Union and Firm Labor Market Power[*]

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Abstract

Can union and firm market power counteract each other? What are the output 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 0.48 percent because they partially counteract distortions coming from oligopsony power. The reallocation of employment across space is key to realize the output gains from unions.

JEL Codes: J2, J42, J51

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

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There is growing evidence, especially for the United States, that links 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 theoretical 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 0.48%. While the effect on output is small, unions have a meaningful distributional role. Without unions, the labor share would be 12 percentage points smaller and average wages 24% smaller. This translates into median welfare losses for the workers of more than 26%. We also find that unions can serve as a partial alternative to more firms competing in the labor market: they increase output compared to an oligopsony scenario, but fall short of the gains from a monopsonistic competition counterfactual—a limit case where establishments become atomistic due to entry of a continuum of competitors. However, unions increase workers' welfare by more than increasing competitors, as unions boost wages by redistributing rents.

Rent redistribution also drives the output gains. In our model, productive firms have more labor market power and rents. Without unions, these firms pocket their rents and hire too few workers. While subsidies can encourage hiring, unions achieve it differently: by redistributing rents to workers. Unions raise wages relatively more in productive, high-rent firms, increasing their employment share and thus improving aggregate productivity.

We proceed in three steps. First, we establish empirically that, within a firm-occupation pair, establishments with higher local employment shares pay lower wages. We identify this effect by using a competitor's national mass layoff shock as an external source of variation to an estab-

[1] See Benmelech et al. (2018), Azar et al. (2020b), Berger et al. (2022), Jarosch et al. (2019), Benmelech et al. (2018) among others.

lishment's local employment share. Second, in line with the empirical evidence and the French institutional setting, we build and estimate a model where (i) employers face upward-sloping labor supplies, and (ii) workers bargain over wages. Third, we use the model to quantify the output and welfare consequences of employers and workers' labor market power.

We start by documenting the link between employer's market power and wages in the French manufacturing sector. We define a local labor market as a combination of a commuting zone, industry, and occupation. At the establishment-occupation level, we proxy labor market power with the local labor market employment share. As employment shares and wages are likely endogenous, 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]

We build a general equilibrium model that incorporates two elements: employer and union labor market power. Our framework without bargaining is similar to the one in Berger, Herkenhoff, and Mongey (2022) (BHM) under Bertrand competition. First, we assume workers have stochastic preferences to work at different places, as in Card, Cardoso, Heining, and Kline (2018), generating an upward sloping labor supply curve at the establishment level. In the absence of bargaining, a discrete set of employers per labor market act strategically and compete for workers in an oligopsonistic fashion. Wages are therefore paid with a markdown, a function of the labor supply elasticity, which depends itself on the employment share. 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 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 a markdown due to oligopsony power and a markup due to wage bargaining. Our model nests as special cases both, a full bargaining setting or a model with

[2]This corresponds to a reduction of roughly 1,000 euros (at 2015 prices) per year if we pass from the first to the third quartile of the employment share distribution.

oligopsonistic competition only. 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. Differences in labor wedges across establishments distort relative wages and create resource misallocation.

The model features a large number of variables to solve. We show that the model is block recursive so we can solve the equilibrium of each local labor market ignoring variables at the sector level. We then show how to aggregate the model and obtain closed-form expressions for the sector-level variables, along proving uniqueness and existence of the general 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. Labor supplies depend on two key parameters related to the heterogeneity of workers' preferences, the *local* and *across-market* elasticities of substitution. 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. We first estimate the across-market elasticity of substitution using establishments that are alone in their local labor markets. Their local labor market equilibrium is a standard system of labor supply and demand equations, where OLS estimates would suffer from simultaneity bias. Rather than instrumenting, we identify the across local labor market elasticities and the inverse labor demand elasticity adapting the identification through heteroskedasticity of Rigobon (2003) which allows to recover the structural parameters by assuming heteroskedasticity across sub-samples.

We then 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 (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: (i) we clarify the general relationship between the elasticity of substitution and the labor supply elasticity and explain the scenarios where they are equivalent; (ii) we establish generally the bias between the labor supply elasticity and a reduced form estimate; and (iii) we show that within-equilibrium variation can identify the local elasticity of substitution. The identification of the local and across-market elasticities do not rely on any wage setting assumption. This makes our strategy portable to different settings. Also, it allows us to separately identify the bargaining powers by matching observed sector-level labor shares.

Even when our model has elements that depart from more traditional environments in the trade and urban literatures, 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 relative to the current equilibrium.[3] 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.

Our counterfactual analysis suggest that employer labor market power is stronger than that of unions. In a scenario without employers' or workers' labor market power, where wages are equal to the marginal revenue product of labor, output increases by 1.6 percent while the labor share rises by 21 percentage points. This translates into 42 percent median welfare gains for workers.

Workers' geographic mobility is the key margin of adjustment to achieve the output gains from unions. Compared to a counterfactual without unions where we restrict labor mobility along different dimensions, we find that: (i) unions increase output through sectoral reallocation within manufacturing; and (ii) reduce the geographical misallocation by extracting more rents in rural areas. This is because there are a handful of concentrated and productive firms in rural areas whose wages and employment would loose more without unions relative to urban areas. On a similar note, we find that unions close the urban-rural wage gap by 14 percentage points—about a third—affecting the geographical composition of manufacturing employment in France.

Literature. This paper speaks to several strands of the literature. First, and most closely related, is the literature on employer labor market power. We depart from other monopsony

[3] Costinot and Rodríguez-Clare (2014) refer to this method as "exact hat algebra".

power frameworks (e.g. Manning, 2011; Card et al., 2018) by having heterogeneous markdowns arising from oligopsony, as in Berger, Herkenhoff, and Mongey (2022), and by extending it to allow for wage bargaining.[4] Different from BHM, we focus on the role of unions as an alternative to labor market competition in a multi-sector, multi-occupation model. Also, we show how to compute counterfactuals using actual establishment micro-data. The paper is complementary to Jarosch et al. (2019) as they consider employer labor market power in a search framework. Bachmann et al. (2022), MacKenzie (2021) and Trottner (2023) 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.

