Union and Firm Labor Market Power

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Abstract

Can union and firm market power counteract each other? What are the efficiency and welfare effects of employer and union labor market power? Using data from French manufacturing firms, we leverage mass layoff shocks to competitors to identify a negative effect of employment concentration on wages. In line with the reduced form evidence and the French institutional setting, we develop and estimate a multi-sector bargaining model that incorporates employer market power. We find that in the absence of unions output decreases by 0.21 percent because they partially counteract distortions coming from oligopsony power. Furthermore, eliminating employer and union labor market power increases output by 1.6 percent and the labor share by 21 percentage points. Workers' geographic mobility is key to realizing the output gains.

JEL Codes: J2, J42, J51

Keywords: Labor markets, Wage setting, Misallocation, Monopsony, Unions

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1 Introduction

There is growing evidence, especially for the United States, linking lower wages to labor market concentration.[1] Indeed, if this concentration reflects monopsony power in the labor market, standard theory predicts that establishments *mark down* wages by paying workers less than their marginal revenue product of labor. On the other hand, if labor market institutions enable workers to organize and have a say over the wage setting process, bargaining can mitigate, or even reverse, the effect of establishments' market power on wages.

In this paper, we study the interaction between union and firm labor market power and quantify their effects on productivity and welfare in the French manufacturing sector. The French case stands out over other developed countries, especially with respect to the U.S., for having regulations that significantly empower workers over employers. We therefore provide a framework that incorporates both, employer and union labor market power. Our main result is that unions mitigate the negative efficiency effects of employer market power. We find that in the absence of unions and holding the total labor supply constant, output decreases by 0.21%. While the effect on output is small, unions have a meaningful distributional role. Without unions, the labor share would be almost 10 percentage points smaller and average wages would be 20% smaller. This translates into median welfare losses for the workers of more than 20%.

We proceed in three steps. First, we establish empirically that, within the same firm, establishments with higher local employment shares pay lower wages for the same occupations. We identify this effect by using a competitor's national mass layoff shock as an external source of variation to an establishment's local employment share. Second, in line with the previous empirical result and the French labor institutional setting, we build and estimate a model where labor market power arises from (i) employers that face upward-sloping labor supplies, and (ii) workers that bargain over wages. Third, we use the model to quantify the efficiency and welfare consequences of employers and workers' labor market power.

We start by documenting the link between employer's market power and wages. We use data on French manufacturing firms from the years 1994 to 2007. To say something about employer labor market power, we first need to specify the relevant labor markets. We define a local labor market as a combination of a commuting zone, industry, and occupation. At the establishment-occupation level, our proxy for the strength of labor market power is the employment share within the local labor market. To explore a link between concentration and labor payments, we need to overcome the endogeneity of the employment shares and the wages. We propose a novel identification strategy where we instrument employment shares with negative employment shocks—or mass layoffs—to competitors. Identification comes from residual within firm-occupation-year variation across establishments located in different local labor markets. Depending on the specification, the estimated semi-elasticity ranges from -0.16 to -0.04. That is, a 1 percentage point increase of employment share lowers the establishment wage by up to 0.16 percent.[2]

After presenting the reduced form evidence, we build a general equilibrium model that incor-

[1] See for example Benmelech, Bergman, and Kim (2018), Azar, Marinescu, Steinbaum, and Taska (2020b), Berger, Herkenhoff, and Mongey (2022), Jarosch, Sorkin, and Nimczik (2019), Benmelech et al. (2018) among others.

[2] This corresponds to a reduction of roughly 1000 euros (at 2015 prices) per year if we pass from the first to the third quartile of the employment share distribution.

porates two elements: employer and union labor market power. First, we borrow from the trade and urban economics literature (e.g. Eaton and Kortum, 2002; Ahlfeldt, Redding, Sturm, and Wolf, 2015) and assume workers have stochastic preferences to work at different places, as in Card, Cardoso, Heining, and Kline (2018). Heterogeneity of workers' tastes implies individual establishment-occupations face an upward sloping labor supply curve, which potentially gives rise to employer labor market power. In the absence of bargaining, as there is a discrete set of establishment-occupations per local labor market, employers act strategically and compete for workers in an oligopsonistic fashion. Wages are therefore paid with a markdown, which is a function of the labor supply elasticity. Similarly to Atkeson and Burstein (2008), this elasticity depends on the employment share within the local labor market. Our framework without bargaining is similar to the one in Berger, Herkenhoff, and Mongey (2022) (BHM) under Bertrand competition. The second important element of the model is collective wage bargaining. We assume wages are set at the establishment-occupation level between establishments and unions acting symmetrically. Both sides internalize how rents are generated and bargain with zero as the outside option.

This wage-setting process leads to a distortion that is reflected in a wedge between the equilibrium negotiated wage and the marginal revenue product of labor. This wedge summarizes both sides of market power as it is a combination of both, a markdown due to oligopsony power, and a markup due to wage bargaining. The model clearly captures that union and firm labor market power constitute countervailing forces. The smaller this wedge is, the larger the market power of employers relative to workers and vice-versa. Heterogeneity of the labor wedge across establishments distorts relative wages and potentially generates misallocation of resources that decrease aggregate output. Heterogeneity comes from two sources: (i) the dependence of the markdown on sector specific labor supply elasticities and employment shares; and (ii) the across sector differences in the markup due to the different bargaining powers. Our model nests as special cases both, a full bargaining setting or a model with oligopsonistic competition only.

The framework features a large number of different establishment-occupation wages plus the product prices. We show that the model is block recursive and how to solve for the general equilibrium in two steps. We solve first for the employment shares within each local labor market ignoring aggreegates. Second, we show how to build sector level fundamentals and solve for aggregate prices. This two-step procedure eases the solution because the model can be rewritten at the sector level.[3] We provide an analytical characterization of the equilibrium at the sector level and along the way prove the existence and uniqueness of the equilibrium.

After the model set-up, we discuss how to identify and estimate the model parameters. We have two types of parameters: the ones related to the labor supply and bargaining, and the ones related to production. Regarding the labor supply, we assume that workers face a sequential decision: in a first stage, they observe their preferences for different local labor markets and choose the one that maximizes their expected utility; in a second stage, they observe their preferences to work for different employers and choose the establishment. Therefore, these labor supplies depend on two key parameters related to the heterogeneity of workers' preferences. These parameters are the *local* and *across-market* elasticities of substitution. The local elasticity measures how strongly workers substi-

[3]The intuition behind this is that after solving for the employment shares while ignoring sector and economy-wide constants, we can fully characterize the allocation of labor and capital *within* each sector. This fact, combined with the information about the establishment-level fundamentals, allows us to aggregate the model at the sector level with corresponding sector-level fundamentals.

tute across establishments within a local labor market, while the across-market elasticity measures how strongly workers substitute across local labor markets in the economy. These two elasticities jointly determine the magnitude of employers' labor market power.

The main challenge is to separately identify the union bargaining powers from the local and across-market elasticities of substitution. We propose a strategy to estimate the elasticities of substitution that is independent from the underlying wage setting process. Therefore, our identification strategy is readily applicable to set-ups with or without bargaining.

We first estimate the across-market elasticity of substitution. We use the insight that this is the only relevant elasticity for the establishments that are alone in their local labor markets, which we refer to as full monopsonists. Their local labor market equilibrium boils down to a standard system representing the labor supply and demand equations. Ordinary least squares estimates present the traditional problem of other price-quantity systems as the estimated elasticities are biased towards zero. Rather than instrumenting to get exogenous variation in the labor supply and demand, we identify the across local labor market elasticities and the inverse labor demand elasticity adapting the identification through heteroskedasticity of Rigobon (2003). This identification strategy allows to recover the structural parameters by assuming heteroskedasticity across sub-samples. We adapt the method by imposing the heteroskedasticity restriction on the variance-covariance of structural shocks across occupations.[4]

In the second step of our estimation strategy, we estimate the local elasticities of substitution using within-market variation in wages and employment levels. To instrument for wages, we rely on firm-level revenue productivities. Even when strategic interactions are present, our approach avoids violating the stable unit of treatment value assumption (SUTVA) that leads to biased estimates as highlighted by Berger, Herkenhoff, and Mongey (2022). BHM show that *within-establishment, across-time* variation cannot identify the labor supply elasticity because non-atomistic establishments' strategic interactions can affect the overall equilibrium, resulting in a SUTVA violation. Instead, we condition on an equilibrium allocation and use *across-establishment, within-market* variation to identify the local elasticity of substitution, which is related to the labor supply elasticity. We expand on BHM's argument in three ways. First, we clarify the general relationship between the elasticity of substitution and the labor supply elasticity and explain the scenarios where they are equivalent. Second, we generally establish the bias between the labor supply elasticity and a reduced form estimate. Third, we show that within equilibrium variation can identify the local elasticity of substitution. After estimating both elasticities of substitution, we estimate the bargaining powers to match the sector labor shares.

Even when our model has some elements like bargaining and oligopsony that depart from more traditional environments in the trade and urban literature, we show that the general equilibrium counterfactual can be computed using only observed wages and employment levels in the data. We do that by writing the model in terms of relative changes with respect to the current equilibrium. This approach, borrowed from the trade literature, allows us to solve for changes of equilibrium

[4] To see the notion behind Identification through Heteroskedasticity, consider the following system: $y = \alpha x + u$ and $x = \beta y + v$, with $var(\epsilon) \equiv \sigma_\epsilon$ and $cov(u, v) = 0$. The system is under-identified as the covariance matrix of (x, y) (which can be directly estimated) yields three moments (σ_x, σ_y and $cov(x, y)$) while we have to solve for four unknowns: $(\alpha, \beta, \sigma_u, \sigma_v)$. Suppose we can split the data into two sub-samples with the same parameters (α, β) but different variances. Now the two sub-samples give us 3+3=6 data moments with only six unknowns: the two parameters (α, β) and the four variances of structural errors.

variables relative to a baseline scenario.[5] We are able to do that because the observed wages and employment levels are sufficient statistics of the fundamentals of the model, in this case the establishments' productivities and amenities.

We quantify the efficiency losses of employers' and workers' labor market power by removing those distortions in a counterfactual economy while keeping workers' preferences fixed. This is a counterfactual scenario where employers are competitive and workers have no bargaining power leading to wages that are equal to the marginal revenue product of labor. We find that output increases by 1.6 percent while the labor share rises by 21 percentage points. This increased labor share goes together with wage gains that in turn translate into 42 percent median expected welfare gains for workers. Removing the heterogeneity of wedges improves the allocation of labor by increasing the employment of more productive establishments. The counterfactual gains in the labor share suggest that employer labor market power is stronger than that of the unions. This is a consequence of the estimated low elasticities of substitution that are in the range but a bit lower than the estimates of Berger, Herkenhoff, and Mongey (2022) for the U.S. Interestingly, we find that removing the bargaining would slightly reduce output compared to the baseline. Thus, given the presence of employers' labor market power, unions seem to have no negative efficiency effects but rather they help to counteract distortions coming from oligopsony power.

Additionally, we find that geographic mobility is the key margin of adjustment to achieve the baseline counterfactual productivity gains, rather than within local labor market or within sector mobility. The intuition behind this is that there are a handful of concentrated and productive firms in rural areas and removing labor market power increases their wage and employment more relative to urban areas. We find that labor market distortions account for 13 percentage points—about a third—of the urban/rural wage gap. Consequently, in the counterfactual with no distortions, the total employment decreases in urban areas relative to the baseline, which changes the geographical composition of manufacturing employment in France.

Finally, we incorporate two extensions to the model. First, we introduce an endogenous labor force participation decision by assuming that workers may voluntarily stay out of the labor force. Output gains after removing all distortions in this case are slightly higher than in the baseline because wage gains increase the labor force participation. Second, we allow for agglomeration forces within the local labor market that also improve the output gains from the baseline counterfactual.

Literature. This paper speaks to several strands of the literature. First, and most closely related, is the literature on employer labor market power. Several empirical papers have documented the importance of labor market concentration on wages, employment and vacancies.[6] The concentration relates critically to the definition of a *local* labor market which most of the papers consider as rigid entities based on combinations of location-industry or location-geography identifiers.[7] Most empirical papers focus on aggregate measures of concentration, as the Herfindahl-Hirschman In-

[5] Costinot and Rodríguez-Clare (2014) refer to this method as "exact hat algebra". They use this approach to compute welfare effects of trade liberalizations using easily accessible macroeconomic data.

[6] Among them there are the papers by Azar, Marinescu, and Steinbaum (2020a); Benmelech et al. (2018); Azar et al. (2020b); Schubert, Stansbury, and Taska (2020); Dodini, Lovenheim, Salvanes, and Willén (2020); Marinescu, Ouss, and Pape (2021)

[7] There have been some advances in considering flexible local labor markets either based on labor flows (Nimczik, 2018), commuting patterns (Manning and Petrongolo, 2017), skill composition (Macaluso, 2017; Dodini et al., 2020), or broadly on workers' outside options (Schubert et al., 2020) inferred from labor flows. We take a more traditional approach and define them based on location-industry-occupation identifiers.

dex, as a proxy for employers labor market power. Our contribution to this empirical literature is to focus on market power at the establishment level and propose a novel identification strategy using exogenous variation from *competitors' mass layoff shocks*.

This paper also contributes to structural work on employer labor market power. We depart from the traditional monopsony power framework (e.g. Manning, 2011; Card et al., 2018) and recent papers with monopsony power by having heterogeneous markdowns arising from market structure and by extending it to allow for wage bargaining.[8] The paper is complementary to Jarosch et al. (2019) in the sense that they consider employer labor market power in a search framework. Recently Jäger, Roth, Roussille, and Schoefer (2022) show that workers do not hold correct beliefs about their outside options which allows firms to mark down wages if there are search costs that are sufficiently high. Bachmann, Bayer, Stüber, and Wellschmied (2022), MacKenzie (2021) and Trottner (2022) have focused on misallocation effects of monopsony power. We contribute to this literature by including unions and studying their counterbalancing effect to the labor market power of firms.

In recent important work, Berger et al. (2022) build a structural model with oligopsonistic competition in local labor markets. We share the objective of measuring the efficiency effects of labor market distortions and reach similar quantitative conclusions when taking together union and firm labor market power, but our contribution differs from theirs in several dimensions: (i) our framework nests theirs as an special case without bargaining; (ii) we incorporate occupations and use them for the identification of the structural parameters; (iii) we allow for differences in structural parameters across industries. In particular, we allow for different local elasticities of substitution and bargaining powers across industries. Importantly, this adds heterogeneity to the labor wedges and employment misallocation; (iv) we show that counterfactuals can be computed without the need to back out underlying productivities and we perform the counterfactuals using actual establishment data.

We also contribute to the literature studying the role of unions. Some papers have focused on the impact of unions on reducing wage inequality (DiNardo, Fortin, and Lemieux, 1995; Farber, Herbst, Kuziemko, and Naidu, 2021). On the contrary, evidence using quasi-experimental variation has found insignificant effects of unionization on wages (Freeman and Kleiner, 1990; Lee and Mas, 2012; Frandsen, 2021). Our paper is related to Lagos (2020) that studies worker amenity and wage compensation under bargaining in Brazil and how they depart from monopsony compensation. We contribute to that paper in studying aggregate effects of firm and union labor market power. There is growing empirical evidence of the ability of unions on weakening the effects of labor market concentration. Marinescu et al. (2021) find negative effects of local labor market concentration on wages for new hires in France that are mitigated in more unionized industries. Similar findings have been reported by Benmelech et al. (2018) in the U.S. and Dodini, Salvanes, and Willén (2021) in Norway. These findings are in line with our structural model and we find that allowing for collective bargaining is key to matching certain empirical regularities. We furthermore provide a framework to rationalize those findings and evaluate aggregate implications.

