | 6,441 |
| Span of Control | 8 | 1 | 3 | 8 | 17 | 70 |

Source: Elaboration based on Quadros de Pessoal.

Note: The Table reports the mean, 10th, 25th, 50th, 75th, and 90th percentile of the individual distribution of wages for managers and non-managers. Wages are base wages (excluding supplementary payments) expressed in full-time equivalent units. In addition, it reports the same distributional moments for the span of control, which we define as the ratio of non-managers to managers within an establishment.

skilled professionals, semi-skilled professionals, and non-skilled professionals to the bottom layer. To distinguish between managers and other occupations, the critical difference is that managers are responsible for the organizational policies of the firm and their adaptation, which require a high degree of qualification in terms of direction, guidance, and coordination of the firm fundamental activities.[13]

## B.3 Summary Statistics

Our classification of occupations implies that 19 percent of workers are managers, while the remaining 81 percent are production workers. Table A.5 reports summary statistics of the wage distribution for each occupation. Along the distribution, managers earn higher wages than production workers, and this gap particularly widens for high-paid workers. Managers earn around twice as much in the bottom quartile as production workers. In the top quartile, managers earn nearly three times as much as production workers.

[13]See Table A.1 for further information about the categories of the occupational classification, which is based on *Decreto-Lei nº. 121/78 de 2 de Junho, Ministério do Trabalho.*

This wage gap arises even though about two-thirds of managers are not top executives but supervisors, team leaders, or intermediary executives (see Table A.2). We measure the number of workers a manager has under his charge (the span of control) with the ratio of non-managers to managers in each establishment. In half of the establishments, managers have a span of control lower than eight workers, and only one-fourth of establishments have managers with a span of control greater than seventeen workers. These results highlight that most establishments assign a small span of control to their managers.

To sum up, we find substantial wage dispersion between managers and production workers. The literature on income inequality mainly attributes wage differences between groups to productivity-enhancing forces such as skill-biased technologies (Katz and Murphy, 1992; Autor, 2014), task-biased technologies (David et al., 2006), and trade specialization (Chetverikov et al., 2016). In the next section, we show evidence of an additional potential force behind both types of wage inequality: heterogeneity in market payroll concentration as a proxy for monopsony power.

## B.4 Measuring Market Payroll Concentration

Our baseline measure of market concentration is the HHI. Given the employment $n_{ij}$ and wage $w_{ij}$ level at firm $i$ in a local labor market $j$, we define the HHI in the market as:

$$\mathrm{HHI}_j := \sum_{i=1}^{N_j} s_{ij}^2 = \frac{1}{N_j} + \sum_{i=1}^{N_j} \left( s_{ij} - \frac{1}{N_j} \right)^2, \tag{20}$$

$$s_{ij} := \frac{w_{ij} n_{ij}}{\sum_{i=1}^{N_j} w_{ij} n_{ij}}. \tag{21}$$

Here, $N_j$ is the number of establishments in market $j$ and $s_{ij}$ stands for the payroll share of the firm $i$. The HHI equals the average payroll market share weighted by the payroll share itself. The index ranges from $\frac{1}{N}$ to 1, where a low value reflects low concentration or many firms having similar payroll shares. Note that this index gives more weight to larger establishments, especially penalizing markets where a few firms have a large share of the market payroll. The rightmost equality of Equation (20) shows that the HHI has an economically meaningful decomposition into two concentration sources. The left term reflects that the concentration level decreases with the *number of establishments*, given that they have identical payroll shares. Given the number of firms, the right term shows that the index increases when there is a higher *variance in payroll shares* across establishments relative to the symmetric case.

## B.5 Stylized Facts

**Fact #1: Managers tend to work in markets with higher payroll concentration.** Figure 1 plots the estimated kernel density of the market level HHI for each occupation and their respective cumulative share of employment. We observe that managers are more likely to belong to a relatively highly concentrated market than production workers. This occurs because their markets are more likely to present higher payroll concentration (see Figure 1a) and because there is a higher share of managers working there (see Figure 1b).