Several empirical papers have documented the importance of labor market concentration on wages, employment and vacancies.[5] 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.[6] Most empirical papers focus on aggregate measures of concentration, like the Herfindahl-Hirschman Index, as a proxy for employer labor market power. Our contribution to this 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.*

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 et al., 1995; Farber et al., 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 concen-

[4] Recent papers studying monopsony power include Lamadon et al. (2022), Deb et al. (2022a), Deb et al. (2022b), Amodio and De Roux (2021), Amodio et al. (2022), Datta (2021), Jha and Rodriguez-Lopez (2021), and Felix (2021) among others.

[5] Azar et al. (2020a); Benmelech et al. (2018); Azar et al. (2020b); Schubert et al. (2020); Dodini et al. (2020); Marinescu et al. (2021) among others.

[6] 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.

tration.[7] 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 evaluate their aggregate implications.

We estimate local and across-market elasticities of substitution, which bound the elasticity of the labor supply.[8] Therefore, our paper contributes to micro estimates of firm labor supply elasticities. Staiger et al. (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). Both our local and across market elasticities of substitution lie in that range. Dube et al. (2020) and Datta (2021) estimate a labor supply elasticity to firm-level wage policies ranging between 3 and 5, which is close to our local elasticity of substitution. Azar et al. (2022) estimate market elasticities of 0.5 and firm elasticities of 5 which are very close to our estimated elasticities of subsitution. Lastly, the median estimate in the meta-analysis of Sokolova and Sorensen (2021) and the estimates in Webber (2015) are close to 1, which is in between our estimates for the across-market and local elasticities of substitution.

Outline. The rest of the paper is organized as follows. Section 1 introduces the data. Section 2 shows the empirical evidence. Section 3 presents the model. Section 4 discusses the identification and estimation. Section 5 has results from the counterfactuals and Section 6 concludes. Additional derivations can be found in the Online Appendix and the Supplemental Material.

1 Data

Most of our analysis relies on the *FICUS* dataset 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.[9] 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

[7] Marinescu et al. (2021) in France, Benmelech et al. (2018) in the U.S. and, Dodini et al. (2021) and Dodini et al. (2024) in Norway.

[8] The local elasticity of substitution bounds it from above and the across-market elasticity from below.

[9] Wage data was imputed before 1994 and after 2007 the industry classification (APE) is not consistent with previous versions. The classification change between the 1993 and 2003 codes is consistent at the 3-digit level.

that are necessary to distinguish across different establishment-occupations of a given firm.

We define four broad categories of occupations: top management, supervisor, clerical and operational.[10] We define a local labor market as the combination of commuting zone, 3-digit industry, and occupation. On average, there are 57,900 local labor markets per year.[11] Our sample consists of approximately 4 million establishment-occupation-year observations that belong to around 1.25 million firms. Details about sample selection and additional summary statistics are in the Supplemental Material.

1.1 Summary statistics

The median occupation at a given establishment has 2 employees. We denote as multilocation firm-occupations the firms have an occupation in different locations.[12] 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.

We categorize manufacturing firms into 97 different 3-digit industries, or sub-industries, which are distributed across 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%.[13] Taking those averages, the profit share would be around 22%.

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.[14] The median local labor market is small and has only 2 establishments and 10 employees. This is a consequence of the handful of manufacturing

[10]The classification is similar to Caliendo et al. (2015). We group together firm owners receiving a wage and top management positions into top management because their distinction was not stable in 2002.

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

[12]See Table VII1 in the Supplemental Material.

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

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

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.[15] 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.

2 Empirical evidence

This section provides evidence of employer labor market power in France and presents the French institutional setting. The purpose of the section is twofold: first, to guide the modeling choices in the structural model developed afterwards; second, to have a credible empirical exercise to validate the estimated structural model.

2.1 Labor market power and wages

We first explore the relationship between employer labor market power and wages at the establishment level. We face the challenge of finding a source of exogenous variation for our proxy of local labor market power, the employment share, that will allow to identify the effect of employer market power on wages. In what follows, we focus on multilocation firm-occupations where the effects are estimated using residual variation across local labor markets within a firm-occupation-year. The baseline specification is:

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

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 in 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.

The specification controls for sector labor demand differences with firm-occupation-year

[15] The HHI of local labor market m ranges from $1/N_m$, if all the establishments have the same shares, to 1. The median HHI is very similar (0.69) if we consider wage bill shares $s^w_{io|m}$ instead of employment shares $s_{io|m}$.

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, for potential geographical spillovers of mass layoff shocks as stressed by Gathmann et al. (2017), and for average local outside options as discussed by Schubert et al. (2020).

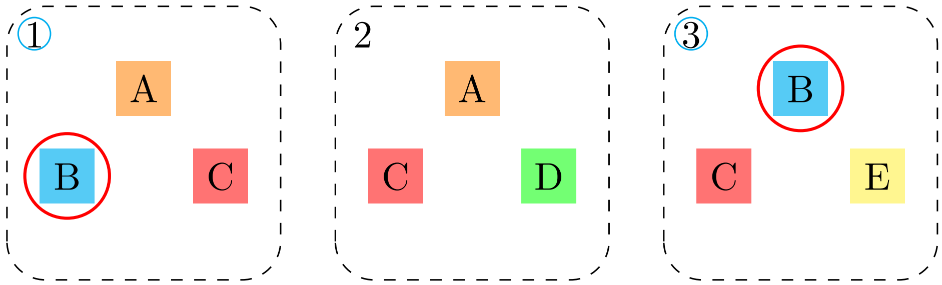
The establishment's employment share, $s_{io|m,t}$, is likely to be endogenous to the wages. On the one hand, everything else equal, higher wages attract more workers and therefore increase the employment share. On the other hand, if there is labor market power on the employer side, we expect two establishments 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.[16] 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. 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 E.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

[16] While the use of *own* mass layoff shocks to analyze the effect on labor market outcomes is not novel (Gathmann et al., 2017; Dodini et al., 2020), we think that using mass-layoff shocks to *competitors* is a novel approach. Using a similar design as ours, a recent paper by Schubert et al. (2020) use granular Bartik-style shocks that predict changes in local hiring growth coming from national firms' hiring growth to build an instrument for aggregate hiring concentration. Our approach differs from theirs importantly in that our instrument builds from exogenous shocks to competitors and we use residual firm variation instead of residual local labor market variation.