The paper relates to the literature on imperfect competition in general. Our approach is similar to Edmond, Midrigan, and Xu (2021) and Morlacco (2018) in trying to quantify the effect of

[8]Recent papers studying the effects of monopsony power include Lamadon, Mogstad, and Setzler (2022), Deb, Eeckhout, Patel, Warren et al. (2022b), Deb, Eeckhout, Patel, and Warren (2022a), Amodio and De Roux (2021), Amodio, Medina, and Morlacco (2022), Datta (2021) and Felix (2021) among others.

heterogeneous market power on aggregate output. They study output and intermediate input market powers respectively while we focus on the effects of labor market power. Recently Hershbein, Macaluso, and Yeh (2020) and Wong (2019) disentangle output and labor market power using, respectively, a production function approach for the U.S. and France. They both find the presence of employer labor market power even when controlling for production function heterogeneity and output market power.

Contrary to the evidence on output market power, other studies suggest that employer labor market power is not the driver behind the decreasing trends of the U.S. labor share (e.g. Lipsius, 2018; Berger et al., 2022) with the exception of Hershbein et al. (2020).[9] The focus of this paper is not on labor share trends but on the effects of employer and union labor market power in a given cross section of firms, markets and industries.

We estimate local and across-market elasticities of substitution, which bound the elasticity of the labor supply.[10] Therefore, our paper contributes to micro estimates of firm labor supply elasticities. Staiger, Spetz, and Phibbs (2010), Falch (2010), Berger et al. (2022) and Datta (2021) use quasi-experimental variation on wages to estimate the firm labor supply elasticities that go from 0.1 (Staiger et al., 2010) to 10.8 (Berger et al., 2022).[11] Both our local and across market elasticities of substitution lie in that range. Dube, Jacobs, Naidu, and Suri (2020) and Datta (2021) estimate a labor supply elasticity to firm level wage policies that is between 3 and 5, which is close to our local elasticity of substitution. Azar, Berry, and Marinescu (2022) estimate market elasticities of 0.5 and firm elasticities of 5 which are very close to our estimated elasticities of subsitution. Finally, the median estimate in the meta-analysis of Sokolova and Sorensen (2021) and the estimates in Webber (2015) are near 1 and therefore close to our across-market elasticity of substitution.

The rest of the paper is organized as follows. Section 2 introduces the data. Section 3 shows the stylized facts and our empirical strategy. Section 4 presents the model. Section 5 discusses details about identification and estimation of the model. Section 6 shows the results from counterfactual exercises. Section 7 presents extensions of the model and Section 8 concludes.

2 Data

Most of our analysis relies on *FICUS* for the years 1994-2007 with firm-level fiscal records consisting of balance sheet information including wage bill, capital stock, number of employees and value added. A break in the industry classification series prevents us from extending the time span of the sample.[12] This dataset includes all French firms except for the smallest ones declaring at the micro-BIC regime and some agricultural firms. We also use *CASD Postes*, an employer-employee dataset with the universe of salaried employees with firm and establishment identifiers. We recover the location, occupation classification, wages and employment that are necessary to distinguish

[9] Karabarbounis and Neiman (2013) documented the falling trend of the labor share and Barkai (2020) and Gutiérrez and Philippon (2016) the rising trend of the profit share for different countries. Output market power has been pointed out as an explanation for the decline of the labor share (e.g. De Loecker, Eeckhout, and Unger, 2020; De Loecker and Eeckhout, 2021).

[10] In particular, the local elasticity of substitution bounds from above the supply elasticity while the across-market elasticity bounds it from below.

[11] Berger et al. (2022) estimate elasticities of substitution. Here we report their local elasticity of substitution which is an upper bound for the labor supply elasticity.

[12] Before 1994 the wage data was imputed and after 2007 the industry classification (APE) is not consistent with previous versions. On the contrary, the classification change between the 1993 and 2003 codes is consistent at the 3-digit level.

Table 1: Establishment-Occupation Summary Statistics

	Mean	Pctl(25)	Median	Pctl(75)	St. Dev.
All sample					
L_{iot}	11.1	1.1	2.3	6.2	59.5
$w_{iot}L_{iot}$	367.2	31.6	71.8	196.6	2,379.5
w_{iot}	34.0	20.9	27.4	39.5	117.1
$s_{io\|m}$	0.20	0.01	0.05	0.24	0.30
(a) Monolocation					
L_{iot}	7.4	1.0	2.1	5.1	29.7
$w_{iot}L_{iot}$	216.7	29.7	64.5	159.6	925.2
w_{iot}	32.8	20.3	26.6	38.5	35.5
$s_{io\|m}$	0.18	0.01	0.04	0.19	0.29
(b) Multilocation					
L_{iot}	26.6	1.3	4.1	15.1	120.3
$w_{iot}L_{iot}$	1,004.7	45.7	139.3	533.0	5,052.4
w_{iot}	39.0	23.6	30.7	43.7	257.7
$s_{io\|m}$	0.29	0.02	0.11	0.48	0.35

Notes: The top panel shows summary statistics for the whole sample. Panels (a) and (b) present respectively summary statistics of monolocation and multilocation firm-occupations. Number of observations for All Sample is 4,151,892. For the Monolocation sample is 3,359,236; and for the Multilocation sample is 792,656. L_{iot} is full time equivalent employment at the establishment-occupation *io*, $w_{iot}L_{iot}$ is the wage bill, w_{iot} is establishment-occupation wage or wage per FTE, $s_{io|m}$ is the employment share out of the local labor market. All the nominal variables are in thousands of constant 2015 euros.

across different establishment-occupations of a given firm. Additionally we use data relating the city codes to commuting zones and Consumer Price Index data to deflate nominal variables.[13]

We define four broad categories of occupations: top management, supervisor, clerical and operational.[14] We define a local labor market as the intersection between commuting zone, 3-digit industry and occupation. There are 57,900 local labor markets per year on average.[15]

Our sample consists of approximately 4 million establishment-occupation-year observations that belong to around 1.25 million firms. Details about sample selection are in Online Appendix G.2.

2.1 Summary statistics

Table 1 presents the final sample establishment-occupation level summary statistics. The median occupation at a given establishment has 2 employees and pays 27,439 euros per worker. Certain firms have the same occupation in different locations, which we denote as multilocation occupations. The micro evidence in the next section focuses on multilocation firm-occupations.[16] Panels (a) and (b) of Table 1 have the summary statistics of occupations belonging to monolocation and multilocation firms. The majority of observations, roughly 80%, belong to monolocation firm-occupations. Occupations in firms with establishments at multiple locations are larger on average with 27 employees versus 7 for occupation-firms at a single location. In both groups, the distribution of employment is concentrated in few large employers, as both medians are smaller than the means. Firms with multilocation occupations pay wages per capita that are 15% higher than the monolocation ones.

[13]The sources are `https://www.insee.fr/fr/information/2114596` and `https://www.insee.fr/fr/statistiques/serie/001643154` respectively.

[14]The classification is very similar to the one in Caliendo, Monte, and Rossi-Hansberg (2015). We group together their first two categories (firm owners receiving a wage and top management positions) into top management because the distinction between the two was not stable in 2002.

[15]We use interchangeably 3-digit industry or sub-industry throughout the text.

[16]The multilocation definition is occupation specific. A firm can have both monolocation and multilocation occupations.

Manufacturing firms can be classified within 97 different 3-digit industries or sub-industries that are present in 364 different commuting zones. We denote the 3-digit industries as h and the commuting zones as n. The average 3-digit industry labor share is 52% and the share of capital is 26%.[17] Taking those averages, the profit share would be around 22%. We refer to the interested reader to consult the tables on Online Appendix H, which present summary statistics on the commuting zones, local labor markets and sub-industries.

We define a local labor market based on location, industry and occupation combinations. Incorporating other elements than the geography is guided by the observed transition rates in the data where, conditional on changing one of the dimensions, occupational transitions are the most common, followed by changes in industry. Following those transition rates, the local labor market, denoted by m, is a combination of commuting zone n, 3-digit industry h and occupation o. We take the standard approach of defining local labor markets based on these administrative classifications.[18]

The median local labor market is small and has only 2 establishments and 10 employees. This is a consequence of the handful of manufacturing firms that are present in the countryside demanding certain occupations. Blue collar workers working in the food industry in Lourdes, close to the Pyrenees, are one example of a local labor market. The median local labor market is concentrated with a Herfindahl-Hirschman Index (HHI henceforth) of 0.68.[19] High median local labor market concentrations do not imply that most of the workers are in highly concentrated environments but rather that there are few local labor markets with low concentration levels and high employment.

3 Empirical evidence

This section provides suggestive evidence of employer labor market power in France and presents the French institutional setting. We start by presenting evidence of a negative relation between employers' local labor market power, proxied by their employment share, and wages. We later explain the institutional framework of the French labor market and the importance of wage bargaining.

3.1 Labor market power and wages

This section explores the relationship between employer labor market power and wages at the establishment level. The challenge is finding a source of exogenous variation for our proxy of local labor market power, the employment share $s_{io|m}$, that will allow to estimate the effect of employer market power on wages. In what follows, we focus on multilocation occupations where the effects are estimated using residual variation across local labor markets within a firm-occupation-year.[20]

The baseline specification is:

$$\log(w_{io,t}) = \beta\, s_{io|m,t} + \psi_{\mathbf{J}(i),o,t} + \delta_{\mathbf{N}(i),t} + \epsilon_{io,t}\,, \tag{1}$$

[17]We follow Barkai (2020) to compute the capital share.

[18]We abstract from defining flexible local labor markets as in Nimczik (2018) for Austria, or how easy it is to change to similar occupations, as considered by Macaluso (2017) or by Schubert et al. (2020) using rich mobility data coming from resumes in the U.S.

[19]The HHI of local labor market m ranges from the inverse of the number of competitors ($1/N_m$), if all the establishments have the same shares, to 1. A local labor market can have a HHI of almost one if one establishment has virtually all the employment. The median HHI is very similar (0.69) if we consider wage bill shares $s^{w}_{io|m}$ instead of employment shares $s_{io|m}$.

[20]Recall that a multilocation occupation of a firm is an occupation that is present in several establishments across the geography.

where $\log(w_{io,t})$ is the log average wage at plant i of firm j and occupation o at local labor market m in year t, $s_{io|m,t}$ is the employment share of the plant out of the market m, $\psi_{\mathbf{J}(i),o,t}$ is a firm-occupation-year fixed effect, $\delta_{\mathbf{N}(i),t}$ is a commuting zone-year fixed effect and $\epsilon_{io,t}$ is an error term. Our parameter of interest is β.

The specification controls for sector labor demand differences with firm-occupation-year fixed effects $\psi_{\mathbf{J}(i),o,t}$. These include, for example, differences in the usage of capital for a given sector or a firm. Occupation labor demand shocks that are firm specific are also captured by the fixed effects $\psi_{\mathbf{J}(i),o,t}$. Lastly, the commuting zone times year fixed effects $\delta_{\mathbf{N}(i),t}$ control for permanent differences across locations and also for potential geographical spillovers of mass layoff shocks as stressed by Gathmann, Helm, and Schönberg (2017).

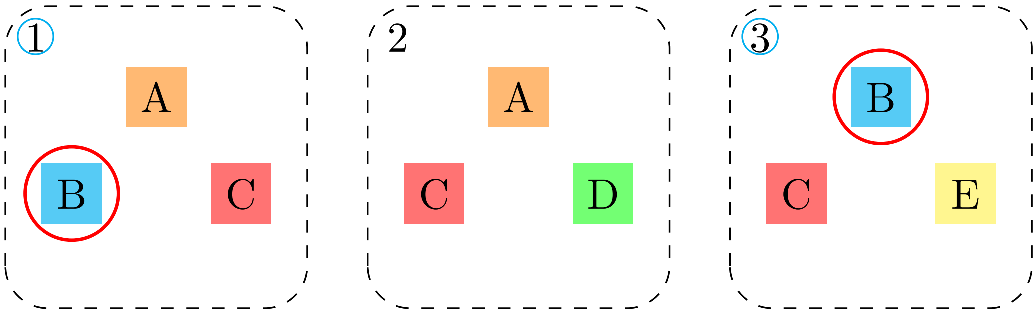
The establishment's employment share, $s_{io|m,t}$, is likely to be endogenous to the wages. On the one hand, everything else equal, higher wages attract more workers and therefore increase the employment share. On the other hand, if there is labor market power on the employer side, we expect two establishments with the same fundamentals to pay differently depending on their local labor market power. That is, everything else equal, we expect a plant with higher employment share to pay relatively less than the one in a more competitive local labor market. Given these endogeneity issues, we propose a novel identification strategy based on mass layoff shocks to competitors.

Our approach uses idiosyncratic shocks to a given firm and instruments the employment shares by using quasi-experimental variation coming from mass layoffs of competitors. We want to have an instrument that induces variation on an establishment's employment dominance in a local labor market that is unrelated to its idiosyncratic characteristics, which an exogenous shock to an establishment's competitor should satisfy. The instrument is built by the presence of a firm having a *national* mass layoff in the same local labor market as non affected establishments. We expect that a national level shock to a competitor is exogenous to the residual within firm-occupation variation across local labor markets that identifies the effect. The main specification is an instrumental variable regression where we compare establishment-occupations of firms that had exogenous increases in concentration due to the competitors' shock against establishment-occupations that were not exposed to the competitors' shock. Online Appendix I.1 discusses the intuition of the instrument within the context of our structural model in a simplified scenario with two establishments.

Figure 1 illustrates how the mass-layoff instrument is implemented. We show an economy with three local labor markets and five firms from A to E. We abstract from different occupations for simplicity. The sample we use in the regression analysis excludes firms that only have establishments in a single local labor market. So in the example portrayed in Figure 1, we would exclude firms D and E from the sample.

In the example, firm B suffers an idiosyncratic shock that leads to a *national* mass layoff (employment decreases in all the local labor markets where it is present) which would change the labor market power of its competitors' establishments in those markets where firm B has an establishment. These are markets 1 and 3. More precisely, the presence of firm B's establishments in the different markets would indicate the "treatment" status of its competitors establishments. Thus, firm A's establishment in market 1 would have an exogenous increase in the local employment share but not firm A's establishment in market 2. The underlying identification assumption is that the national mass layoff shock to firm A is independent of its competitors establishments' locations.

Figure 1: Mass Layoff Instrument



Notes: This figure illustrates how we construct the instrument. Firm B suffers a *national* mass layof shock which reduces employment in all the local labor markets where it is present. This idiosyncratic shock changes the labor market power of non-affected establishments in markets 1 and 3.

As we use a firm fixed effect, our regression would compare the outcomes between firm A's establishments across markets. In other words, we use within-firm, across-establishments variation to identify the reduced-form effect. We restrict our sample to multi-location firms that did not suffer a mass layoff shock and have establishments in local labor markets affected by a mass layoff shock to a competitor (markets 1 and 3) and establishments in non-affected local labor markets (market 2). In the example of Figure 1, our sample would be the establishments of firms A and C.

To construct our instrument in the data, we first need to identify the firms suffering a mass layoff.[21] We classify a firm-occupation as having a mass layoff if the establishment-occupation employment at t is less than a threshold κ% of the employment last year for all the firm establishments. Ideally, we would like to identify firms that went bankrupt ($\kappa = 0$). Unfortunately, we cannot externally identify if a firm disappears because it went bankrupt or changes firm identifiers keeping the number of competitors at the local market constant.