Table 1 reports particular moments of the distribution of the HHI. The employment-weighted average of the HHI is 38 percent higher for managers than for production workers. In particular, the average HHI is 0.27 for managers and 0.20 for production workers. To provide context for these numbers, one would observe the same level of concentration with four and five equally-sized establishments, respectively. Table 1 also reports moments from the distribution of the median and maximum payroll share across local labor markets. The average largest establishment in a local labor market accumulates about 8 percentage points more market payroll in the market of managers than in the market of production workers. Besides, in most labor markets, the median establishment has a payroll share in managerial markets that is twice as large as the payroll share in the markets of production workers.

The aforementioned facts show that firms' employment policies lead to greater market payroll concentration in managerial occupations. To understand the sources that bring about this observation, we analyze facts related to the organization of work of firms.

**Fact #2: Nearly two times as many firms compete for production workers as**

Table A.6: Distributional Moments of Establishments across Local Markets

| | Mean | P10 | P25 | P50 | P75 | P90 |
|---|---|---|---|---|---|---|
| **Managers** | | | | | | |
| Nº Establishments | 116 | 3 | 10 | 38 | 153 | 379 |
| **Production Workers** | | | | | | |
| Nº Establishments | 221 | 5 | 16 | 63 | 236 | 542 |

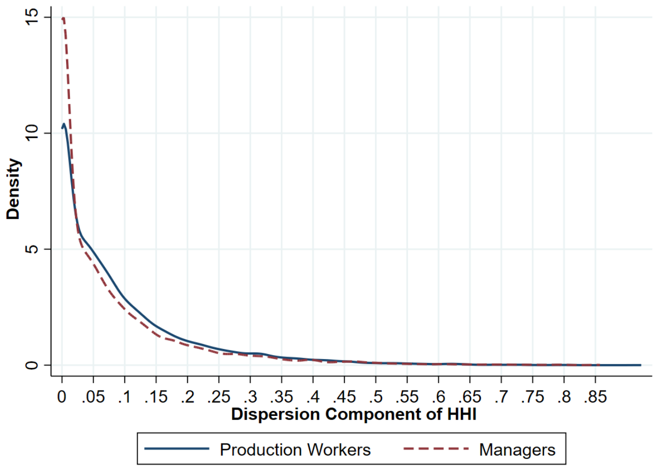
Source: Elaboration based on Quadros de Pessoal.

Note: The Table reports the (employment weighted) mean, the 10th, 25th, 50th, 75th, and 90th percentiles of the number of establishments across local labor markets by occupation.

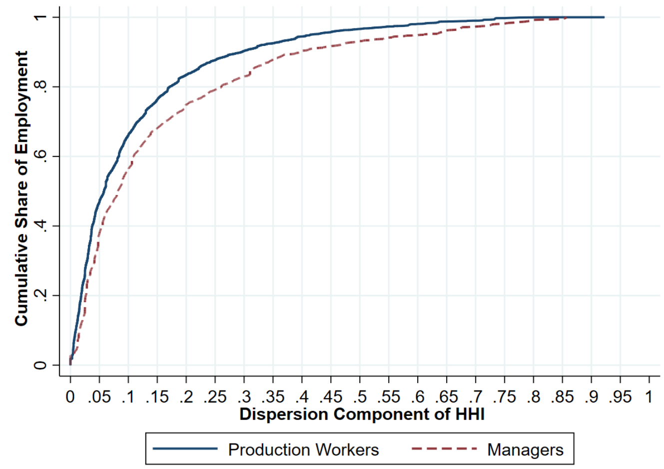
**for managers.** For both occupations, around two-fifths of the observed level of market concentration stems from the number of firms competing in the labor market (see Table 2). Table A.6 reports some distributional moments of the number of establishments across local labor markets. The average production worker works in a market with almost two times as many establishments as the average manager. This fact indicates that only a proportion of establishments find management necessary to organize their production in addition to what is carried out by the entrepreneur. Other things being equal, this observation implies lower market payroll concentration for production workers relative to that of managers.