Figure 1: Mass Layoff Instrument



Notes: Firm B suffers a *national* mass layoff shock which changes the labor market power of non-affected establishments in markets 1 and 3.

with three local labor markets and five firms (abstracting from occupations) from A to E. Firm B suffers an idiosyncratic shock that leads to a *national* mass layoff which would change the labor market power of its competitors' establishments in those markets where firm B is present. For example, 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 B is independent of its competitors establishments' locations.

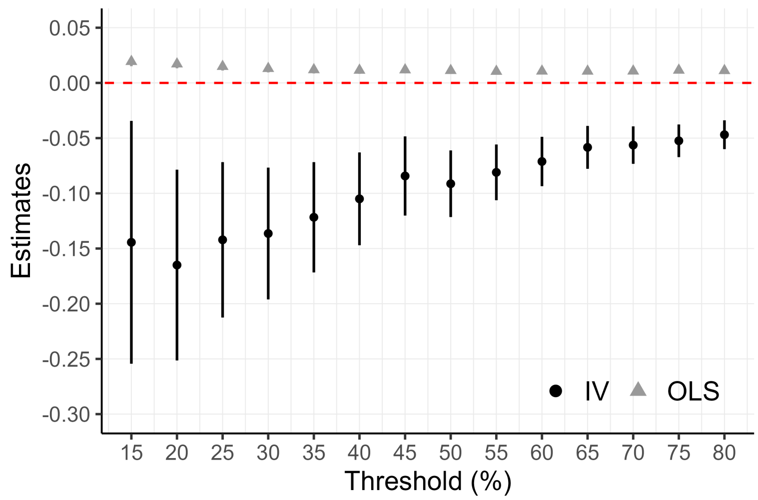
We restrict our sample to multi-location firms that meet two conditions: (i) they did not experience a mass layoff shock themselves , and (ii) they have establishments in local labor markets affected and unaffected by a mass layoff shock to competitors. In the example of Figure 1, our sample would be the establishments of firms A and C.

To construct our instrument, we first need to identify the firms suffering a mass layoff.[17] We classify a firm-occupation as having a mass layoff if the establishment-occupation employment at t is less than a threshold $\kappa\%$ 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 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

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

Figure 2: Impact of Employment Share on Wages



Notes: y-axis: point estimates and 95% confidence bands of the OLS and IV exercises from equation (1), x-axis: 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.

the selection of the threshold. Lacking a clear candidate for κ, we try different cut-off values.[18]

We present the OLS and IV point estimates and their 95% confidence intervals in Figure 2.[19] 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 $\kappa = 15\%$ (i.e. an 85% 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.[20] For the more standard threshold of $\kappa = 70\%$ (a 30% employment 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. Online Appendix E.1.2 presents several robustness checks by changing the instrument, the fixed effects, and the definition of local labor market. We also include the logarithm of es-

[18] A standard value is κ =70% (e.g. Hellerstein et al., 2019; Dodini et al., 2020), a 30% employment loss.

[19] Restricting to firm-occupations classified as not having a mass layoff the sample changes depending on κ.

[20] Computed with the employment share differences between percentiles 75 and 25 from Table VII1 in the Supplemental Material for the median wage. The the average wage analogous is roughly 1,100 euros.

tablishment employment as an additional control to take into account changes along the labor demand curve. Our main result—that 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 now explain the institutional setting and the importance of unions in France.

2.2 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, though trade union affiliation in France is among the lowest of all the OECD countries. 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%).[21]

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. The French institutional framework implies that coverage of collective agreements in 2014 was as high as 98.5% despite the low union affiliation rates. This is in contrast to the 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.[22] 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

[21] See Table E1 in Online Appendix E.3 for a comparison with more countries.

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

Romans, 2014, page 7).

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.[23] As a consequence, firm level wage bargaining is common even at relatively small establishments across sectors. 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) and affects about 70% of wage employment. This share was 61% for firms above 50 employees. In our final sample, manufacturing firms with more than 50 workers—where bargaining is expected to be frequent and there are mandatory profit-sharing rules (Nimier-David et al., 2023)—constitute 74% of employment and 80% of value added.[24]

We would like to to determine whether sector or occupation dimensions of bargaining hold greater relevance in the manufacturing sector. To explore this, we run regressions on wages using a proxy for rents and compare the dispersion of estimates across different sectors and occupations; the details are in the Supplemental Material. We find that that the dispersion of sector estimates is almost four times greater than that of occupations. Then, in the model below, we assume differentiated bargaining powers depending on the sector.

We now present a model with both firm labor market power and—in line with the French institutional setting—unions.

3 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 $\mathcal{M} = \bigcup_{b \in \mathcal{B}} \mathcal{M}_b$ and the set of all markets

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

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

within sector b as $\mathcal{M}_b = \bigcup_{h \in b} \mathcal{M}_h$. The distribution of establishments across local labor markets is determined exogenously.

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 a local labor market m, 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 sector specific capital. We assume the economy is a small open economy so 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, which is the same for all workers in establishment-occupation io, 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.

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:

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

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

where θ_b is the elasticity of the intermediate good produced by firms in sector b and $\sum_b \theta_b = 1$ and profit maximization implies that the representative firm spends a fixed proportion θ_b on the sector composite (3). The final good price, which we choose as the numeraire, is equal to: $P = 1 = \prod_{b \in \mathcal{B}} \left({}^{P_b}/_{\theta_b}\right)^{\theta_b}$.

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, their output is aggregated linearly. 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 occupation.

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 that incorporates elements coming from the demand of capital. Details on these derivations are in the Supplemental Material. In the rest we use the production function after substituting the optimal choice for capital.

Labor supply

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 indirect utility of worker k working for establishment i at occupation o in local labor market m is: $\mathcal{U}_{kio} = w_{io} z_{kio} u_{km}$.