The choice of κ presents a trade-off as a lower threshold leads to considering stronger negative shocks and the generated instrument will more likely capture purely idiosyncratic firm shocks. But at the same time, a lower threshold reduces the number of events considered potentially leading to a higher variance of the estimates. This creates a bias-variance trade-off in the selection of the threshold. Lacking a clear candidate for κ, we try different cut-off values.[22]

We present the OLS and IV point estimates and their 95% confidence intervals in Figure 2.[23] As the employment share is endogenous, the OLS estimates are biased towards zero. On the contrary, the IV estimates are negative and statistically significant, regardless of the choice of the cutoff κ. Moreover, the figure shows clearly the trade-off in the selection of κ. The lower the threshold, the stronger the impact but the higher the variance of the estimated effect. We estimate a semi-elasticity of -0.14 with $\kappa = 20\%$ (i.e. an 80% employment loss). This estimate implies that one p.p. increase in the employment share causes a 0.14% decrease of the establishment wage. This translates into a wage loss of roughly 900 euros per year when passing from the first to the third quartile of employment shares.[24] For the more standard threshold of $\kappa = 70\%$ (a 30% employment

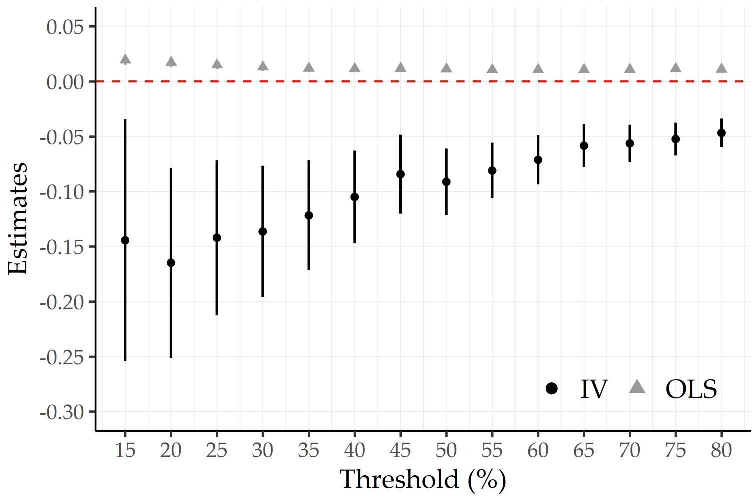
[21] We give more details on the construction of the instrument in Online Appendix I.1.

[22] A standard value in the literature is κ =70% (e.g. Hellerstein, Kutzbach, and Neumark, 2019; Dodini et al., 2020). That is a 30% employment loss.

[23] We are restricting to firm-occupations classified as not having a mass layoff. The regression sample therefore changes depending on κ which is why the OLS estimates change slightly with κ.

[24] This computation is done taking the employment share differences between the percentile 75 and 25 from Table 1 for the median wage. The analogous computation with the average wage gives a wage reduction of roughly 1100 euros.

Figure 2: Impact of Employment Share on Wages



Notes: This figure presents the point estimates and 95% confidence bands of the OLS and IV exercises on the y-axis. The x-axis presents different thresholds κ that define a mass layoff shock. The instrument is the presence of a firm with a mass layoff shock in the local labor market. We focus on non-affected competitors (not suffering a mass layoff shock). Equation (1) shows the specification.

reduction) the estimate is halved to -0.06. As we increase the threshold κ the estimated coefficient converges to the OLS estimate and the variance is reduced. In Online Appendix I.1.2 we perform several robustness checks by changing the instrument, the fixed effects and the definition of local labor market. We find that our main result—that the wages are negatively related to employment shares—is robust to these different specifications.

The empirical evidence up to now focused on establishing the presence of employer labor market power of French manufacturing firms. We find that firms pay lower wages in local labor markets where they have relatively higher labor market power. We now explain the institutional setting and the importance of unions in France.

3.2 Unions

The institutional framework of the French labor market is characterized by legal requirements that give unions an important role even in medium sized firms. The French labor market is known to be one where unions are relevant players, despite the fact that trade union affiliation in France is among the lowest of all the OECD countries.[25] According to administrative data, the unionization rate in France was 9% in 2014, which is slightly below the one in the U.S. (10.7%) and well below the ones in Germany (17.7%) or Norway (49.7%).[26]

Low affiliation rates do not translate into low collective bargaining coverage for the French case. Collective bargaining agreements extend almost automatically to all the workers, unionized or not. That is, if an agreement is reached in a particular sector, all the workers within the sector are covered. Table 2 presents the unionization and collective bargaining coverage rates for several countries. This institutional framework implies that coverage of collective agreements was in 2014 as high as 98.5% in France despite the low union affiliation rates.[27] This is in stark contrast to the

[25] Article in The Economist 'Why French unions are so strong'.
[26] Source: OECD data https://stats.oecd.org/Index.aspx?DataSetCode=TUD. Unionization rate is also denoted as union density.
[27] The data source of collective bargaining agreements is the OECD as for unionization rates.

Table 2: Union Density and Collective Bargaining Coverage

Country	Union Density	Coverage	Country	Union Density	Coverage
Western Europe			**Southern Europe**		
Austria	27.7	98.0	Italy	36.4	80.0
France	9.0	98.5	Spain	16.8	80.2
Germany	17.7	57.8	**Americas**		
Netherlands	18.1	85.9	Canada	29.3	30.4
Switzerland	16.1	49.2	Chile	15.3	19.3
Northern Europe			United States	10.7	12.3
Finland	67.6	89.3	**Asia & Oceania**		
Ireland	26.3	33.5	Australia	15.1	59.9
Norway	49.7	67.0	Japan	17.5	16.9
United Kingdom	25.0	27.5	Korea	10.0	11.9

Notes: Year 2014. All the variables are in percents. *Union Density* is the unionization rate which is unionized workers relative to total employment. *Coverage* is the collective agreement coverage; the ratio of employees covered by collective agreements divided by all wage earners with the right to bargain. The data comes from the OECD and the sources are administrative data except for Australia, Ireland and the United States which are based on survey data. The regions are defined according to the United Nations M49 area codes.

U.S. collective bargaining agreements that only apply to union members and therefore coverage is very similar to the unionization rate.

Collective bargaining can happen at different levels. Firms and unions can negotiate at some aggregate level (e.g. industry, occupation, region) and also at economic units such as the group, firm or plant.[28] When wage bargaining happens at the firm level it affects all the workers. Most firms that explicitly bargain over wages do so at the firm level (rather than at the plant or occupation level). In 2010, 92% of mono-establishment firms that had a specific collective bargaining agreement negotiated it at the firm level. Of the multi-establishment firms with specific agreements, 45% negotiated at least partially at the establishment level (Naouas and Romans, 2014).[29]

Legal requirements regarding union representation depend on firm or plant size. The first requirements start when the establishment reaches 10 employees and there is an important tightening of duties when reaching the threshold of 50 employees.[30] As a consequence, firm level wage bargaining is common even at relatively small establishments. In fact, 52% (51%) of establishments with at least 20 employees bargained over wages in 2010 (in 2004) (See Table 1 of Naouas and Romans, 2014).[31]

Theoretically, workers organize into unions to extract rents from the firm through bargaining. Bargaining can happen at different levels in France and here we want to inform the modeling decisions in the next section by quantifying bargaining differences depending on industries or occupations. We build a proxy of rents at the firm level and then compare how the correlation of wages with rents is differentiated depending on the industries and occupations. In particular we compute rents at the firm level $y_{\mathbf{J}(i),t}$ by computing value added minus capital expenditures per worker. The reduced form model is the following:

$$\ln w_{io,t} = \gamma_k \ln y_{\mathbf{J}(i),t} + \epsilon_{io,t},$$

[28]Several collective agreements can coexist at a given establishment.

[29]Source https://dares.travail-emploi.gouv.fr/dares-etudes-et-statistiques/etudes-et-syntheses/dares-analyses-dares-indicateurs-dares-resultats/article/la-negociation-salariale-d-entreprise-de-2004-a-2010, page 7.

[30]The Appendix of Caliendo et al. (2015) provides a comprehensive summary of size related legal requirements in France.

[31]The prevalence of wage bargaining was 44% for establishments with 11 employees or more.

where γ_k is the elasticity of wages with respect to rents and k denotes either 2-digit sector b or occupation o, $y_{\mathbf{J}(i),t}$ is the proxy of rents at the firm level and $\epsilon_{io,t}$ is the error term.

Results in Online Appendix I.3 show that the elasticities at the sector level range from 0.14 for *Metallurgy* to 0.4 for *Food*. On the contrary, when running the same regressions per occupation the elasticities range from 0.27 for *Supervisor* to 0.38 for *Top management*. Given the higher dispersion of the elasticities at the sector level, we will assume differentiated bargaining powers depending on the sector later on in the model.

Having established the existence of employer labor market power and the importance of unions, the next section lays out a model in line with the stylized facts and the French labor market institutions.

4 Model

The economy consists of discrete sets of establishments $\mathcal{I} = \{1, ..., I\}$, locations $\mathcal{N} = \{1, ..., N\}$ and sectors $\mathcal{B} = \{1, ..., B\}$. Each establishment can have several occupations $o \in \mathcal{O} = \{1, ..., O\}$. Each establishment i is located in a specific location n and belongs to sub-industry h in a particular sector b. We define a local labor market m as the combination between location n, 3-digit industry h and occupation o, i.e. m will be combinations of $n \times h \times o$.

We denote the set of establishments that are in local labor market m as $\mathcal{I}_m$ with cardinality N_m. We define the set of all local labor markets as $\mathcal{M}$ and the set of all markets within sector b (within sub-industry h) as $\mathcal{M}_b$ ($\mathcal{M}_h$).[32] The distribution of establishments across local labor markets is determined exogenously. Every establishment can belong only to one location and one sub-sector but can have several occupations and therefore belong to different local labor markets. We define the set of local labor markets that have at least one establishment of sector b as $\mathcal{N}_b$.

The economy is populated by an exogenous measure L of workers who are homogeneous in ability but heterogeneous in tastes for different workplaces. They decide their workplace (establishment-occupation) in two steps without any restriction on mobility. First, workers choose in which local labor market m they would like to be employed, and second, they choose in which establishment i of that local labor market they will work. Workers do not save so they do not own any capital.

Capital and output markets are competitive. Establishments are owned by absent entrepreneurs who rent the capital and collect the profits. We assume the economy is a small open economy and capital is specific for each sector. Thus, the sector specific rental rates of capital R_b are exogenous.

Firms and workers bargain over wages at the establishment-occupation io level. The equilibrium bargained wage is the solution to a reduced form Nash bargaining problem where establishments and unions are symmetric. Both have zero threat points and internalize how the marginal cost changes when moving along the labor supply curve. The assumption of null outside options for workers is in line with new evidence of insensitivity of wages to outside options such as the value of nonemployment (Jäger, Schoefer, Young, and Zweimüller, 2020).[33]

Having a discrete set of establishments per local labor market means that when bargaining, both parties internalize the effect of their wages on the labor supply of their most immediate competitors.

[32] More formally this means $\mathcal{M} = \bigcup_{b \in \mathcal{B}} \mathcal{M}_b$ and $\mathcal{M}_b = \bigcup_{h \in b} \mathcal{M}_h$.

[33] We show in the Appendix that the same equilibrium wages arise with a different bargaining protocol where employer labor market power is incorporated through workers' outside options.

This reflects the idea that competition for labor is mostly local. Geography in our model is only important to define local labor markets.

In the following we first set up the production side of the economy and workers' labor supply decisions. Second we present equilibrium wages in the oligopsonistic competition case (in the absence of bargaining) and finally we incorporate bargaining into the model.

Production

The final good Y is produced by a representative firm with an aggregate Cobb-Douglas production function using as inputs a composite good Y_b for each sector b:

$$Y = \prod_{b \in \mathcal{B}} Y_b^{\theta_b}, \tag{2}$$

where θ_b is the elasticity of the intermediate good produced by firms in sector b and $\sum_b \theta_b = 1$. Profit maximization implies that the representative firm spends a fixed proportion θ_b on the sector composite Y_b:

$$P_b Y_b = \theta_b P Y. \tag{3}$$

The final good price, which we choose as the numeraire, is equal to:

$$P = 1 = \prod_{b \in \mathcal{B}} \left(\frac{P_b}{\theta_b} \right)^{\theta_b}.$$

Firms produce in a perfectly competitive goods market. P_b is the price of the homogeneous good produced by every firm in sector b, Y_b is their production and P is the price of the final good. Y_b is the aggregate of output of all the firms in that sector:

$$Y_b = \sum_{i \in \mathcal{I}_b} y_i, \tag{4}$$

where $\mathcal{I}_b$ is the set of establishments that belong to sector b. The establishment production function y_i is an aggregate of occupation productions. Establishment i produces using occupation o specific inputs, labor L_{io} and capital K_{io}, with a decreasing returns to scale technology. Output elasticity with respect to labor β_b and capital α_b are sector specific and establishment-occupations are heterogeneous in their total factor productivity. We assume that occupations are perfect substitutes and their output is aggregated linearly. That is, total establishment output y_i is the sum of occupation specific outputs y_{io}. Decreasing returns to scale in the occupation output y_{io} generate an incentive to produce using several occupations.

Establishment i's output, y_i, is defined as:

$$y_i = \sum_{o=1}^{O} y_{io} = \sum_{o=1}^{O} \widetilde{A}_{io} K_{io}^{\alpha_b} L_{io}^{\beta_b}. \tag{5}$$

The choice of this particular production function is motivated by tractability and empirical reasons. The linearity of the aggregation within establishments allows for the separability of different local labor markets which has an important computational advantage as it allows us to solve each labor market independently. The second reason is data motivated. With our specification, the absence of a particular occupation in an establishment can be rationalized by having null productivity in that particular occupation. An alternative specification, where labor is a Cobb-Douglas composite of occupations, is at odds with the pervasive prevalence of missing at least one occupation category. The median establishment lacks at least one occupation. Lacking a particular occupation, those establishments would not be able to produce if labor is a Cobb-Douglas composite of occupations, unless we were to assume establishment-specific output elasticities.

Substituting the demand for capital, the establishment-occupation production is:

$$y_{io} = P_b^{\frac{\alpha_b}{1-\alpha_b}} A_{io} L_{io}^{\frac{\beta_b}{1-\alpha_b}}, \quad A_{io} \equiv \widetilde{A}_{io}^{\frac{1}{1-\alpha_b}} \left(\frac{\alpha_b}{R_b}\right)^{\frac{\alpha_b}{1-\alpha_b}}, \tag{6}$$

where A_{io} is a transformed productivity of io that incorporates elements coming from the demand of capital. Details on these derivations and the model under an alternative production function—where all occupations within an establishments are aggregated within a Cobb-Douglas specification—are in Online Appendix A. From now on we work with the production function after substituting out the optimal choice for capital.

Labor supply

We now present the worker preferences that give rise to upward sloping establishment-occupation specific labor supplies. A worker k derives utility by consuming the final good and by the product of two idiosyncratic utility shocks: one establishment-occupation specific preference shifter z_{kio} and another one common for all establishments in local labor market m, u_{km}. The utility of a worker k working for establishment i at occupation o in local labor market m is:

$$\mathcal{U}_{kio} = c_k z_{kio} u_{km}. \tag{7}$$

Following Eaton and Kortum (2002) in the trade literature and Redding (2016) and Ahlfeldt et al. (2015) in urban economics literature we assume that the idiosyncratic utility shocks are drawn from two independent Fréchet distributions:

$$P(z) = e^{-T_{io} z^{-\varepsilon_b}}, \quad T_{io} > 0, \varepsilon_b > 1 \tag{8}$$

$$P(u) = e^{-u^{-\eta}}, \quad \eta > 1, \tag{9}$$

where the parameter T_{io} determines the average utility derived from working in establishment i and occupation o. In contrast, we normalize these parameters to one for the sub-market specific shock u. The shape parameters ε_b and η control the dispersion of the idiosyncratic utility. They are inversely related to the variance of the taste shocks. We name the parameters ε_b and η as the textitlocal and *across* labor market elasticities of substitution. If both elasticities have high values, workers have similar tastes for different local labor markets and establishment-occupations. This in turn implies that workers can substitute more easily different jobs and their labor supply is more elastic.