**Fact #3: Greater variance in payroll shares in the average market of managers.** The remaining three-fifths of the observed level of concentration stems from the dispersion in payroll shares across establishments relative to the symmetric case (see Table 2). Figure A.9a plots the distribution of the dispersion component of the HHI across local labor markets for each occupation. The distribution of the dispersion component of the HHI is very similar for both production workers and managers. However, looking at the distribution of employment across these market types, we find that fewer production workers work in markets with relatively high levels of payroll dispersion. As a result, the employment-weighted average dispersion level equals 0.15 for managers and 0.11 for production workers. Hence, employment sorting across markets implies that the average manager works in a market with

Figure A.9: Distribution of the Variance in Payroll Shares by Occupation




(a) Probability Distribution




(b) Cumulative Share of Employment

Source: Elaboration based on QP.

Note: the Figure plots the kernel density of the component of the payroll HHI related to the dispersion in payroll shares to the symmetric market with identical firms. It displays the density for managers (red) and production workers (blue). In addition, the graph plots the CDF of employment with respect to the aforementioned variable.

a higher payroll dispersion than the average production worker.

# C Derivations

## C.1 Labor Supply

## C.2 Labor Demand

## C.3 Equilibrium

## C.4 Quantification of Labor Supply Elasticities

This section explains in detail the quantification of the parameters determining the structural labor supply elasticities: $(\eta_o, \theta_o)$.

### C.4.1 Estimation of the Reduced-Form Elasticities

**Within-market elasticity**

To estimate the within-market *reduced-form labor supply elasticity*, we use establishment-level wages and employment. As both variables are jointly determined in equilibrium, we need to leverage an exogenous change in the labor demand. To this end, we develop a framework with components similar to the one in Ahlfeldt et al. (2022).

We compute total employment $L_{i,j,o,t}$ and average hourly real wages $w_{i,j,o,t}$ in occupation $o$ for each establishment $i$ in location $j$ at period $t$. It is worth stressing that, unlike Ahlfeldt et al. (2022), we do not need to impute working hours because our database already provides this information. For each occupation $o$, we separately estimate the following regression:

$$logw_{i,j,o,t} = \beta \; logL_{i,j,o,t} + \mu_{j,o,t} + \upsilon_{i,j,o,t}, \tag{22}$$

where $\beta = 1/\epsilon$ is the inverse of the reduced-form labor supply elasticity. We include location-time fixed effects to isolate any time-varying shock in a given local labor market. Still, the error $\upsilon_{i,j,o,t}$ may capture establishment-time-specific shocks to labor demand and supply, which may be correlated with establishment size. Thus, to consistently estimate $\beta$, we use the standard shift-share approach to simulate labor demand shocks that go back to Bartik (1991) and are formalized more recently through the exogeneity of the shares (Goldsmith-Pinkham et al., 2020) or the exogeneity of the shifts (Borusyak et al., 2022). The intuition of the instrument is that we exploit national trends in employment to predict establishment-level labor demand shocks. More concretely, we combine local shares and aggregate shifts to employment as follows:

$$\hat{L}_{i,j,o,t} = \underbrace{\frac{L_{i,j,o,2007}}{\sum_i L_{i,s,o,2007}}}_{\text{Firm's Employment Share in Sector } s} \times \underbrace{\sum_i L_{i,s,o,t}}_{\text{National Employment in Sector } s} . \tag{23}$$

We set 2007 as the initial year for the share component. Then, we measure the shares as the employment in occupation $o$ in a given establishment located in $j$ at $t$ ($L_{i,j,2007,o}$) over the national level of employment for that occupation in sector $s$ in 2007 ($L_{i,j,2007,o}$). Recall that our definition of local labor market $j$ implicitly includes a sector, as it is the intersection between sector ($s$) and municipality ($r$) given an occupation $o$. We multiply this by the total employment of a given sector and occupation ($\sum_i^I L_{iso}$) every year after 2007 to predict current establishment employment according to national trends and initial shares. With the modified employment, we estimate Equation (22) by an instrumental variable with $\hat{L}_{i,j,o,t}$ as an instrument for $L_{i,j,o,t}$. In this estimation, we assume that the instrument is unrelated to unobserved constant or time-varying characteristics that affect specific establishments within the same industry, location, and year.