Following trade and urban literatures (e.g. Eaton and Kortum, 2002; Ahlfeldt et al., 2015) we assume that the idiosyncratic utility shocks are drawn from two independent Fréchet distributions: $P(z) = e^{-T_{io} z^{-\varepsilon_b}}$, $T_{io} > 0$, $\varepsilon_b > 1$ and $P(u) = e^{-u^{-\eta}}$, $\eta > 1$, 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 and are inversely related to the variance of the taste shocks. We call ε_b and η as the *local* and *across* labor market elasticities of substitution.

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 observes the establishment idiosyncratic shocks and chooses the establishment that maximizes expected utility. The establishment-occupation labor supply is the product of the unconditional probability of working in io, Π_{io}, times the total measure of workers L:

$$L_{io} = \Pi_{io} \times L = \frac{T_{io} w_{io}^{\varepsilon_b}}{\Phi_m} \times \frac{\Phi_m^{\eta/\varepsilon_b} \Gamma_b^{\eta}}{\Phi} \times L = s_{io|m} \times s_m \times L, \tag{7}$$

where $s_{io|m}$ is the employment share within market m, and s_m is the employment share of market m. Φ_m and Φ are local market m and economy-wide aggregates defined as:

$$\Phi_m \equiv \sum_{i'} T_{i'o} w_{i'o}^{\varepsilon_b}, \quad \Phi_b \equiv \sum_{m' \in \mathcal{M}_{b'}} \Phi_{m'}^{\eta/\varepsilon_b}, \quad \Phi \equiv \sum_{b \in \mathcal{B}} \Phi_b \Gamma_b^{\eta},$$

where Γ_b are sector-specific constants.

Bargaining

To ease the exposition we start by characterizing the equilibrium wages without bargaining when establishment-occupations set wages strategically. The Proposition below characterizes the local labor market equilibrium under oligopsony.

Proposition 1 (Oligopsony). *Let $MRPL_{io} \equiv \beta_b A_{io} L_{io}^{\frac{\beta_b}{1-\alpha_b}-1} P_b^{\frac{1}{1-\alpha_b}}$. In the absence of bargaining, profit maximization of establishment-occupations competing strategically lead to the following equilibrium conditions:*

$$w_{io}^{O} = \mu_{io} \times MRPL_{io}, \quad \mu_{io} = \frac{e_{io}}{e_{io}+1}, \quad e_{io} = \varepsilon_b \left(1 - s_{io|m}\right) + \eta \, s_{io|m}, \tag{8}$$

where w_{io}^{O} is the wage in the oligopsony equilibrium, μ_{io} is the endogenous markdown that depends on the labor supply elasticity e_{io} which is a function of the employment share $s_{io|m}$.

All the proofs are in Online Appendix A. 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 is a decreasing function of the employment share $s_{io|m}$. Heterogeneous markdowns potentially reduce aggregate output by distorting relative wages across establishment-occupations and therefore the labor allocations. We formalize the source of misallocation in Section 3.1.

We now introduce bargaining between employers and unions.[25] 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.

The framework with bargaining is a right-to-manage model (Nickell and Andrews, 1983) with binding labor supply where the outside option of workers and firms is non-production. 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 supply 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, implies that unions bargain to extract part of the generated rents by internalizing how the marginal cost changes when introducing an additional worker.

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 $1 - \varphi_b$. Online Appendix B.1

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

presents more detail on the bargaining set up and discuss alternative bargaining arrangements that lead to the same negotiated equilibrium wages. The equilibrium bargained wage is:

$$w_{io} = \underbrace{\left[(1-\varphi_b)\,\mu_{io} + \varphi_b \, \frac{1-\alpha_b}{\beta_b} \right]}_{\text{Wedge } \lambda(\mu_{io},\varphi_b)} \times \underbrace{\beta_b A_{io} L_{io}^{\frac{\beta_b}{1-\alpha_b}-1} P_b^{\frac{1}{1-\alpha_b}}}_{\text{MRPL}}. \tag{9}$$

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 $\frac{1-\alpha_b}{\beta_b} \geq 1$.

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 the ones in Proposition 1. 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 $w^B = (1 + \varphi_b \frac{1-\alpha_b-\beta_b}{\beta_b}) \times MRPL$.

General 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)-(7) and (9) are satisfied $\forall\ io \in \mathcal{I}_m$, $m \in \mathcal{M}$ and $b \in \mathcal{B}$.

3.1 Characterization of the equilibrium

Solving the model amounts to finding establishment wages, sector prices and allocations. The perfect substitutability assumption of the production function and the invariance of local employment shares to aggregate variables imply 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 that the model is block recursive: we can solve the equilibrium of each local labor market separately without taking into account aggregate variables.

Proposition 2 (Block Recursivity)**.** *Each local labor market equilibrium is independent of aggregate variables and is given by the following N_m systems:*

$$s_{io|m} = \frac{\left(T_{io}^{\frac{1}{\varepsilon_b}} \lambda_{io} A_{io}\right)^{\frac{\varepsilon_b}{1+\varepsilon_b \delta}}}{\sum_{j \in \mathcal{I}_m} \left(T_{jo}^{\frac{1}{\varepsilon_b}} \lambda_{jo} A_{jo}\right)^{\frac{\varepsilon_b}{1+\varepsilon_b \delta}}}, \quad \lambda_{io} = (1 - \varphi_b) \frac{e_{io}}{e_{io} + 1} + \varphi_b \frac{1}{1 - \delta}, \tag{10}$$

where e_{io} is given by (8)*.*

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 3 (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* (10)*.*

Proposition 3 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.[26] Before 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 4 (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:*

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

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

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

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. 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 prices $\{P_b\}_{b\in\mathcal{B}}$ are enough to characterize employment and output at the sector level:

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

Online Appendix A contains the aggregation of the model 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 4, the sector labor supply L_b will depend on both $\mathbf{s}$ and $\mathbf{P}$, and the sector

[26]Our proof of existence and uniqueness is suited to the framework in Berger et al. (2022). As far as we know, this result is not in their paper, so we derive it in the Supplemental Material.

level output can be written as:

$$Y_b = P_b^{\frac{\alpha_b}{1-\alpha_b}} \Omega_b A_b L_b(\mathbf{P}, \mathbf{s})^{1-\delta}. \tag{11}$$

We need to find 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 (11) we obtain:

$$P_b^{\frac{1}{1-\alpha_b}} A_b \Omega_b L_b(\mathbf{P}, \mathbf{s})^{1-\delta} = \theta_b \prod_{b' \in \mathcal{B}} P_{b'}^{\frac{\alpha_{b'}}{1-\alpha_{b'}}} A_{b'} \Omega_b L_{b'}(\mathbf{P}, \mathbf{s})^{1-\delta}. \tag{12}$$

Given the employment shares from the first step of the solution, the next proposition establishes the existence and uniqueness of the general equilibrium.