The labor supply elasticities in this framework are different from the Frisch elasticity studied by public economists. Our baseline model features a constant level of aggregate employment and workers do not decide the *amount* of hours to work but rather the *workplace* to which they want to supply their labor. The Frisch elasticity of labor supply is zero in our baseline environment but workers do not supply their labor inelastically to any establishment.

We assume that establishments cannot discriminate against workers based on their taste shocks. This implies that establishment i for occupation o pays the same wage w_{io} to all its employees, leaving the marginal worker indifferent between working in io or somewhere else. Small wage reductions induce the movement of the marginal worker but infra-marginal workers stay.[34]

The only source of worker income are wages, therefore the indirect utility of worker k is:

$$\mathcal{U}_{kio} = w_{io} z_{kio} u_{km}. \tag{10}$$

A worker chooses where to work in two steps: first, they choose their local labor market after observing local labor market shocks u_{km}. After picking a local labor market, the worker then observes the establishment idiosyncratic shocks and chooses the establishment that maximizes expected utility. Following the usual derivations as in Eaton and Kortum (2002), the probability of a worker choosing establishment i and occupation o is a product of two terms: the employment share of the establishment-occupation within the local labor market $s_{io|m}$ and the employment share of the local labor market itself s_m. The probability $\Pi_{io} = s_{io|m} \times s_m$ writes as:

$$\Pi_{io} = \frac{T_{io} w_{io}^{\varepsilon_b}}{\Phi_m} \times \frac{\Phi_m^{\eta/\varepsilon_b} \Gamma_b^{\eta}}{\Phi}, \tag{11}$$

where $\Phi_m \equiv \sum_{i'} T_{i'o} w_{i'o}^{\varepsilon_b}$ is a local labor market aggregate, and the economy wide constant is $\Phi \equiv \sum_{b' \in \mathcal{B}} \Phi_{b'} \Gamma_{b'}^{\eta}$, where $\Phi_{b'} \equiv \sum_{m' \in \mathcal{M}_{b'}} \Phi_{m'}^{\eta/\varepsilon_{b'}}$. The Γ_b terms are sector-specific constants. In equilibrium, the first fraction is equal to $s_{io|m}$ and the second term in (11) is s_m.

Integrating over the continuous measure of workers L, the labor supply L_{io} for establishment and occupation o is:

$$L_{io}(w_{io}) = \frac{T_{io} w_{io}^{\varepsilon_b}}{\Phi_m} \times \frac{\Phi_m^{\eta/\varepsilon_b} \Gamma_b^{\eta}}{\Phi} L. \tag{12}$$

The inverse labor supply is upward sloping as long as the local and across labor market elasticities of substitution are finite. In the limit where both tend to infinity, workers are indifferent across workplaces and the inverse labor supply becomes flat.

4.1 Absence of bargaining

To ease the exposition of our baseline model, in this section we characterize equilibrium wages in the absence of bargaining. Given the labor supply curves with finite elasticities, establishments post wages taking into account the labor supply curves (12) they face. This monopsony power translates into a markdown between the wages and the marginal revenue products of labor. When

[34] One can view these taste shocks as mobility costs in a static model that could be present when changing jobs across the geography, industry and occupations.

the establishments solve their wage posting problem they act strategically. They look at probability Π_{io} and take into account the effect of wages on the establishment-occupation term $T_{io}w_{io}^{\varepsilon_b}$ and also on the local labor market aggregate Φ_m. However, they take as given economy wide aggregates (Φ and L).[35] The finite set of establishments per local labor market generates strategic interactions among the competitors. The strategic interactions within a local labor market induces oligopsonistic competition that features a heterogeneous markdown.

The first order condition for the establishment-occupation wage io under oligopsonistic competition is:

$$w_{io}^{MP} = \frac{e_{io}(s_{io|m})}{e_{io}(s_{io|m})+1}\beta_b A_{io} L_{io}^{\frac{\beta_b}{1-\alpha_b}-1} P_b^{\frac{1}{1-\alpha_b}}, \tag{13}$$

where $e_{io}(s_{io|m}) = \varepsilon_b\,(1-s_{io|m}) + \eta\, s_{io|m}$ is the labor supply elasticity.[36] This expression is similar to Card et al. (2018) with the difference that we have variable perceived elasticities that arise from the strategic interaction between establishments. The fraction $\frac{e_{io}(s_{io|m})}{e_{io}(s_{io|m})+1}$ in equation (13) is the markdown and it is defined as:

$$\mu(s_{io|m}) \equiv \frac{\varepsilon_b\,(1-s_{io|m}) + \eta\, s_{io|m}}{\varepsilon_b\,(1-s_{io|m}) + \eta\, s_{io|m} + 1}. \tag{14}$$

In the absence of bargaining, the wedge between the marginal revenue product of labor and the wages boils down to a markdown (14). We denote this object in short notation as μ_{io}.

As long as workers find different local labor markets to be less substitutable than establishments within a local labor market (i.e. as long as $\eta < \varepsilon_b$), the markdown (14) is a decreasing function of the employment share $s_{io|m}$. Once an establishment is big with respect to the nearby competitors, it internalizes that it is facing a more inelastic labor supply of workers willing to stay and applies a markdown further away from 1. In the limit where ε_b or η tend to infinity, establishments face an infinitely elastic labor supply and the labor market would be perfectly competitive with a markdown $\mu(s_{io|m}) = 1$.

Heterogeneous markdowns distort relative wages across establishment-occupations and therefore the labor allocations. By distorting the labor allocation across the production units, the heterogeneous markdown generates misallocation of resources and potentially reduces aggregate output even in the case where total employment is fixed, and the lower wages do not discourage workers from entering the labor force. We formalize the source of misallocation in Section 4.4.[37]

When the markdown is constant and total labor supply fixed, labor market power does not have efficiency consequences as it affects only the division of output into the labor share and the profit share. This is not longer true if we were to allow an endogenous leisure or labor force participation

[35] Similar to Atkeson and Burstein (2008), this type of behavior could be rationalized either by assuming a myopic behavior of the establishment or by having a continuum of local labor markets.

[36] On the contrary, the labor supply elasticity in Berger et al. (2022) is related to payroll shares. This difference comes from the fact that agents in their model make an intensive labor supply decision (equation (B3) in their online appendix) while in ours they do not (which would be equivalent to labor supply being their equation on top of (B3) times employment). Under Bertrand competition, the labor supply elasticity in their model is: $\frac{\partial \log(L_{io})}{\partial \log(w_{io})} = \eta + (\theta - \eta)\frac{\partial \log(W_j)}{\partial \log(w_{ij})}$. The latter partial derivative in their framework is $(\frac{w_{ij}}{W_j})^{1+\eta}$ which is the payroll share of the establishments. Note that if one was abstracting from the intensive labor supply margin, that wage ratio would be equal to the employment share as it can be seen in the equation on top of (B3) in their online appendix. Similarly, taking their notation and writing our framework without amenities and $W_j \equiv (\sum_{i\in\mathcal{I}_m} w_{io}^{\eta})^{1/\eta}$, the latter partial derivative would be the employment share.

[37] Online Appendix D provides an illustration of the distributional and efficiency consequences.

decision. Counterfactually increasing wages would increase total labor supply L and therefore total output.[38]

4.2 Bargaining

We now introduce bargaining between employers and unions.[39] We assume that bargaining happens at the establishment-occupation level and involves only wages rather than indirect utilities because workers do not know each others' taste shocks. Given the perfect substitutability of occupations in the production function, bargaining at the occupation level is equivalent to a situation where bargaining happens at the establishment level but there are different wage agreements per occupation.

We assume that workers and establishments are symmetric in the bargaining protocol: first, both parties enter the bargaining with a null outside option and, second, internalize how they generate rents as they move along the labor supple curve. The former implies that if bargaining were to fail, workers could not earn any income and establishments could not produce. The zero outside option for the workers is in line with recent evidence of a lack of response of wages to changes in outside options such as unemployment benefits (Jäger et al., 2020). The second assumption, where unions also internalize how the marginal cost changes when introducing an additional worker, is behind the idea that unions will be bargaining to extract part of the generated rents.

The bargained equilibrium wage is the solution to a reduced form Nash bargaining where the union's bargaining power is φ_b and that of the establishment is $1 - \varphi_b$. On the Appendix, we give more detail on the bargaining set up and discuss other situations that lead to the same negotiated equilibrium wages.

The equilibrium bargained wage is:

$$w_{io} = \underbrace{\left[(1 - \varphi_b)\, \mu_{io} + \varphi_b \, \frac{1 - \alpha_b}{\beta_b} \right]}_{\text{Wedge } \lambda(\mu_{io}, \varphi_b)} \times \underbrace{\beta_b A_{io} L_{io}^{\frac{\beta_b}{1-\alpha_b} - 1} P_b^{\frac{1}{1-\alpha_b}}}_{\text{MRPL}}. \tag{15}$$

The wedge between equilibrium wages and the marginal revenue product of labor, $\lambda(\mu_{io}, \varphi_b) \equiv (1 - \varphi_b)\mu_{io} + \varphi_b \frac{1-\alpha_b}{\beta_b}$, is a combination of two parts. First, a markdown μ_{io} that would be present under oligopsonistic competition in the absence of bargaining, and second, a markup $\frac{1-\alpha_b}{\beta_b}$. When there are decreasing returns to scale, $\frac{1-\alpha_b}{\beta_b} > 1$, workers can extract some quasi-rents through the bargaining process. Bargained wages will be above or below the marginal revenue product depending on the union's bargaining power φ_b and the relative strength of markdowns and markups as the labor wedge is a convex combination between $\mu_{io} < 1$ and $\frac{1-\alpha_b}{\beta_b} \geq 1$.

If the within local labor market elasticity is greater than the across one, i.e. $\varepsilon_b > \eta$, then the perceived labor supply elasticity e_{io} is decreasing in the local labor market employment share. Hence, even if unions bargain over wages, one would observe a negative relationship between employment shares $s_{io|m}$ and wages w_{io} as long as they don't extract all the quasi-rents i.e. as long

[38] The constant $\mu = \frac{\eta}{\eta+1}$ drives down the wages. If total labor supply were endogenous, workers' decision between consumption c and leisure l would be distorted. Denote by w the wage under monopsonistic competition and by $\tilde{w}$ the wage under a competitive labor market. Worker's maximization under endogenous labor supply leads the marginal rate of substitution to be equal to the wage rate. $w < \tilde{w}$ and therefore $-\frac{U_l}{U_c} = w < \tilde{w}$. Meaning that workers would supply less labor than in the perfectly competitive case.

[39] We use the terms workers and unions interchangeably.

as $\varphi_b < 1$.

A desirable feature of the model is that it nests both the oligopsonistic competition and bargaining only settings as special cases. The former is equivalent to the limit case where the union's bargaining power φ_b is equal to zero. Equilibrium wages would be equal to a markdown times the marginal revenue product of labor $w^{MP} = \mu_{io} \times MRPL$. A traditional bargaining model on a perfect competition setting—where the outside option for workers is the competitive wage—would yield the same result as in our specification when $e_{io} \longrightarrow \infty$. In such case, if there are decreasing returns to scale, bargained wages incorporate a markup over the marginal product and become $w^B = (1 + \varphi_b \frac{1-\alpha_b-\beta_b}{\beta_b}) \times MRPL$.

4.3 Equilibrium

For given sector rental rates of capital $\{R_b\}_{b=1}^{B}$, the general equilibrium of this economy is a set of wages $\{w_{io}\}_{io=1}^{IO}$, output prices $\{P_b\}_{b=1}^{B}$, a measure of labor supplies to every establishment and occupation $\{L_{io}\}_{io=1}^{IO}$, capital $\{K_{io}\}_{io=1}^{IO}$ and output $\{y_{io}\}_{io=1}^{IO}$, sector $\{Y_b\}_{b=1}^{B}$ and economy wide output Y, such that equations (2)-(12) and (15) are satisfied $\forall$ $io \in \mathcal{I}_m$, $m \in \mathcal{M}$ and $b \in \mathcal{B}$.

4.4 Characterization of the equilibrium

Solving the model amounts to finding establishment wages, sector prices and allocations. The perfect substitutability assumption of the production function implies the block recursivity of the model where local labor market equilibria are independent from aggregates. To further simplify the aggregation and the solution of the model, we restrict the labor demand elasticity to be the same across sectors. That is, we assume the output elasticities to satisfy $\frac{\beta_b}{1-\alpha_b} = 1 - \delta$, where $\delta \in [0,1]$. Block recursivity allows to split the solution of the model in two, while the parametric restriction on the output elasticities allow us to solve for the aggregate prices in closed form. First, we solve for local employment shares, which are independent of aggregate variables. We show that there is always a unique equilibrium of employment shares in each local labor market. Second, with the solution for the employment shares, we aggregate the local labor markets and show that the model can be rewritten at the sector b level. This last aggregate model is, in turn, enough to solve for sector prices in closed-form.

We first establish the fact that the model is block recursive where we can solve the equilibrium of each local labor market separately without taking into account aggregate variables.

Proposition 1 (Block Recursivity)**.** *Each local labor market equilibrium is independent of aggregate variables and is given by the following N_m systems:*

$$s_{io|m} = \frac{\left(T_{io}^{\frac{1}{\varepsilon_b}} \lambda_{io} A_{io}\right)^{\frac{\varepsilon_b}{1+\varepsilon_b \delta}}}{\sum_{j \in \mathcal{I}_m} \left(T_{jo}^{\frac{1}{\varepsilon_b}} \lambda_{jo} A_{jo}\right)^{\frac{\varepsilon_b}{1+\varepsilon_b \delta}}}, \tag{16}$$

$$\lambda_{io} = (1 - \varphi_b) \frac{e_{io}}{e_{io} + 1} + \varphi_b \frac{1}{1 - \delta}, \tag{17}$$

$$e_{io} = \varepsilon_b (1 - s_{io|m}) + \eta\, s_{io|m}. \tag{18}$$

The proof of Proposition 1 is in Online Appendix B. The employment shares are not affected by the aggregate variables for two reasons: (i) the relative wages within a local labor market do not change with aggregate variables; and (ii) employment shares are homogeneous of degree zero to labor-market changes in productivities, amenities, or wedges. Given the block recursivity of the local labor market equilibria, we can now establish the existence and uniqueness of the local labor market equilibrium:

Proposition 2 (Existence and Uniqueness of Local Equilibrium)**.** *If $\eta < \varepsilon_b \, \forall \, b \in \mathcal{B}$, then there exist unique vectors of employment shares $\{s_{io|m}\}_{io \in \mathcal{I}_m}$, wedges $\{\lambda_{io}\}_{io \in \mathcal{I}_m}$, and elasticities $\{e_{io}\}_{io \in \mathcal{I}_m}$ for every local labor market m that solve the system formed by equations (16)-(18).*

Proposition 2 tells us that the characterization of the local labor market is uniquely pinned down, so we can use the employment shares and wedges as inputs when aggregating the model. For the proof see Online Appendix B. Our proof of existence and uniqueness can be applied easily to the local labor market equilibrium presented in Berger et al. (2022). As far as we know, this result has not been previously demonstrated in their paper, so we also derive it in the Online Appendix.