Table C.1 shows the IV estimates of the reduced-form elasticities by occupations. We find that managers have a smaller labor supply elasticity than production workers, indicating that managers are less responsive to wage changes. Overall, our estimates are in the range of the literature. Most estimates based on inverse methods, i.e., estimating the inverse labor supply elasticity in the baseline specification, find estimates around 5.24 (Sokolova and Sorensen, 2021). Quantifying the model to county-level data in the U.S., Monte et al. (2018) finds a labor supply elasticity of 3.3. Using municipality-level German data, Ahlfeldt et al. (2015) find a labor supply elasticity of 5.5.

Table C.1: Within-Market Firm Substitutability Regression

| | **Production Workers** | | **Managers** | |
|---|---|---|---|---|
| Dependent Variable: Log Wage | **OLS** | **IV** | **OLS** | **IV** |
| Log employment | 0.0500*** | 0.0623*** | 0.1639*** | 0.1645*** |
| | (0.0002) | (0.0005) | (0.0005) | (0.0017) |
| Market-Year FE | Yes | Yes | Yes | Yes |
| Observations | 2,580,623 | 459,960 | 1,036,216 | 119,165 |
| Implied Elasticity ($1/\beta$) | 19.96 | 16.05 | 6.10 | 6.08 |
| Inferred within-market substitutability ($\eta_o$) | 19.96 | 16.05 | 6.10 | 6.08 |

Note: The Table reports the estimates from regressing equation (17) by OLS and IV for each occupation. Standard errors in parentheses. Source: 2002-2016, QP.

### Across-market elasticity

To estimate the across-market *reduced-form labor supply elasticity* we use municipality-level wages and employment. The specification, in this case, takes the following form:

$$\text{Log}\, w_{m,o,t} = \beta\, \text{Log}\, L_{m,o,t} + \alpha_{m,o} + e_{m,o,t}, \tag{24}$$

where $w_{m,o,t}$ is the average wage in municipality $m$, $L_{m,o,t}$ is the total employment in municipality $m$, and $\alpha_{m,o}$ are municipality fixed effects for each occupation. Because employment and wages are jointly determined in equilibrium, we use the following shift-share instrument for $L_{m,o,t}$:

$$\hat{L}_{m,o,t} = \sum_s \left( \underbrace{\frac{L_{i,m,s,o,2007}}{\sum_i L_{i,m,s,o,2007}}}_{\text{Industry-Municipality Share}} \times \underbrace{\sum_i L_{i,s,o,t}}_{\text{National Employment in Sector } s} \right). \tag{25}$$

The intuition for the instrument is similar to before, but now we exploit across-municipality variation, instead of establishment-level variation, over time that stems from national employment shocks to sectors. To explain why the instrument might be valid, we argue that multiple shifts to employment by sector, at the national level, are unrelated to local economic conditions. Hence, in this setup, the national employment trends by sector adjust the local labor demand exogenously.

In terms of results, Table C.2 shows the estimates from regression 24. We find that the elasticity is lower for managers (1.4) than for production workers (2.53). Suggesting that, according to the definition of our model, it is more costly for managers to move across markets than for production workers.

Table C.2: Across-Market Firm Substitutability Regression

| | (1) Production Workers | (2) Managers |
|---|---|---|
| Log employment | 0.433*** | 1.008*** |
| | (0.027) | (0.078) |
| Municipality FE | Yes | Yes |
| Observations | 1,946 | 1,946 |
| Implied Elasticity ($1/\beta$) | 2.31 | 0.99 |
| Inferred across-market substitutability ($\theta_o$) | 2.58 | 0.70 |

Note: The Table reports the estimates from equation (18) with IV. Confidence intervals at the 95% level. Standard errors are clustered at the municipality level. Source: 2007-2016, QP.