Proposition 5 (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* (12) *and it has a closed-form expression.*

Propositions 3 and 5 imply existence and uniqueness of the equilibrium for any set of valid parameters, productivities, and amenities.

4 Identification and estimation

We follow a sequential strategy to identify and estimate the parameters and fundamentals consisting of four 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. Third, 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. Fourth, we show how to use the observed data on employment and wages to identify the amenities and revenue productivities.

4.1 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 inverse labor demand and labor supply of full monopsonists in logs is:

$$\ln w_{io} = \mathcal{C}_b^D - \delta \ln L_{io} + \ln A_{io}, \tag{13}$$

$$\ln L_{io} = \mathcal{C}_b^S + \eta \ln w_{io} + \ln \widetilde{T}_{io}, \tag{14}$$

where $\mathcal{C}_b^D$ is an industry-specific demand constant, $\widetilde{T}_{io} = T_{io}^{\eta/\varepsilon_b}$ and $\mathcal{C}_b^S$ is an industry-specific supply constant.[27] These equations form a price-quantity linear system, which suffers from 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, this approach can be context-specific and not portable to other scenarios. Thus, we use the identification through heteroskedasticity method proposed by Rigobon (2003) to identify the across-market elasticity of substitution η and the inverse elasticity of labor demand δ. This approach imposes restrictions on the covariance matrix of the structural shocks—the productivities and amenities—across different subsets of the data.[28]

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

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

[28] 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.

demand can be estimated using OLS.

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, splitting the sample in two allows the identification of parameters as the number of data moments equals the number of parameters to estimate.[29]

Let us return to the labor demand and supply equations for the full monopsonists as described by (13) and (14). 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.

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, 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 or more general working environments are similarly related to productivity within our two categories. With these restrictions, the system has twelve unknowns, allowing to identify δ and η. Details are in Online Appendix C.

[29] 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) yields three moments (σ_x, σ_y and $cov(x, y)$) while we have 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. The two sub-samples give six moments with six unknowns: the two parameters (α, β) and the four variances of structural errors.

4.2 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 (7) in logs is:

$$\ln(L_{io}) = \varepsilon_b \ln(w_{io}) + f_m + \ln(T_{io}), \tag{15}$$

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:

$$\widehat{Z}_j = \frac{P_b Y_j}{\sum_{i \in j} \sum_o L_{io}^{1-\delta}},$$

where $P_b Y_j$ is value added at firm j. We use the estimate for δ from our first estimation step to build the instrument.

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 local labor market fixed effect f_m can account for any such cross-market correlation, and the validity of the instrument is not compromised as long as the shocks remain uncorrelated within m. Nonetheless, we use a lagged instrument instead of a contemporaneous one to minimize potential endogeneity concerns.

Our identification strategy so far does not rely on any assumptions about the wage-setting process. This makes our approach easy to use in different wage setting contexts.

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: $\left.\frac{d \ln L_{io}}{d \ln w_{io}}\right|_{w_{-io}}$.

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 firm's labor supply curve after the shock has occurred. This change in the equilibrium allocation violates the stable unit treatment value assumption (SUTVA). Then, by using within-firm across-equilibrium variation in a reduce-form exercise we are measuring $\frac{d\ln L_{io}}{d\ln w_{io}}$ rather than $\left.\frac{d\ln L_{io}}{d\ln w_{io}}\right|_{w_{-io}}$.

Consider the following decomposition of the reduced-form estimate:[30]

$$\frac{d\ln L_{io}}{d\ln w_{io}} = \frac{d\ln\left(L_{io}/L_{jo}\right)}{d\ln\left(w_{io}/w_{jo}\right)}\left(1-\frac{d\ln w_{jo}}{d\ln w_{io}}\right)+\frac{d\ln L_{jo}}{d\ln w_{io}}, \tag{16}$$

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. The structural labor supply elasticity is:

$$\left.\frac{d\ln L_{io}}{d\ln w_{io}}\right|_{w_{-io}} = \varepsilon_b + \underbrace{\left.\frac{d\ln L_{jo}}{d\ln w_{io}}\right|_{w_{-io}}}_{\text{Cross-elasticity}} = \varepsilon_b(1-s_{io})+\eta s_{io},$$

where the cross-elasticity is equal to $-\varepsilon_b s_{io}+\eta s_{io}$ given our Bertrand competition environment.

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

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

The reduced-form estimate is equal to the labor supply elasticity in two cases. First, when the establishment is atomistic i.e. $s_{io}\to 0$ because other firms in the market do not respond, so $\frac{d\ln w_{jo}}{d\ln w_{io}}=0$. Second, when the local and across-market elasticity of substitution are the same. In such case, the employment loss of the competitors is completely offset by the increase in employment to the local labor market. Then, the cross-elasticity is zero, and $\frac{d\ln L_{jo}}{d\ln w_{io}}-\varepsilon_b\frac{d\ln w_{jo}}{d\ln w_{io}}=0$. In both cases, the labor supply elasticity is equal to the local elasticity of substitution.[31]

BHM use the relation between the reduced-form estimate and the structural elasticity to indirectly infer the structural parameters ε_b and η. However, this requires assuming 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.

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

[31] There is a third trivial case when the firm is the only one in the market and the supply elasticity is η.