Before turning to the characterization of the general equilibrium of the model, the following proposition measures the aggregate misallocation effects of the heterogeneous labor wedges $\lambda(\mu_{io}, \varphi_b)$.

Proposition 3 (Aggregation at the Sector Level)**.** *Give each local labor market equilibrium $\{s_{io|m}\}_{io \in \mathcal{I}_m}$ we can characterize the output and labor supply at the sector level as functions of sectoral measures of productivities, labor wedges and misallocation, as well as the vector of sector prices $\{P_b\}_{b \in \mathcal{B}}$ as follows:*

Productivities:

$$A_m = \sum_{i \in \mathcal{I}_m} A_{io} \tilde{s}_{io|m}^{1-\delta}, \quad A_b = \sum_{m \in \mathcal{M}_b} A_m \tilde{s}_{m|b}^{1-\delta},$$

where $\tilde{s}_{io|m}$ and $\tilde{s}_{m|b}$ are the establishment and local labor market employment shares that would arise if all establishments had a constant labor wedge λ.

Labor wedges:

$$\lambda_m = \sum_{j \in \mathcal{I}_m} \lambda_{jo} \frac{A_{jo}}{A_m \Omega_m} s_{io|m}^{1-\delta},$$
$$\lambda_b = \sum_{m \in \mathcal{M}_b} \lambda_m \frac{A_m \Omega_m}{A_b \Omega_b} s_{m|b}^{1-\delta},$$

Misallocation:

$$\Omega_m = \sum_{i \in \mathcal{I}_m} \frac{A_{io}}{A_m} s_{io|m}^{1-\delta}, \quad \Omega_b = \sum_{m \in \mathcal{M}_b} \Omega_m \frac{A_m}{A_b} s_{m|b}^{1-\delta}.$$

Let $\mathbf{s}_b \equiv \{s_{io|m}\}_{io \in \mathcal{I}_b}$ be the vector containing all the employment shares of all the establishment-occupations in sector b. Then, sector level measures A_b, λ_b and Ω_b and the vector of sector prices $\{P_b\}_{b \in \mathcal{B}}$ are enough to *characterize employment and output at the sector level:*

$$L_b = \frac{\Phi_b\left(P_b, \mathbf{s}_b\right)\Gamma_b^{\eta}}{\sum_{b' \in \mathcal{B}} \Phi_{b'}\left(P_{b'}, \mathbf{s}_{b'}\right)\Gamma_{b'}^{\eta}} L$$
$$Y_b = P_b^{\frac{\alpha_b}{1-\alpha_b}} \Omega_b A_b L_b^{1-\delta}$$

Online Appendix B contains the aggregation of the model to the sector level and the characterization of sector employments as functions of prices and the vector of employment shares $\mathbf{s}_b$.

We now turn to the second step of the model solution. The block recursive nature of the local labor market equilibria allow to characterize the employment shares within the sector without the knowledge of prices $\{P_b\}_{b \in \mathcal{B}}$. That was the key part of the first step. In the second step we take as given these employment shares and solve for the sector prices. Let $\mathbf{s} = \{\mathbf{s}_b\}_{b \in \mathcal{B}}$ be the vector of all employment shares obtained in the first step. Also, let $\mathbf{P} = \{P_b\}_{b \in \mathcal{B}}$. Then, as shown in Proposition 3, the sector labor supply L_b will depend on both $\mathbf{s}$ and $\mathbf{P}$, and the sector level output can be written as:

$$Y_b = P_b^{\frac{\alpha_b}{1-\alpha_b}} \Omega_b A_b L_b(\mathbf{P}, \mathbf{s})^{1-\delta}. \tag{19}$$

Solving the model now amounts to finding the sector prices that clear the markets for intermediate goods. Using the final good production function (2), the intermediate good demand (3), and sector output (19) we obtain:

$$P_b^{\frac{1}{1-\alpha_b}} A_b \Omega_b L_b(\mathbf{P}, \mathbf{s})^{1-\delta} = \theta_b \prod_{b' \in \mathcal{B}} P_{b'}^{\frac{\alpha_{b'}}{1-\alpha_{b'}}} A_{b'} \Omega_b L_{b'}(\mathbf{P}, \mathbf{s})^{1-\delta}. \tag{20}$$

Online Appendix B explains in detail how to get to this expression. Collecting all these expressions for the different sectors forms a system of B equations with B unknowns. Given the employment shares obtained in the first step of the solution, the following proposition establishes the existence and uniqueness of the general equilibrium.

Proposition 4 (Existence and Uniqueness of General Equilibrium)**.** *Given a vector of employment shares* $\mathbf{s}$*, and* $\frac{\beta_b}{1-\alpha_b} = 1 - \delta \quad \forall\, b$*, then there exists a unique vector of prices* $\mathbf{P}$ *such that solves the system formed by* (20) *and it has a closed-form expression.*

On top of showing existence and uniqueness, Proposition 4 shows that there is an analytical solution for the sector prices. For the proof and the closed-form solution for the prices, see Online Appendix B. Taking together Propositions 2 and 4 we can conclude that there exists a unique solution to the model for any set of valid parameters and vectors of productivities and amenities.

5 Identification and estimation

We follow a sequential identification and estimation strategy of the parameters consisting of three steps. First, we identify the parameters that are constant across markets: the inverse elasticity of labor demand δ and the across-market elasticity of substitution η. To do so, we adapt the identification-through-heteroskedasticity proposed by Rigobon (2003). Second, we identify the local elasticities of substitution $\{\varepsilon_b\}_{b=1}^{B}$ by instrumenting for wages in the labor supply equation. In the third step, we calibrate the remaining parameters—the output elasticities $\{\alpha_b\}_{b=1}^{B}$, union bargaining powers $\{\varphi_b\}_{b=1}^{B}$, and final good elasticities $\{\theta_b\}_{b=1}^{B}$—to match their respective industry-specific capital, labor, and expenditure shares. After showing how to estimate the parameters, we explain how to use the observed data on employment and wages to identify the amenities and revenue productivities.

5.1 Common parameters η and δ

We identify the common parameters η and δ by focusing on establishment-occupations that are the sole employer in their local labor markets (i.e., $s_{io|m} = 1$), which we refer to as full monopsonists. These establishments only compete for workers across local labor markets, making the across-market elasticity of substitution η the only relevant parameter for their labor supply.

The labor demand of full monopsonists can be expressed in logs as:

$$\ln w_{io} = \mathcal{C}_b^D - \delta \ln L_{io} + \ln A_{io}, \tag{21}$$

where $\mathcal{C}_b^D$ is an industry-specific demand constant. Their labor supply in logs is:

$$\ln L_{io} = \mathcal{C}_b^S + \eta \ln w_{io} + \ln \widetilde{T}_{io}, \tag{22}$$

where $\widetilde{T}_{io} = T_{io}^{\eta/\varepsilon_b}$ and $\mathcal{C}_b^S$ is an industry-specific supply constant.[40] These equations form a standard price-quantity linear system, which suffers from a textbook case of simultaneity bias.

The standard approach to obtain consistent estimates for, say, the inverse demand elasticity δ is to find an instrument that shifts the supply curve. However, finding such instruments can be context-specific and not portable to other scenarios. Thus, we propose an alternative method to obtain consistent estimates without relying on specific demand and supply shifters.

We identify the across-market elasticity of substitution η and the inverse elasticity of labor demand δ using the identification through heteroskedasticity method proposed by Rigobon (2003). This approach imposes restrictions on the covariance matrix of the structural shocks—the productivities and amenities—across different subsets of the data.[41]

To gain intuition on the method, we follow Rigobon's example of the simplest demand and supply system, where the shocks are independent. Split the sample in two and assume that the supply shocks have a larger variance in the second subsample than in the first subsample, while the demand shocks have a constant variance. As the variance of the supply shocks increases, the cloud of price and quantity realizations spreads across the demand curve. This can be visualized as an ellipse that tilts towards the demand curve. When the variance of the supply shocks approaches infinity, the ellipse converges to the demand curve, and the slope of the demand can be estimated using OLS.

[40]More precisely, $\mathcal{C}_b^D = \ln \left(\left[(1-\varphi_b)\frac{\eta}{\eta+1} + \varphi_b \frac{1}{1-\delta} \right] \beta_b P_b^{\frac{1}{1-\alpha_b}} \right)$, where the markdown is equal to $\mu(s=1) = \frac{\eta}{\eta+1}$, and $\mathcal{C}_b^S = \ln(L/\Phi) + \eta \ln(\Gamma_b)$.

[41]Rigobon and Sack (2004) and Nakamura and Steinsson (2018) also use heteroskedasticity-based estimates to quantify the impact of monetary policy on asset prices and, on real interest rates and inflation respectively.

Rigobon's method extends this idea when the form of heteroskedasticity is unknown, showing that the relative change in variances across subsamples identifies the system. In the example above, we get three moments per subsample from the covariance matrix of prices and quantities. With two subsamples, we get six moments to identify the six unknowns of the system: the slopes of the demand and supply curve, and the variances of the demand and supply shocks in each subsample.

Let us return to the labor demand and supply equations for the full monopsonists as described by (21) and (22). After subtracting the sector b average and rearranging we get:

$$\begin{pmatrix} \overline{\ln(L_{io})} \\ \overline{\ln(w_{io})} \end{pmatrix} = \frac{1}{1+\eta\delta} \begin{pmatrix} 1 & -\eta \\ \delta & 1 \end{pmatrix} \begin{pmatrix} \ln(\widetilde{T}_{io}) \\ \ln(A_{io}) \end{pmatrix},$$

where $\overline{\ln(L_{iot})}$ and $\overline{\ln(w_{iot})}$ are the demeaned logarithms of employment and wages respectively.

To apply Rigobon's method, we split the data using the four different occupations, resulting in twelve moments from the covariance matrix of employment and wages per occupation. However, this also means that the system has fourteen unknowns: η, δ, and twelve unknowns from the four covariance matrices of the structural shocks. Therefore, we need to impose at least two restrictions.

We impose the necessary restrictions by first grouping the four occupations into two categories: white-collar (top management and clerical) and blue-collar (supervisor and operational). Our identification assumption is that the covariance between productivities and amenities is constant across occupations within each category. This assumption reflects the idea that amenities such as working hours, repetitiveness of the tasks or more general working environments are similarly related to productivity within our two categories. With these restrictions, we end up with a system with twelve unknowns, allowing us to identify δ and η. See Online Appendix E for details.

5.2 Local elasticities of substitution ε_b

We identify local elasticities of substitution ε_b using variation within a local labor market and an instrumental variables approach. The establishment-occupation labor supply (12) in logs is:

$$\ln(L_{io}) = \varepsilon_b \ln(w_{io}) + f_m + \ln(T_{io}), \tag{23}$$

where f_m is a local labor market fixed-effect which absorbs all the endogenous intercepts within each local labor market.

We instrument for wages using a proxy $\widehat{Z}_j$ of firm revenue productivity:

$$\widehat{Z}_j = \frac{P_b Y_j}{\sum_{\mathbf{J}(i)} \sum_o L_{io}^{1-\delta}},$$

where $P_b Y_j$ is value added at the firm j and $\mathbf{J}(i)$ denotes the set of establishments belonging to firm j. We use the estimate for δ from our first estimation step to build the instrument.[42]

In the first estimation step, we allow for the possibility that the structural shocks T_{iot} and A_{iot} are correlated *across* local labor markets. The validity of our instrument in this step is not compromised

[42]Ideally, we would like to have the average of the revenue productivities, $\frac{1}{N_{\mathbf{J}}} \sum_{\mathbf{J}(i)} \sum_o \frac{P_b Y_{io}}{L_{io}^{1-\delta}}$, but as we only observe value added at the firm level we use the ratio estimator instead $\frac{\sum_{\mathbf{J}(i)} \sum_o P_b Y_{io}}{\sum_{\mathbf{J}(i)} \sum_o L_{io}^{1-\delta}} = \frac{P_b Y_j}{\sum_{\mathbf{J}(i)} \sum_o L_{io}^{1-\delta}}$.

by the possible across local labor market correlation of amenities and productivities as they may remain uncorrelated *within* each local labor market. The local labor market fixed effect f_m can account for any such cross-market correlation. Nonetheless, we use a lagged instrument instead of a contemporaneous one to minimize potential endogeneity concerns.

It is important to note that our identification strategy so far does not rely on any assumptions about the wage-setting process. This makes our approach easy to adapt and use in different contexts, for example, in settings with no bargaining.

Elasticity of substitution and labor supply elasticity with strategic interactions. Our method avoids the identification issues raised by Berger et al. (2022) (BHM) for identifying supply or demand elasticities under strategic interactions. Paraphrasing BHM, the labor supply elasticity asks the following question: *how much would employment change within a firm after increasing its wage by one percent and holding the other firms' response constant?* Thus, the supply elasticity is a partial equilibrium object: $\frac{d\ln L_{io}}{d\ln w_{io}}\Big|_{w_{-io}}$.

BHM argue that even when there is a well-identified idiosyncratic demand shock and no labor supply shifters, we cannot identify the firm's labor supply elasticity. This is because the strategic interactions of other market participants will change the labor supply curve that the firm faces after the shock has occurred. This change in the equilibrium allocation violates the stable unit treatment value assumption (SUTVA), meaning that when we use within-firm across-equilibrium variation in a reduce-form exercise, we are measuring $\frac{d\ln L_{io}}{d\ln w_{io}}$ rather than $\frac{d\ln L_{io}}{d\ln w_{io}}\Big|_{w_{-io}}$.

More precisely, consider the following decomposition of the reduced-form estimate:[43]

$$\frac{d\ln L_{io}}{d\ln w_{io}} = \frac{d\ln\left(L_{io}/L_{jo}\right)}{d\ln\left(w_{io}/w_{jo}\right)}\left(1-\frac{d\ln w_{jo}}{d\ln w_{io}}\right)+\frac{d\ln L_{jo}}{d\ln w_{io}}, \tag{24}$$

where L_{jo} and w_{jo} are the employment and wages for any other establishment jo within the local labor market of establishment io. In our setup, the elasticity of substitution $\frac{d\ln\left(L_{io}/L_{jo}\right)}{d\ln\left(w_{io}/w_{jo}\right)}$ is constant within a sector and equal to ε_b. In contrast to the reduced form response, the structural labor supply elasticity is equal to

$$\frac{d\ln L_{io}}{d\ln w_{io}}\Big|_{w_{-io}} = \varepsilon_b + \underbrace{\frac{d\ln L_{jo}}{d\ln w_{io}}\Big|_{w_{-io}}}_{\text{Cross-elasticity}},$$

where the cross-elasticity is equal to $-\varepsilon_b s_{io} + \eta s_{io}$ given our Bertrand competition environment. Thus, we get the main text's expression for the labor supply elasticity, $\varepsilon_b(1-s_{io})+\eta s_{io}$.

The relation between the reduced form estimate and the labor supply elasticity is:

$$\underbrace{\frac{d\ln L_{io}}{d\ln w_{io}}}_{\text{Reduced-form}} = \underbrace{\frac{d\ln L_{io}}{d\ln w_{io}}\Big|_{w_{-io}}}_{\text{Supply elasticity}} + \underbrace{\left(\frac{d\ln L_{jo}}{d\ln w_{io}} - \frac{d\ln L_{jo}}{d\ln w_{io}}\Big|_{w_{-io}}\right) - \varepsilon_b\frac{d\ln w_{jo}}{d\ln w_{io}}}_{\text{Bias}}.$$

The reduced-form estimate is equal to the labor supply elasticity when the establishment is atom-

[43]Derivation: $\frac{d\ln L_{io}}{d\ln w_{io}} = \frac{d\ln L_{io}}{d\ln\left(w_{io}/w_{jo}\right)}\frac{d\ln\left(w_{io}/w_{jo}\right)}{d\ln w_{io}} = \frac{d\left(\ln L_{io}-\ln L_{jo}+\ln L_{jo}\right)}{d\ln\left(w_{io}/w_{jo}\right)}\frac{d\left(\ln w_{io}-\ln w_{jo}\right)}{d\ln w_{io}} = \frac{d\ln\left(L_{io}/L_{jo}\right)}{d\ln\left(w_{io}/w_{jo}\right)}\left(1-\frac{d\ln w_{jo}}{d\ln w_{io}}\right)+\frac{d\ln L_{jo}}{d\ln w_{io}}$.