## C.5 Estimation of the Mass Layoff Shocks

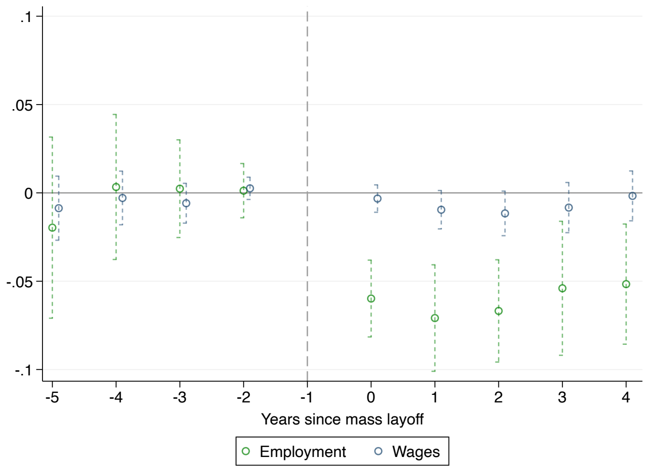
The mass layoff definition we use is a drop of 100 workers in any establishment for two consecutive years between 2004 to 2016. Moreover, we also require the establishment to account for at least one percent of the municipality's employment. We make this last requirement to consider sizable shocks within the local economy. To quantify the impact of mass-layoff shocks at the municipal level, we use an event-study specification that takes the following form:

$$y_{mt} = \xi + \sum_{k=-5}^{5} \beta_k \mathbf{1}\{k = t - g\} + \gamma_m + \gamma_t + X_{it}'\theta + \epsilon_{mt}. \tag{26}$$

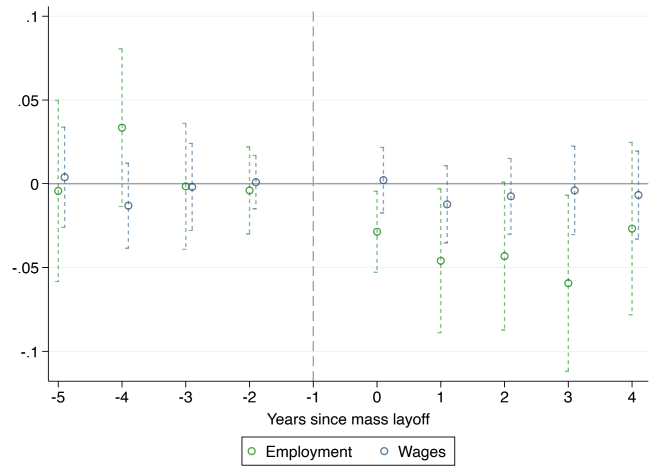
Here, the year that a mass layoff occurs in an establishment of a municipality is $g$, the years are $t$, and the event time indicators are $k$.[14] Year fixed effects ($\gamma_t$) and municipality fixed effects ($\gamma_m$) control for unobserved constant characteristics across all municipalities and within municipalities, respectively. The covariates $X_{it}$ control for baseline characteristics regarding the size and structure of the cities interacted with time to flexibly control for time-varying variables. More precisely, these variables are the log of the municipality's employment, the share of manufacturing employment, the share of highly educated workers, the share of male workers, and the share of young workers. The parameters of interest are $\beta_k$, which come from $k$ event time dummy variables. These dynamic treatment effects measure the effect on $y$ relative to an omitted period, which is when $k = -1$. We use Callaway and Sant'Anna (2021) estimator to control further for heterogenous treatment effects across cohorts and aggregate all results across cohorts for the main coefficient shown in the main text. Figure C.1a shows the dynamic pre- and post-treatment coefficient on employment and wages following a mass layoff shock. Importantly, pre-treatment coefficients are around zero, indicating that treated and control groups were on a similar path before treated municipalities were hit by a mass layoff. Overall, the most negative significant results happen on the employment margin, not on the wage margin, for both types of workers.

[14] We define the cohorts of treated municipalities from the first time, in our sample period, they had a mass layoff. Other mass layoffs may happen in the same municipality later on.

Figure C.1: Event Study Estimates by Occupation




(a) Production workers




(b) Managers

Note: These coefficients plot the estimated event study estimates using Callaway and Sant'Anna (2021) estimator. We exploit 72 events of mass layoffs across time in our sample period. We identify mass layoffs as a drop of 100 workers in a given establishment for two consecutive years. Source: QP, 2004-2016.

## C.6 Quantification of Firm Distribution