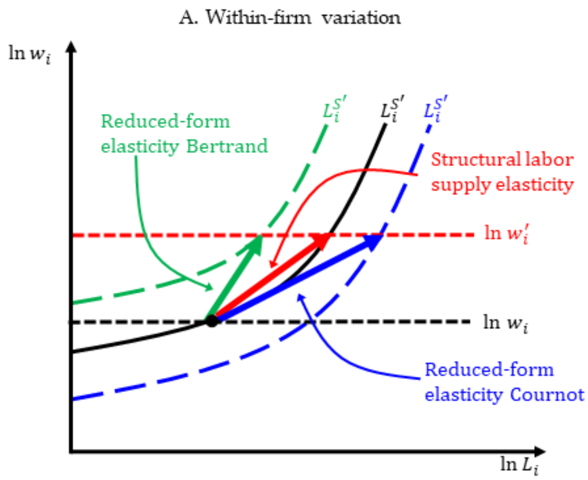


Figure 3: Within-firm, across-equilibria variation vs Across-firm, within-equilibrium variation

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

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 L_i^S. But if the firm is not atomistic, the wage increase after a positive idiosyncratic productivity shock 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.[32]

A regression of log employment on log wages within a local labor market *conditional* on an equilibrium allocation identifies ε_b.[33] Consider Figure 3 panel B. We have three different

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

[33]The argument extends to observations from different equilibria, provided we control for the equilibrium changes. We can use the differentiated wage and employment responses across time to labor demand shocks within a labor market. In such setting, one could run the regression in time differences and condition on a labor market fixed effect that controls for equilibrium changes. This variation identifies the local elasticity of substitution. To see this, let Δx be the change across time of variable x. Then, without supply shifters, $\frac{\Delta \ln w_i - \Delta \ln w_j}{\Delta \ln L_i - \Delta \ln L_j} = \varepsilon_b^{-1}$. The identification strategy would also work with instruments that generate differentiated labor demand responses within a local labor market such as changes in tax codes (Berger et al., 2022).

establishments that only differ in their productivities. As they are not atomistic, the labor supply intercepts—which are a function of the competitors wages—are different.[34] For any two establishments i, j, the slope of the straight line connecting two points in the log wage and employment plane is $\frac{\ln w_i - \ln w_j}{\ln L_i - \ln L_j} = \varepsilon_b^{-1}$. Since we are conditioning on an equilibrium allocation, SUTVA is not violated, and the slope estimate of regressing log employment on log wages must be equal to ε_b.[35] This regression estimates the local elasticity of substitution.

In conclusion, the source of BHM's identification problem comes from using variation from different equilibrium allocations and not controlling for the equilibrium changes. However, this problem is not present when using within-equilibrium variation. In Online Appendix C.2 we do a simulation exercise to show that even with bargaining and supply shifters we can recover the elasticity of substitution ε_b using our instrumental variable approach.

4.3 Bargaining power φ_b and output elasticities α_b, θ_b

We follow Barkai (2020) to construct the sector rental rates per year $\{R_{bt}\}_{b=1}^{B}$. We estimate α_b to match the average capital share, i.e., $\mathbb{E}_t\left[\frac{R_{bt}K_{bt}}{P_{bt}Y_{bt}}\middle| b\right] = \alpha_b$. 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 an increasing function of φ_b.[36] We set φ_b such that we match the average sector labor shares across years in the data with the model counterpart.

4.4 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

[34] The log inverse labor supply is equal to $\log w_{io} = \frac{1}{\varepsilon}\log\left(\frac{L_{io}}{L_m - L_{io}}\right) + \frac{1}{\varepsilon}\log\left(\sum_{j\neq i} w_{jo}\right)$.

[35] Consider a regression: $\ln L_i = b_0 + b_1 \ln w_i$ without supply side shifters so we do not include an error term. Demeaning both $\ln L_i$ and $\ln w_i$ and regressing those without a constant term we get the estimate of b_1: $b_1 = \frac{d\left[\ln(L_i) - \frac{1}{N}\sum_j \ln(L_j)\right]}{d\left[\ln(w_i) - \frac{1}{N}\sum_j \ln(w_j)\right]} = \frac{d\ln\left(L_i\Big/\left(\prod_j L_j\right)^{1/N}\right)}{d\ln\left(w_i\Big/\left(\prod_j w_j\right)^{1/N}\right)} = \varepsilon_b$.

[36] The labor share for sector b is $LS_b(\varphi_b) = \beta_b \sum_{io\in\mathcal{I}_b} w_{io}L_{io}\left(\sum_{io\in\mathcal{I}_b} w_{io}L_{io}/\lambda(\mu_{io},\varphi_b)\right)^{-1}$

Table 1: 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 labor share

wage first order conditions. We observe employment and wages at the establishment-occupation from equation (9) and $\beta_b \lambda(\mu_{iot}, \varphi_b)$ depends on the estimated parameters and observed employment shares. It is clear that given the wages and employment in the data, one can only back out transformed TFPRs, $Z_{iot} = P_{bt}^{1/1-\alpha_b} A_{iot}$, which are a function of the establishment-occupation physical productivity A_{iot} and prices $P_{bt}^{1/1-\alpha_b}$.[37] Section 5.1 explains how to compute counterfactuals with revenue productivities. Online Appendix C.4 contains details on how we back out amenities T_{iot} to ensure that we match employment.

4.5 Estimation results

Table 1 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. 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 2.

Our across local labor market labor supply elasticity is the same as a recent estimate by Berger et al. (2022) (Table 3) for the U.S. 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.[38]

[37] Normally in the literature, revenue productivities are defined as $P_{bt} A_{iot}$. Instead, we define the revenue total factor productivities $P_{bt}^{1/1-\alpha_b} A_{iot}$. Backing out productivities A_{iot} from the data would require normalizations to get rid of sector prices.

[38] See Jolivet et al. (2006) for a comparison of French mobility against the U.S.

According to our estimates, (i) the employment weighted average bargaining power of French manufacturing is 0.37;[39] 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 et al. (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).[40] 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 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*.

4.6 Estimation fit

We validate the model by replicating the empirical evidence of Section 2 linking micro-level concentration to wages. We then compare the model's predicted reduced-form relationship between labor shares and labor market concentration at the sector 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.