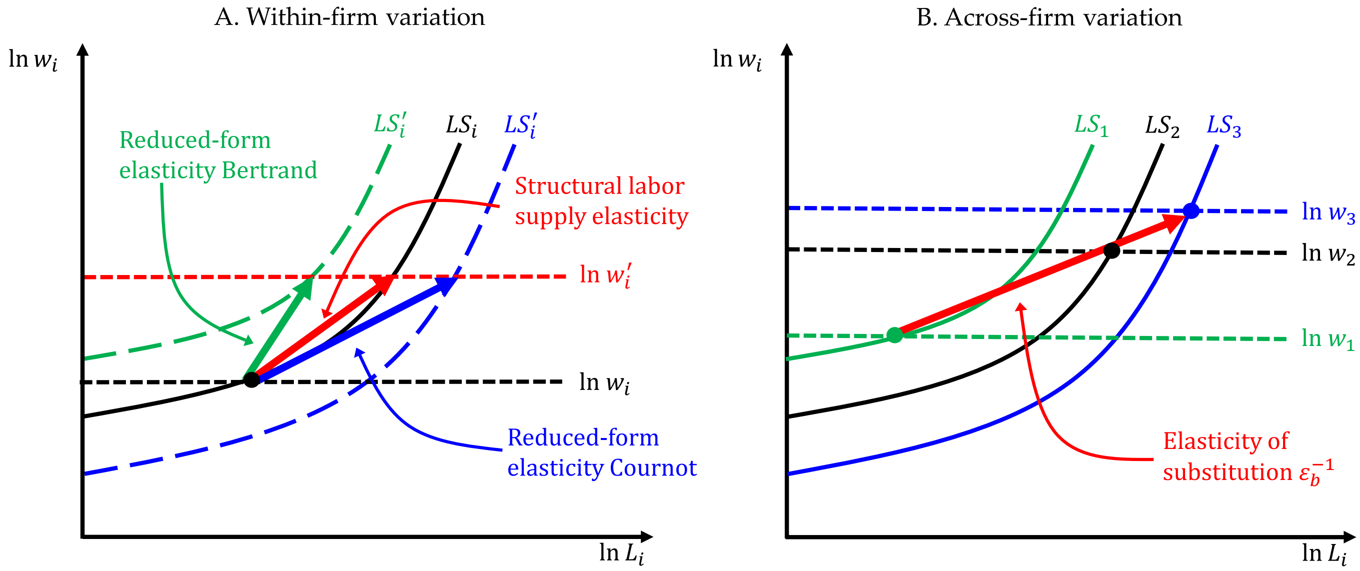


Figure 3: Within-firm, across-equilibria variation vs Across-firm, within-equilibrium variation

Notes: **Panel A** shows how the relationship between reduced-form and structural labor supply elasticities following an idiosyncratic shock depend on the nature of the market competition. **Panel B** illustrates that variation across employment and wages within a local labor market identify the elasticity of substitution ε_b.

istic i.e. $s_{io} \to 0$. In that case, the other firms in the market do not respond, so $\frac{d \ln w_{jo}}{d \ln w_{io}} = 0$, and $\frac{d \ln L_{jo}}{d \ln w_{io}} = \frac{d \ln L_{jo}}{d \ln w_{io}}\Big|_{w_{-io}}$. In this case, the labor supply elasticity is equal to the elasticity of substitution.

BHM suggests using the relation between the reduced-form estimate and the structural elasticity to indirectly infer the structural parameters ε_b and η. However, this requires to assume a wage-setting process which will pin down the form of the structural elasticity. In contrast, our method identifies both parameters without making any assumptions about the wage-setting process.

Consider Figure 3 panel A to illustrate the argument. Assume there is no bargaining. The structural labor supply elasticity measures the employment response to a wage increase along the same labor supply curve LS_i. But if the firm is not atomistic, the wage increase will affect the other firms in the market, leading to a shift in establishment i's labor supply curve. Under Bertrand competition, wages are strategic complements, resulting in an upward shift in the labor supply, and the reduced-form elasticity will be smaller than the structural elasticity. Under Cournot competition, the employment levels are strategic substitutes, resulting in a downward shift in the labor supply, and the reduced-form elasticity will be greater than the structural elasticity. Therefore, different assumptions about the type of competition can lead to different estimates for ε_b and η.[44]

BHM's identification problem arises when using variation from different equilibrium allocations, but this problem is not present when using within-equilibrium variation. For example, suppose we have data for a local labor market and there are no supply shifters and no bargaining, so all the variation in wages and employment levels across firms are solely due to differences in productivities. Since the equilibrium allocation remains the same, SUTVA is not violated if we regress log employment on log wages. However, this regression does not estimate the labor supply elasticity but rather the local elasticity of substitution.

To understand why a regression of log employment on log wages within a local labor market

[44] The labor supply elasticity in the Cournot competition case is given by $\left(\frac{1}{\varepsilon_b}(1-s_i) + \frac{1}{\eta}s_i\right)^{-1}$.

identifies ε_b, consider Figure 3 panel B. We have three different supply curves for establishments that only differ in their productivities. As they are not atomistic, they have different labor supplies. For any two establishments i, j, the slope of the straight line connecting two points in the log wage and employment plane is $\frac{\ln w_i - \ln w_j}{\ln L_i - \ln L_j} = \varepsilon_b^{-1}$. This slope is constant for any pair of points, so the slope estimate of regressing log employment on log wages must be equal to ε_b.[45]

In Online Appendix E.2 we do a simulation exercise to show that in a set-up like ours with bargaining and supply shifters, we can recover the elasticity of substitution ε_b using our instrumental variable approach.

5.3 Bargaining power φ_b and output elasticities α_b, θ_b

We follow Barkai (2020) to construct the sector rental rates per year $\{R_{bt}\}_{b=1}^{B}$. Using these rates, we can get capital shares of output from the data. From the first order condition for capital, the industry b capital share is:

$$\frac{R_{bt}K_{bt}}{P_{bt}Y_{bt}} = \alpha_b.$$

We estimate α_b such that $\mathbb{E}_t\left[\frac{R_{bt}K_{bt}}{P_{bt}Y_{bt}}\middle| b\right] = \alpha_b$. We use the restriction of constant inverse labor demand elasticity $\frac{\beta_b}{1-\alpha_b} = 1 - \delta$, to back out the output elasticities with respect to labor.

We pin down the union bargaining powers with the sector labor shares. Given data on wages and employment, the sector labor share is equal to:

$$LS_b(\varphi_b) = \frac{\beta_b \sum_{io \in \mathcal{I}_b} w_{io} L_{io}}{\sum_{io \in \mathcal{I}_b} w_{io} L_{io} / \lambda(\mu_{io}, \varphi_b)},$$

where φ_b is the only parameter left to estimate. We set φ_b such that we match the average sector labor shares across years in the data with the model counterpart.

5.4 Amenities and Revenue Productivities

Amenities and revenue productivities are identified to match wages and labor allocations in equilibrium. We recover establishment-occupation revenue productivities (TFPR) using the wage first order conditions. We observe employment and nominal wages at the establishment-occupation level from the data. Equation (15) in nominal terms is:

$$P_t w_{iot} = \beta_b \lambda(\mu_{iot}, \varphi_b)\, P_t P_{bt}^{\frac{1}{1-\alpha_b}} A_{iot} L_{iot}^{-\delta}, \tag{25}$$

where $P_t w_{iot}$ and L_{iot} are observed and $\beta_b \lambda(\mu_{iot}, \varphi_b)$ depends on the estimated parameters and observed employment shares. Equation (25) makes clear that given the observed nominal wages and employment, one can only back out transformed TFPRs, $Z_{iot} = P_t P_{bt}^{\frac{1}{1-\alpha_b}} A_{iot}$, which are a function

[45] More explicitly, consider a regression model of the form $\ln L_i = b_0 + b_1 \ln w_i$, where we assume there are no supply side shifters so we do not include an error term. We can first demean both $\ln L_i$ and $\ln w_i$ and then regress those demeaned variables without a constant term to get the estimate of b_1. Thus, the estimate for b_1 is equal to $\frac{d\left[\ln(L_i) - \frac{1}{N}\sum_j \ln(L_j)\right]}{d\left[\ln(w_i) - \frac{1}{N}\sum_j \ln(w_j)\right]} = \frac{d \ln\left(L_i / \left(\prod_j L_j\right)^{1/N}\right)}{d \ln\left(w_i / \left(\prod_j w_j\right)^{1/N}\right)} = \varepsilon_b$.

Table 3: Main Estimates

Param.	Name	Estimate	Identification
η	Across labor market elasticity	0.42	Heteroskedasticity
δ	1 - Returns to scale	0.04	Heteroskedasticity
$\{\varepsilon_b\}$	Within labor market elasticity	1.22 - 4.05	Labor supply
$\{\beta_b\}$	Output elasticity labor	0.57 - 0.85	Capital share and δ
$\{\varphi_b\}$	Union bargaining	0.06 - 0.73	sector LS

of the establishment-occupation physical productivity A_{iot} and prices $P_t P_{bt}^{\frac{1}{1-\alpha_b}}$.[46] Online Appendix E.4 contains details on how we back out amenities T_{iot} to ensure that we match employment. The next section presents the main estimation results and how well our model fits the data.

5.5 Estimation results

Table 3 shows the estimation results of the main parameters. The most important parameters of the estimation are the elasticities of substitution and the union bargaining powers.

The estimated across local labor market elasticity is $\widehat{\eta} = 0.42$ and the sector specific local labor market labor supply elasticities $\widehat{\varepsilon}_b$ range from 1.22 to 4.05. The across local labor market elasticity being lower than the within ones ($\widehat{\eta} < \widehat{\varepsilon}_b \quad \forall b$), workers are more elastic within than across local labor markets. This implies that the structural labor wedge $\lambda(\mu_{io}, \varphi_b)$ of our calibrated model is decreasing in employment shares $s_{io|m}$, in line with the empirical evidence from Section 3.

Our across local labor market labor supply elasticity is the same as a recent estimate by Berger et al. (2022) for the U.S.[47] On the contrary, all of our sector specific within local labor market elasticities lie below their estimate of 10.85. This might be a consequence of the lower job-to-job transition rates that characterize the French labor market.[48]

According to our estimates, (i) the employment weighted average bargaining power of French manufacturing is 0.37[49]; and (ii) there is important heterogeneity of bargaining power across industries ranging from 0.06 for *Chemical* to 0.73 for *Telecommunications*.

Our estimates for manufacturing bargaining power in France are consistent with previous studies. In particular, Cahuc, Postel-Vinay, and Robin (2006) estimate a bargaining power of 0.35 for top management workers, which is similar to our estimate, in a framework with search frictions and on-the-job search. Additionally, recent estimates for different manufacturing industries in France by Mengano (2022) are also in line with the middle range of our estimates, although his estimate is lower and less variable across industries (0.24).[50] Finally, we find our bargaining power estimates to be reasonable as there is a positive correlation of 0.33 between establishment size and union bargaining power, in line with the more restrictive legal duties regarding union representation for larger establishments in the French law.

The estimate of the inverse labor demand elasticity, δ, is $\widehat{\delta} = 0.04$. This parameter is also related

[46]Normally in the literature, revenue productivities are defined as $P_t P_{bt} A_{iot}$. Instead, we define the revenue total factor productivities $P_t P_{bt}^{\frac{1}{1-\alpha_b}} A_{iot}$. Given that one cannot observe sector prices P_{bt}, backing out productivities A_{iot} from the data would require carrying out some normalizations to get rid of sector prices and be able to compute counterfactuals.

[47]See Table 3 in Berger et al. (2022).

[48]See Jolivet, Postel-Vinay, and Robin (2006) for a comparison of French mobility against the U.S.

[49]The simple average of sector bargaining powers is 0.41.

[50]See Tables A.2. and A.3. in the Appendix of his paper and Table E1 in our Online Appendix.

to the average returns to scale of the production function which are about 0.97. The combination of δ and the estimated capital elasticities per sector $\{\alpha_b\}_{b\in\mathcal{B}}$ allow us to recover the values for the output elasticities with respect to labor, $\{\beta_b\}_{b\in\mathcal{B}}$, as $\beta_b = (1-\alpha_b)(1-\delta)$. These elasticities go from 0.56 for *Transport* to the 0.85 for *Shoe and Leather Production*.

5.6 Estimation fit

We validate the model by replicating the empirical evidence of Section 3 linking micro-level concentration to wages and sector concentration to the sector labor shares. We then compare the model's predicted reduced-form relationship between labor shares and labor market concentration at the industry level. In the Online Appendix, we also show that the model fits well non-targeted labor shares at the sub-industry level and the evolution of total value added.[51]

Micro evidence

In the empirical evidence from Section 3 we measure the effects of concentration on wages by using shocks to local competitors. These shocks capture an exogenous change in the relative position within the local labor market of an establishment. Thus, our aim is to induce such exogenous changes to the local labor market of establishments and test if the quantitative response in the simulated model is similar than in the reduced form regression. The firm and commuting zone fixed effects in the regression absorb the general equilibrium effects of the shocks. Therefore, we exploit the model variation in wages without taking into account changes in sector prices or employment levels.

Using wage and employment data, we can identify amenities T_{io} and revenue productivities (TFPRs) $Z_{io} = P_b^{\frac{1}{1-\alpha_b}} A_{io}$. The TFPRs are multiplied by the same sector-wide constant, $P_b^{\frac{1}{1-\alpha_b}}$. As shown by Proposition 1, the local labor market equilibrium is invariant to any rescaling of the productivities. This means we can completely characterize the employment shares $s^S_{io|m}$ in the local labor market equilibrium using only the identified TFPRs and amenities. Using the estimated amenities and TFPRs for 2007, we simulate shocks in establishment-occupations' productivities and solve again for the equilibrium employment shares within each local labor market. With this employment shares, we compute wages that ignore any local market, sector, or economy wide constants, meaning, the wages we use in this simulation are only a function of TFPRs, amenities, and wedges, which are a function of local market employment shares. More precisely, we use $w^S_{io} = \left(T_{io}^{\frac{1}{\varepsilon_b}} \lambda_{io} Z^S_{io}\right)^{\frac{1}{1+\varepsilon_b\delta}}$, where Z^S_{io} is the simulated TFPR. With these simulated data, we explore the link of employment shares to log wages according to the following linear model:

$$\log(w^S_{io}) = f_b + \beta\, s^S_{io|m} + u_{io},$$

where $\log(w_{io})$ is the logarithm of simulated wages, f_b is a sector fixed effect, $s^S_{io|m}$ is the equilibrium employment share of establishment-occupation io in the local labor market m, and u_{io} is an error term. We include the sector fixed effect f_b to capture any remaining sector price differences in the revenue productivities.

[51]See Figure E2.