Micro evidence. In the empirical evidence from Section 2 we measure the effects of concentration on wages by using shocks to local competitors. These shocks capture an exogenous change in the relative position of an establishment within the local labor market. Thus, our aim is to induce such exogenous changes to the local labor market of establishments and test if the

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

[40] See Tables A.2. and A.3. in the Appendix of his paper and Table III1 in our Supplemental Material.

quantitative response in the simulated model is similar to 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 the estimated amenities and TFPRs for 2007, we simulate shocks in establishment-occupations' productivities and solve again for the equilibrium employment shares $s^S_{io|m}$ within each local labor market. With this employment shares, we compute wages normalizing aggregates, $w^S_{io} = \left(T_{io}^{\frac{1}{\varepsilon_b}} \lambda_{io} Z^S_{io}\right)^{\frac{1}{1+\varepsilon_b \delta}}$, 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 $\log(w^S_{io})$ is the logarithm of simulated wages, f_b is a sector fixed effect, $s^S_{io|m}$ is the equilibrium employment share, and u_{io} is an error term. We include the sector fixed effect f_b to capture sector price differences in the revenue productivities.

To replicate the exogenous change in establishment's employment share $s^S_{io|m}$, 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. The instrument 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 2007.

Panel (a) in Table 2 presents the estimation results in the data and in the simulations. The estimated coefficient is -0.229 in the baseline simulation with unions. The point estimate is a little below the minimum one presented on Figure 2 but still within the confidence intervals as shown in the *Data* column. On the contrary, the estimate in the *Oligopsony* simulation without bargaining is -0.454 and lies outside the confidence intervals of the empirical evidence. We take this as evidence that the model is able to replicate the strength of the relationship between employment shares and wages and that unions are required to match its strength.

Table 2: Model Validation: Data vs. Model

	Data	Oligopsony	Baseline Model
(a) Micro			
	$\log(w_{io,t}^{D})$	$\log(w_{io}^{S,O})$	$\log(w_{io}^{S})$
$s_{io\|m,t}$	$[-0.25, -0.03]$	-0.45	-0.23
(b) Macro			
	$\log(LS_{h,t}^{D})$	$\log(LS_{h,t}^{M,O})$	$\log(LS_{h,t}^{M})$
$\log(\overline{HHI}_{h,t})$	-0.056^{***}	-0.416^{***}	-0.161^{***}

Notes: Panel (a). *Data*: range of confidence intervals from Section 2, *Oligopsony*: estimates from simulated log wages $\log(w_{io}^{S,O})$ when there is no bargaining (when the labor wedge is $\lambda(\mu_{io}, 0) = \mu_{io}$) and in the baseline model $\log(w_{io}^{S})$ under the same simulated shocks. Panel (b): aggregate regression as in Online Appendix E.2. The number of observations is 1,357. *Data*: dependent variable is the logarithm of 3-digit industry labor share $\log(LS_{h,t}^{D})$ from the data. Next two columns present the model generated log labor shares when there is no bargaining $\log(LS_{h,t}^{M,O})$ and in our framework where bargaining is incorporated $\log(LS_{h,t}^{M})$. We run the regressions with sector-year fixed effects. *p<0.1; **p<0.05; ***p<0.01

Macro evidence. We now turn to aggregate empirical evidence relating labor market concentration to the labor share, while highlighting the importance of unions to match 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. Panel (b) in Table 2 presents the results. The first column shows the estimate using the labor shares from the data, while the rest correspond to the two alternative models with and without unions.[41] The negative relationship between labor share and concentration in the model with only oligopsonistic competition (*Oligopsony*) is about 8 times higher than in the data. Looking at the last column that corresponds to our model, we find that the negative relationship is a third as much as the model without unions.[42] The results 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.

[41] The empirical evidence is complemented with different fixed effect specifications in Table III3 of the Supplemental Material. Results remain similar.

[42] 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.

5 Counterfactuals

In this section we evaluate the output 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. We perform counterfactuals for the year 2007, but before discussing them, we briefly explain how we can compute them using revenue productivities.

5.1 Computing counterfactuals using revenue productivities

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 multiplicative of productivities. Since the revenue productivities $Z_{io} = P_b^{1/1-\alpha_b} A_{io}$ are a product of the sector price and the productivities A_{io}, we can fully characterize the counterfactual local labor market equilibrium. We denote with a prime the variables in the counterfactual (e.g. P'_b) and with a hat the relative variables (e.g. $\widehat{P}_b = \frac{P'_b}{P_b}$). The revenue productivity in the counterfactual will differ from the baseline due to endogenous prices and can be written as:

$$Z'_{io} = P_b'^{1/1-\alpha_b} A_{io} = \left(\frac{P'_b}{P_b}\right)^{1/1-\alpha_b} P_b^{1/1-\alpha_b} A_{io} = \widehat{P}_b^{1/1-\alpha_b} Z_{io}.$$

Using the counterfactual employment shares and wedges, we can rewrite the rest of the model relative to the baseline equilibrium. This allows us to use "exact hat algebra" techniques (Costinot and Rodríguez-Clare, 2014) to compute the counterfactual equilibrium using only the observed levels of wages and employment. As it is clear from the equation above, we can use the baseline TFPRs Z_{io} as fundamentals in the "hat" economy. Online Appendix B.2 explains the details.

5.2 The effects of two-sided labor market power

Table 3 presents the results of various counterfactual scenarios assuming free mobility of workers. 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 unions in the oligopsonistic competition

Table 3: Counterfactuals: Efficiency and Distribution

		Gains (%)		
	LS (%)	ΔY	Δ Wage	Δ Welfare (L)
Baseline $\lambda(\mu, \varphi_b)$	50.62	-	-	-
Counterfactuals				
Oliposony $\lambda(\mu, 0) = \mu_{io}$	38.57	-0.48	-24.18	-26.17
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
Monopsony $\lambda(\mu, 0) = \frac{\varepsilon_b}{\varepsilon_b + 1}$	48.95	1.82	-1.55	-4.92

Notes: Results in percentages. *LS*: aggregate labor share. The last three columns are changes relative to the baseline. ΔY: aggregate output, Δ *Wage*: aggregate wage (employment weighted average of establishment-occupation wages). Δ *Welfare (L)*: median expected welfare of the workers. *Oligopsony*: main counterfactual with $\lambda = \mu_{io}$, *No wedges*: wedge equal to one (perfect competition), *Bargain*: standard bargaining framework where the workers' outside options are the competitive wages and they do not internalize movements along the labor supply, *Monopsony*: no bargaining but monopsonistic competition (infinitesimal firms).

counterfactual reduces output by 0.48%, implying that union bargaining power attenuates labor market distortions in the model. In the oligopsonistic scenario, labor wedges are slightly more heterogenous, leading to increased distortions and an output reduction.