Table 4: Concentration and Labor Share: Data vs. Model

	Data: $\log(LS^D_{h,t})$		Oligopsony: $\log(LS^{M,MP}_{h,t})$		Model: $\log(LS^M_{h,t})$	
	(1)	(2)	(3)	(4)	(5)	(6)
$\log(\overline{HHI}_{h,t})$	-0.054^{***}	-0.056^{***}	-0.388^{***}	-0.416^{***}	-0.175^{***}	-0.161^{***}
	(0.013)	(0.013)	(0.009)	(0.003)	(0.007)	(0.005)
Sector FE	Y	N	Y	N	Y	N
Sector-Year FE	N	Y	N	Y	N	Y
R^2	0.29	0.343	0.901	0.903	0.946	0.909

Notes: The number of observations is 1357. The dependent variable of the first two columns is the logarithm of 3-digit industry labor share at year t, $\log(LS^D_{h,t})$ from the data. Next two columns present the model generated log labor shares $\log(LS^{M,MP}_{h,t})$ when the model does not incorporate wage bargaining. This is a framework where the labor wedge λ boils down to $\lambda(\mu_{io}, 0) = \mu_{io}$. Last two columns present the analogous regressions with our framework where bargaining is incorporated $\log(LS^M_{h,t})$. Throughout the different frameworks column 1 presents estimates with sector fixed effects and column 2 results with sector-year fixed effects. *p<0.1; **p<0.05; ***p<0.01

To replicate the exogenous change in establishment's employment share $s_{io|m}$, we use as an instrument the weighted average of the productivity changes of each establishment-occupation's competitors, where the weights are the employment shares in the baseline scenario. More clearly, the instrument for $s_{io|m}$, is:

$$\sum_{jo \in \{m \setminus io\}} \frac{Z^S_{jo}}{Z_{jo}} \frac{L_{jo}}{\sum_{ko \in \{m \setminus io\}} L_{ko}},$$

where L_{jo} is the observed employment for establishment-occupation jo in the baseline year, 2007.

The estimated coefficient is -0.203 with a standard error of 0.035. The point estimate is a little below the minimum one presented on Figure 2 but still within the confidence intervals. We take this as evidence that the model is able to replicate the strength of the relationship between employment shares and wages.[52]

Macro evidence

We now turn to aggregate empirical evidence relating labor market concentration to the labor share, while underscoring the importance of unions to match the aggregate empirical evidence in France.

We run regressions of 3-digit industry labor shares from the data and model generated labor shares on the average industry Herfindahl-Hirschman Indices and compare their estimates. We also compare the results when using a model without unions. Table 4 presents the results. The first 2 columns show the estimates using the labor shares from the data, while the rest correspond to the two alternative models with and without unions.[53] The negative relationship between labor share and concentration in the model with only oligopsonistic competition (columns 3 and 4) is about 8 times higher than in the data. Looking at the last two columns that correspond to our model, we find that the negative relationship is half as much as the model without unions.[54] These results

[52]The first stage of the instrumental variable is highly significant (p-value<0.001) and the point estimate is negative. This is an expected result, as for a larger average productivity of the competitors the employment share should diminish. The OLS estimate is 0.851 with standard error 0.005. The positive sign is expected as all the variation comes from productivity changes shifting establishment's demand.

[53]The empirical evidence is complemented in Table I2 of the Online Appendix, where we show alternative regressions of labor share on concentration measures using different fixed effects. The results do not change significantly.

[54]On the contrary, models with bargaining only and with employer labor market power without strategic interactions would not match the data as the effect of concentration on the labor shares would be null. These results support the mechanism of our structural model where union bargaining power and employer labor market power are relevant.

highlight the importance of including employer market power in the model to explain the negative correlation between labor shares and concentration measures, as well as the need for unions to moderate this relationship.

6 Counterfactuals

In this section we evaluate efficiency and welfare effects of the labor wedges coming from labor market power and we quantify how firm and union labor market power counteract each other. As mentioned in section 5.6, observed employment and wage levels are sufficient to identify amenities and revenue productivities in the model. Also, the characterization of the local labor market equilibrium is invariant to local market-wide constants that are multiplcative of productivities. Since the revenue productivities Z_{io} are a product of the sector price and the productivities A_{io}, we can fully characterize the counterfactual local labor market equilibrium. With the counterfactual employment shares and wedges, we can rewrite the rest of the model in relative changes with respect to the baseline equilibrium. This allows us to use "exact hat algebra" techniques, as outlined by Costinot and Rodríguez-Clare (2014), to calculate the counterfactual equilibrium using only the observed levels of wages and employment and without the need to estimate or parameterize a distribution of productivities and amenities. Appendix TBD explains the details.

In our main analysis we start by eliminating the structural labor wedges and computing the output and welfare gains when workers have free mobility and total labor supply is fixed. We then evaluate how firm and union power neutralize each other by turning off each of the forces at a time. That is, we first characterize the competitive equilibrium allocation where wages are equal to the marginal revenue product, and then, we characterize the oligopsony-only and bargaining-only equilibria to disentangle the relative distortions coming from each side of labor market power. We perform the main counterfactuals for 2007, the last year of our sample.

We then evaluate how important is labor mobility to obtain efficiency gains by progressively restricting worker's adjustment. We first allow workers to reallocate within an sector. Then, we only allow workers to move across local labor markets that have the same sector-occupation combination. In this case, workers can move across commuting zones and (3-digit) sub-industries within their (2-digit) sector and occupation. Finally, in the most restricted case, workers can only reallocate in establishments within their local labor markets.

6.1 The effect of two-sided labor market power

Table 5 presents the results of various counterfactual scenarios assuming free mobility. The first column displays the labor shares in the baseline and each counterfactual scenario. The subsequent columns show the percentage gains of each scenario compared to the baseline, with column 2 representing output gains. Eliminating labor wedges increases aggregate output by 1.62%.

The second counterfactual, which assumes unions retain their labor market power while employer power is eliminated, achieves output gains almost comparable to eliminating both distortions.[55] This is because the labor wedges become $\lambda(1, \varphi_b) = 1 + \varphi_b \frac{\delta}{1-\delta}$ and the only heterogeneity

[55]This counterfactual is a situation where none of the sides would internalize movements along the labor supply but bargain over wages.

Table 5: Counterfactuals: Efficiency and Distribution

		Gains (%)		
	LS (%)	ΔY	Δ Wage	Δ Welfare (L)
Baseline $\lambda(\mu, \varphi_b)$	50.62	-	-	-
Counterfactuals				
No wedges $\lambda(1,0) = 1$	72.26	1.62	45.06	42.07
Bargain $\lambda(1, \varphi_b) = 1 + \varphi_b \frac{\delta}{1-\delta}$	73.38	1.60	47.27	44.34
Oliposonistic $\lambda(\mu, 0) = \mu_{io}$	40.94	-0.21	-19.29	-20.53

Notes: First column presents the aggregate labor share (in percent) for the baseline and the different counterfactuals. The last three columns are changes with respect to the baseline in percentages. ΔY is the change of aggregate output, Δ *Wage* is the change in aggregate wage. Aggregate wage is an employment weighted average of establishment-occupation wages. Δ *Welfare (L)* is the change of the median expected welfare of the workers. The main counterfactual is the one without wedges $\lambda = 1$. The second counterfactual *Bargain* is the standad bargaining framework where the workers' outside options are the competitive wages and they don't internalize movements along the labor supply. *Oligopsonistic* is the counterfactual where the wedge is equal to the equilibrium markdown under oligopsonistic competition. Counterfactuals are performed for the year 2007.

comes from the sector-specific bargaining powers, resulting in small distorsionary effects.

The third counterfactual, which retains employer labor market power but eliminates union power, results in a 0.21% reduction in output compared to the baseline, implying that union bargaining power attenuates labor market distortions in the calibrated model. The slightly more heterogeneous labor wedges in this scenario, lead to increased distortions and a reduction in output.

With respect to the distributional effects we look at the aggregate labor share, which is a value added weighted sum of sector labor shares, $\beta_b \lambda_b$. Using the demand of the final good producer (3), the aggregate labor share is:[56]

$$LS = \sum_{b \in \mathcal{B}} \beta_b \lambda_b \theta_b. \tag{26}$$

Column 1 of Table 5 compares the aggregate labor shares of the baseline and the different counterfactuals. Completely removing structural labor wedges increases the labor share by 21 percentage points, from 50.62% in the baseline to 72.26% in the counterfactual. The labor share increases slightly more, up to 73.38%, in the counterfactual where employer labor market power disappears. In contrast, the labor share is reduced to 40.94% in the counterfactual with only oligopsonistic competition. There are two reasons why the labor share gains are large relative to output gains: (i) baseline labor wedges are small but have limited heterogeneity, so there is limited room for output gains; and (ii) the calibrated baseline model features high aggregate profit shares, so there is a high potential for labor share increases. As δ is close to zero, there are almost no quasi-rents coming from the decreasing returns to scale, which, combined with the low capital shares, implies high profit shares in the baseline. Removing the labor wedges shifts the profit previously earned by the firm owners to the workers.

Increases in the aggregate wage do not imply that wage inequality is reduced. Due to the idiosyncratic preferences of workers for different establishments, they will still face a labor supply with finite elasticity. Combined with differences in productivities and amenities, this set-up still yields different wages, even if wedges are equalized.[57]

A higher labor share implies higher wages and higher welfare for the workers. To measure the

[56] All the counterfactuals without labor wedges, i.e., $\lambda_b = 1 \, \forall b$, lead to the same aggregate labor share.
[57] In the limit where workers would be indifferent across different workplaces, there would remain a unique equilibrium wage.

change in workers' welfare, we calculate their median welfare, which is:[58]

$$Median(\mathcal{U}_{iok}) \propto \Phi^{\frac{1}{\eta}}.$$

Columns 3 and 4 of Table 5 show the relative change in average wages and median welfare with respect to the baseline. In the case with no labor wedges, average wages and median welfare increase by 45% and 42%, respectively. In contrast, in the oligopsonistic case, average wages and median welfare are reduced by 19% and 20%. Welfare gains are larger than output gains, as the workers not only benefit from the productivity boost but also from the redistribution of pure rents from the owners.

The main takeaway from our exercises is that unions not only redistribute a significant portion of total output towards workers, but also increase the economy's overall efficiency compared to the case with only oligopsony. While the redistribution effect is expected, given that unions are meant to counteract powerful employers, the efficiency increase is not so obvious. A bargaining arrangement redistributes more to workers if there are more rents to give away. This limits how much rent large employers can get and, as an indirect consequence, also limits the heterogeneity of labor wedges, improving the labor allocation within a local labor market.

To see why unions can improve the efficiency of a local labor market, we can compare how the labor wedge changes when increasing the bargaining power for establishments of different size. More precisely, we can observe that:

$$\frac{\partial^2 \lambda_{io}}{\partial \varphi_b \partial s_{io}} = -\frac{\partial \mu_{io}}{\partial s_{io}} > 0.$$

Therefore, unions increase the labor wedge by more to larger establishments compared to smaller ones, reducing the overall variance of wedges and the potential misallocation of labor within a local labor market. However, as different sectors have have different bargaining powers, unions can still distort the overall employment allocation across sectors. For example, in the knife-edge case where the local and across elasticities of substitution are the same the markdowns are constant for any establishment, and unions would generate inefficiencies by distorting the allocation across sectors. By having unions in this case, the labor wedge would be a sector constant, so within sector allocations would remain undistorted, but the sector wedge would affect the sectoral employment and prices.

6.2 The importance of labor mobility in realized efficiency gains

We perform three additional counterfactuals to locate the output gains in an environment with mobility costs. Counterfactuals differ in their mobility restrictions, where we allow mobility to happen only within sector, sector-occupation and local labor market. Table 6 compares the free mobility case with the restricted mobility cases. Comparing the output gains in column 1 across the different scenarios, we find that the key margin of adjustment is geographical mobility. Fixing employment at the sector-occupation level accounts for 82% of the gains of the free mobility case. Restricting workers to stay in their particular local labor market output gains are 0.49%, which

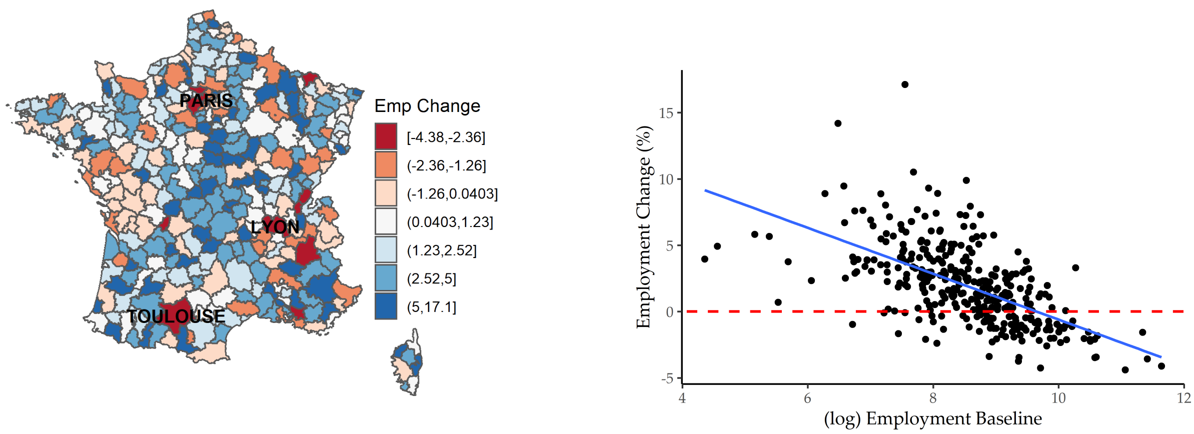
[58] As the across local labor market elasticity η is smaller than 1, the expected value of the Fréchet distribution is not defined. We therefore can only compute the median and the mode of the workers' welfare.

Table 6: Counterfactuals: Limited Mobility

	ΔY (%)	Δ Prod (%)	Contribution ΔY (%)		
			GE	Productivity	Labor
Free mobility	1.62	1.33	9	83	8
Mobility within					
Sector	1.32	1.33	-1	101	0
Sector-occ	1.33	1.35	-2	102	0
Local market	0.49	0.49	-2	102	0

Notes: Results in percentages. First column presents the ΔY is the change of aggregate output with respect to the baseline, Δ *Prod* is the change in aggregate productivity from decomposition (27). Last three columns present the contribution of each of the elements of the decomposition (27) to output gains. *Free Mobility* presents the main counterfactual without wedges and under free mobility of labor. *sector* is the counterfactual where mobility is restricted to be only within sector, *sector-occ* fixes employment at the sector-occupation and allows for mobility across locations and across 3-digit sub-industries, and *Local market* allows for mobility only across establishments within local labor markets. Counterfactuals are performed for the year 2007.

Figure 4: Employment Change (%) in the Counterfactual



Notes: The map presents employment changes with respect to the baseline economy in percentages within commuting zones. Counterfactuals are performed for the year 2007. The figure in the right plots the employment change versus the log of employment in the baseline. The blue line is a fitted line from an OLS regression.

constitute only 30% of the gains under free mobility. The table does not report changes in the labor share as this will be identical in all cases from (26) with $\lambda_b = 1$ for all b.

These results underscore the importance of free mobility of labor across locations as the main driver for output gains. Figure 4 shows the percentage change of manufacturing employment in the free mobility case. Each block is the aggregation of local labor markets to the commuting zone. The main conclusion from the counterfactual analysis is that, in the absence of labor wedges, manufacturing employment in big cities, such as Paris, Lyon, Marseille or Toulouse would be reduced. The counterfactual reveals that there are a handful rural productive establishments in concentrated local labor markets. In the baseline these have lower wage markdowns and lower employment. Moving to the counterfactual, those are the ones with the biggest relative wage and employment gains.[59]

Turning now to the source of the output gains, we can use the aggregate production function and the relative sector output and decompose the logarithm of the relative final output into three

[59] Another potential reason is the differential in the amenities. The reduction of manufacturing labor in the big cities could be magnified if they have in general worse amenities.

terms:[60]

$$\ln \widehat{Y} = \underbrace{\sum_{b\in\mathcal{B}} \theta_b \ln \widehat{P}_b^{\frac{\alpha_b}{1-\alpha_b}}}_{\Delta \text{ GE}} + \underbrace{\sum_{b\in\mathcal{B}} \theta_b \ln \widehat{\Psi}_b}_{\Delta \text{ Productivity}} + \underbrace{\sum_{b\in\mathcal{B}} \theta_b \ln \widehat{L}_b^{1-\delta}}_{\Delta \text{ Labor}}. \tag{27}$$

The first term on the right hand side corresponds to the capital effects or general equilibrium effects of capital flowing to different sectors as a response to changes in relative prices. The second term, arguably the most important, represents total productivity gains from less misallocation. This term suffers the most from labor market concentration as big productive firms are shrinking their relative participation, therefore reducing overall productivity. The third term corresponds to how labor is allocated across sectors.

Columns 3 to 5 of Table 6 show the decomposition of relative changes of output.[61] The main source of output gains come from productivity. sector productivity is an employment weighted sum of establishment-occupation productivities (that are unchanged). The source of aggregate productivity and output gains is therefore the reallocation of workers towards productive establishments.

Column 2 shows the productivity gains in the different mobility cases. Those are similar as long as labor is mobile at the sector level. General equilibrium effects determine the reallocation of employment across industries and total output gains but mobility restrictions below the sector level prevent the reallocation towards productive establishments and reduce the productivity gains.

We show in Online Appendix F.1 that most significant gains of the counterfactual productivity happen outside urban areas. As a result, the largest gains relative to the baseline in wages and employment are in commuting zones that do not include big cities.

6.3 Additional exercises

In Online Appendix F.2 we explore how differences in labor market power affect the population composition and wage gap between rural and urban locations. We find that the importance of cities in manufacturing would have declined more slowly in absence of labor market power. A potential reason is that the closure of manufacturing establishments in cities would increase the labor concentration of urban areas, making small labor markets relatively more attractive. We also find that the urban-rural wage gap is reduced from 36 to 23 percent. This implies that labor market power can explain more than a third of the observed urban-rural wage gap.

7 Extensions

The main counterfactual had some strong assumptions. In particular, the total labor supply was fixed and there were no agglomeration externalities. In this section, we propose extensions to relax these assumptions. First, we allow for an endogenous labor participation decision. Second, we introduce agglomeration forces in the local labor markets. All the details are left for the Online Appendix C.

[60] See Online Appendix A for the detailed derivations.

[61] Note that $\Delta Y = \widehat{Y} - 1 \approx \ln \widehat{Y}$. The decomposition is with respect to $\ln \widehat{Y}$. The share of the gains that come from *Productivity* is $\frac{\sum_{b\in\mathcal{B}} \theta_b \ln \widehat{\Psi}_b}{\ln Y}$. Each row from columns 3 to 5 sums up to 100.

7.1 Endogenous labor force participation

We briefly present the extension with endogenous labor force participation decisions. We assume workers can decide between working and staying at home. In the latter case, they earn wages related to home production. Staying at home is now an endogenous choice, as workers compare the utility from working and staying at home when making their labor decision.

We incorporate the option of being out-of-the-labor-force (from now on OTLF) by defining a new (3-digit) sub-industry for each (2-digit) sector. These new sub-industries have only one 'establishment', indexed by u, per commuting zone. Each of these establishments 'employ' different occupations paying them a home production wage w_{uo}. The establishment-occupations define a new set of local labor markets $\mathcal{U}$ that correspond to combinations of commuting zones, occupations, and the new sub-industries.

Similar to the baseline model, we assume that workers face idiosyncratic shocks that are labor market specific and have the same Fréchet distribution. Thus, the number of workers OTLF in a particular commuting zone-sector u and occupation o is:

$$L_{uo} = \frac{(T_{uo} w_{uo}^{\varepsilon_b})^{\eta/\varepsilon_b} \Gamma_b^{\eta}}{\Phi} L, \quad \Phi \equiv \Phi_e + \Phi_u.$$

Here Φ is now formed of two components. First, $\Phi_e \equiv \sum_{m \in \mathcal{M}} \Phi_m^{\eta/\varepsilon_b} \Gamma_b^{\eta}$ is the part of Φ that comes from the employed workers. The second component is $\Phi_u \equiv \sum_{uo \in \mathcal{U}} (T_{uo} w_{uo}^{\varepsilon_b})^{\eta/\varepsilon_b} \Gamma_b^{\eta}$ collects the terms that correspond to all workers OTLF. L is the total labor supply of both, the employed and the OTLF workers.

We lack detailed data on the geographical distribution of out-of-the-labor-force status as labor force surveys provide information only at the more aggregated regional level. Basing our counterfactuals in those surveys would require the assumption of constant rates of labor participation for entire regions. Instead, we use commuting zone level unemployment rates as proxies for OTLF rates.

To map the model with the data, we assume that the OTLF rate is the same across industries and occupations in each commuting zone and define the proportion of workers OTLF in each local labor market uo accordingly. Similar to how we identify amenities in the baseline model, the proportion of OTLF workers in each local market identifies the home production amenity and income $T_{uo} w_{uo}^{\varepsilon_b}$. We assume that the home production incomes are fixed in the counterfactuals.

Table 7 shows the results of the counterfactuals with endogenous labor force participation. The counterfactual output gain is 1.98%. Introducing the endogenous labor participation margin induces higher output gains than in the baseline (*Fixed L*). In contrast to the output gain decomposition in Table 6, around 30% of the gains come from the increased total employment. Labor force increases 1% in the main counterfactual without wedges. This extensive margin of adjustment in the total labor supply amplifies the original differences in output gains across counterfactuals. In particular, output losses from oligopsonistic competition are as high as 1.29% because total labor force participation is reduced by -0.75%. Despite featuring high wage gains, the increase in total employment is minor in the counterfactual because we assume that workers have idiosyncratic shocks to stay OTLF.

Table 7: Counterfactual: Endogenous Participation

	ΔY (%)	Δ Prod (%)	Δ L (%)	Contribution ΔY (%)		
				GE	Prod	Labor
Fixed L	1.62	1.33	0.00	9	83	8
Endogenous Participation						
No wedges $\lambda(1,0)=1$	1.98	1.18	1.00	11	60	29
Bargain $\lambda(1,\varphi_b)=1+\varphi_b\frac{\delta}{1-\delta}$	2.04	1.18	1.04	10	58	32
Oligopsonistic $\lambda(\mu,0)=\mu(s)$	-1.29	-0.59	-0.75	2	46	53

Notes: Results in percentages. First column ΔY is the change of aggregate output with respect to the baseline, Δ *Prod* is the change in aggregate productivity from decomposition (27) and ΔL is the counterfactual change in total employment. Last three columns present the contribution of each of the elements of the decomposition (27) to output gains. *Fixed L* is the main counterfactual without wedges, under free mobility of labor and fixed total labor supply. The main counterfactual is the one without wedges $\lambda = 1$. All the other counterfactuals in this table allow for endogenous labor force participation. *No wedges* is analogous to the main counterfactual without wedges. *Bargain* is the standad bargaining framework where the workers' outside options are the competitive wages and they don't internalize movements along the labor supply. *Oligopsonistic* is the counterfactual where the wedge is equal to the equilibrium markdown under oligopsonistic competition.

Table 8: Counterfactuals: Agglomeration

	ΔY (%)	Δ Prod (%)	Contribution ΔY (%)		
			GE	Productivity	Labor
No Agglomeration	1.62	1.33	9	83	8
Agglomeration					
$\gamma = 0.05$	1.73	1.40	8	82	10
$\gamma = 0.1$	1.84	1.48	7	81	12
$\gamma = 0.15$	1.96	1.57	6	81	13
$\gamma = 0.2$	2.08	1.66	5	80	15
$\gamma = 0.25$	2.22	1.75	3	80	17

Notes: Results in percentages. First column ΔY is the change of aggregate output with respect to the baseline, Δ *Prod* is the change in aggregate productivity from decomposition (27). Last three columns present the contribution of each of the elements of the decomposition (27) to output gains. *No Agglomeration* is the main counterfactual without wedges, under free mobility of labor, fixed total labor supply and no agglomeration forces. All the other counterfactuals in this table allow for agglomeration within the local labor market. Similarly to the main counterfactual, workers are freely mobile and total employment is fixed. We present different counterfactuals depending on the agglomeration elasticity γ.

7.2 Agglomeration

In this section we present an extension of the model that includes agglomeration forces at the local labor market level. To keep the model tractable, we assume that the productivity is: $\widehat{A}_{io} = \widetilde{A}_{io} L_m^{\gamma(1-\alpha_b)}$. The agglomeration effect is a local labor market externality with elasticity $\gamma(1-\alpha_b)$. The wage first order condition is:

$$Pw_{io} = \beta_b \lambda(\mu_{io}, \varphi_b) Z_{io} L_{io}^{-\delta} L_m^{\gamma}. \tag{28}$$

Similarly to the baseline counterfactual, we back out the transformed TFPRs, Z_{io}, to match observed establishment-occupation wages, w_{io}, under the assumption of agglomeration externalities. In the case where employment for a given local labor market is high, the backed out productivity of the establishments in that market m is lower than for the main counterfactual.

Table 8 summarizes the counterfactual results for different values of γ. All the counterfactuals in Table 8 also assume the absence of labor wedges and free mobility but introduce agglomeration forces in local labor markets. As γ becomes higher, the more important are the agglomeration forces and the higher are the efficiency gains. The reason behind this result is that increasing γ

the local labor market employment L_m becomes more important in (28). Consequently, differences in employment levels across local labor markets amplify their productivity differences. The movements towards small local labor markets are therefore bigger than in the main counterfactual (*No Agglomeration*). Output gains are monotonic in the importance of agglomeration externalities.

8 Conclusion

We evaluate the efficiency and welfare costs of employer and union labor market power and how those forces counteract each other. We find that removing structural labor wedges increases output by 1.62% and that unions countervail distortions generated from firm labor market power as output would be reduced by 0.20% in a counterfactual without unions. Gains from removing union and firm power are amplified up to 1.98% when we allow for an endogenous labor force participation margin. The main mechanism behind the output gains is the reallocation of resources towards more productive establishments. Removing labor market distortions also leads to significant labor share and wage gains. These results imply that the employer labor market power is more important than that of unions in determining the labor wedge for manufacturing in France.

There are some potential insights for policy. The counterfactual without labor wedges suggests that there is missing employment in French rural areas due to employer labor market power. Eliminating these distortions would not only increase wages but also the efficiency of manufacturing. Our estimated model shows how unions counteract employer labor market power and homogenize the wedge across establishments within a sector. Meaning, as long as establishments within a sector face a similar union institutional setting, workers' bargaining power will dampen the heterogeneity of labor wedges that stem from differentiated employer labor market power.

However, empowering unions can not completely correct for the inefficiencies caused by the employers' market power. Empowering unions could lead to some unmodeled adverse effects like reducing the entry of new establishments. Nonetheless, the efficient allocation can be implemented by hiring subsidies that would be establishment specific and depend on the establishments' employment share. Those subsidies could be financed by uniform taxes on profits or payroll.

The implementation of such a tax policy would be cumbersome and not realistic. So what could be a second-best alternative? Our counterfactuals with mobility restrictions offer a partial answer to this question. When workers can move across commuting zones, but within a sector-occupation combination, the productivity gains are close to the case where workers can move freely. On top of that, we see that workers would reallocate into rural areas. But, when we restrict workers to stay within its local labor market, the productivity gains are around a third of the free mobility case. This means that the workers' geographical reallocation matters the most to get the productivity gains from removing labor market power. Policies aimed to make rural areas more attractive could trigger such employment reallocation, mitigating the efficiency losses from labor market power.

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Appendix for Publication

Bargaining details

We provide derivations under the baseline bargaining protocol where employers and unions have zero outside options and internalize movements along the labor supply curve. An alternative bargaining protocol leading to the same equilibrium condition for the wages is at the end.

Each establishment has different occupation profit functions $(1-\alpha_b)P_bF(L_{io}) - w^u_{io}L_{io}$, where the optimal capital decision has been taken. We assume that workers and establishments are symmetric both having null threat points and internalizing the generation of rents as they move along the labor supply curve. During the bargaining establishments and unions choose wages to maximize:

$$\max_{w^u_{io}} \left[w^u_{io}L_{io}(w^u_{io})\right]^{\varphi_b}\left[(1-\alpha_b)P_bF(L_{io}(w^u_{io})) - w^u_{io}L_{io}(w^u_{io})\right]^{1-\varphi_b},$$

where we made explicit the fact that both parties internalize how labor supply is a function of equilibrium wages. φ_b is the union's bargaining power, w^u_{io} the wage bargained with the unions at establishment-occupation io, L_{io} the number of workers employed at establishment-occupation io in equilibrium, $(1-\alpha_b)F(L_{io})$ is the output of the establishment-occupation after substituting for the optimal decision of capital. The first order condition of the above maximization problem are:

$$\varphi_b\frac{(1-\alpha_b)P_bF(L_{io}) - w^u_{io}L_{io}}{w^u_{io}L_{io}}\left[L_{io} + w^u_{io}\frac{\partial L_{io}}{\partial w^u_{io}}\right] + (1-\varphi_b)\left[(1-\alpha_b)P_b\frac{\partial F(L_{io})}{\partial L_{io}}\frac{\partial L_{io}}{\partial w^u_{io}} - L_{io} - w^u_{io}\frac{\partial L_{io}}{\partial w^u_{io}}\right] = 0.$$

Using the definition of the perceived labor supply elasticity $e_{io} = \dfrac{\partial L_{io}}{\partial w_{io}}\dfrac{w_{io}}{L_{io}}$ and rearranging the first order condition:

$$w^u_{io} = \varphi_b(1-\alpha_b)P_b\frac{F(L_{io})}{L_{io}} + (1-\varphi_b)(1-\alpha_b)P_b\frac{\partial F(L_{io})}{\partial L_{io}}\frac{e_{io}}{e_{io}+1},$$

where $\mu(s_{io}) \equiv \dfrac{e_{io}}{e_{io}+1}$ is the markdown that establishments would set under oligopsonistic competition.

After substituting the optimal decision for capital, the output elasticity with respect to labor of $F(L_{io})$ is $1-\delta$. Then, from the definition of the output elasticity we have that $\frac{1}{1-\delta}\frac{\partial F(L_{io})}{\partial L_{io}} = \frac{F(L_{io})}{L_{io}}$. Thus, the bargained wage becomes:

$$w^u_{io} = \underbrace{(1-\alpha_b)P_b\frac{\partial F(L_{io})}{\partial L_{io}}}_{MRPL_{io}}\left[(1-\varphi_b)\frac{e_{io}}{e_{io}+1} + \varphi_b\frac{1}{1-\delta}\right],$$

where we recovered the expression from the main text.

Alternative bargaining protocol. The alternative bargaining assumption leading to the same equilibrium wages is that employers and unions bargain over wages without internalizing movements along the labor supply and workers' outside options are the oligopsonistic competition wages w^M_{io} under the allocation with the given equilibrium wages. This alternative protocol is quite ad-hoc as the employer labor market power is embedded in the workers outside options. The bargaining problem would be:

$$\max_{w^u_{io}} \left[w^u_{io}L_{io} - w^M_{io}L_{io}\right]^{\varphi_b}\left[(1-\alpha_b)P_bF(L_{io}) - w^u_{io}L_{io}\right]^{1-\varphi_b}.$$