The second counterfactual, which eliminates labor wedges as in perfect competition, increases aggregate output by 1.62%. The third counterfactual which assumes unions retain their labor market power while employer power is eliminated, achieves output gains almost comparable to eliminating both distortions with no wedges.[43] This is because the labor wedges become $\lambda(1, \varphi_b) = 1 + \varphi_b \frac{\delta}{1-\delta}$ and the only heterogeneity comes from the sector-specific bargaining powers, resulting in small distortionary effects. Lastly, we explore the role of unions as substitutes of competition in the *Monopsony* counterfactual which is a limiting case when employment shares tend to zero, and there is no bargaining. Surprisingly, this counterfactual yields the highest output gains of 1.82, but the workers' welfare falls. Similarly to the *Bargain* counterfactual, the labor wedge is a sector constant (below 1 in this case) and the higher output gains come from employment reallocation across sectors.

The aggregate labor share captures the distributional effects. Using the demand of the final

[43] The *Bargain* counterfactual is a situation where none of the sides would internalize movements along the labor supply but bargain over wages.

good producer (3), the aggregate labor share is:[44]

$$LS = \sum_{b \in \mathcal{B}} \beta_b \lambda_b \theta_b. \tag{17}$$

Column 1 of Table 3 compares the aggregate labor shares of the baseline and the different counterfactuals. Removing unions decreases the labor share by 12 percentage points, from 50.62% in the baseline to 38.57% in the counterfactual. The labor share rises to 73.38% in the counterfactual where employer labor market power is eliminated which is slightly above to the labor share in the counterfactual without labor wedges (72.26%). Finally, the labor share is slightly reduced from the baseline to 48.95% in the counterfactual where we increase competition and firms compete monopsonistically. There are two reasons why the labor share changes are large relative to output gains except in the *Monopsony* counterfactual: (i) baseline labor wedges 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 changes. 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.[45]

A lower labor share implies lower wages and lower welfare for the workers. To measure the change in workers' welfare, we calculate their median welfare.[46] Columns 3 and 4 of Table 3 show the change in average wages and median welfare relative to the baseline. In the oligopsonistic case, average wages and median welfare are reduced respectively by 24% and 26%. In contrast, in the case with no labor wedges, average wages and median welfare increase by 45% and 42%. The welfare losses exceed the output losses because workers not only experience a decline in productivity but also suffer from the redistribution of pure rents to the owners. In the *Monopsony* counterfactual workers benefit from higher output but receive a lower labor share and lower wages, which implies that their welfare slightly decreases compared to the baseline.

The main takeaways of the counterfactuals are: (i) unions not only redistribute a significant

[44] All the counterfactuals leading to the same sector wedge, λ_b, have the same aggregate labor share.

[45] Increases in the aggregate wage with *No wedges* do not imply that wage inequality is decreased. Establishments face a labor supply with finite elasticity due to idiosyncratic shocks which yields different wages in equilibrium, even if wedges are equalized.

[46] As the across local labor market elasticity η is smaller than 1, the expected value of the Fréchet distribution is not defined. We compute the median of the workers' welfare which is proportional to $\Phi^{\frac{1}{\eta}}$.

portion of total output towards workers, but also increase the economy's overall productivity compared to the case with only oligopsony; and (ii) unions can be an alternative to increased labor market competition in improving productivity, but fall short.[47] Focusing on the first, while the redistribution effect of unions is expected, the productivity gains are not so obvious. In the model, an increase in the bargaining powers reduces the dispersion of wedges across firms. Note that: $\frac{\partial^2 \lambda_{io}}{\partial \varphi_b \partial s_{io}} = -\frac{\partial \mu_{io}}{\partial s_{io}} > 0$. As a result, unions lead to a greater increase in the labor wedge in larger establishments compared to smaller ones. This, in turn, reduces the overall variance of wedges and the potential misallocation of labor within a local labor market. To better understand this, consider the following decomposition of the labor share:

$$\frac{w_{io}L_{io}}{P_bY_{io}} = \beta_b\lambda_{io} = \underbrace{\beta_b}_{\text{Perf. Comp.}} - \underbrace{\beta_b(1-\mu_{io})}_{\text{Oligopsonistic Rents}} + \underbrace{\varphi_b \overbrace{\left[\underbrace{(1-\alpha_b-\beta_b)}_{\text{DRS Rents}} + \underbrace{\beta_b\,(1-\mu_{io})}_{\text{Oligopsonistic Rents}}\right]}^{\text{Total Rents}}}_{\text{Bargaining gains}}.$$

Under perfect competition and no bargaining, the labor share is equal to the output elasticity β_b. The term $\beta_b(1-\mu_{io})$ captures the oligopsonistic rents that the firm would obtain in the absence of bargaining under the current allocation. The third term, involving φ_b, represents the bargaining gains that redistribute rents from the establishment towards the workers based on their bargaining power. These total rents are a combination of oligopsonistic rents resulting from labor market power and rents arising from the decreasing returns to scale technology.

Bargaining allows for a redistribution of rents, leading to an increase in the firm's labor share. Abstracting from changes in employment shares, the redistribution narrows the gap between the labor share of large establishments—with low markdowns and high rents—and small establishments—with high markdowns and low rents—reflecting a lower dispersion of wedges across establishments and lower misallocation.[48] The mechanism suggests that rent-sharing rules such as the one explained in Nimier-David et al. (2023) may have positive productivity effects through an improved allocation of labor across firms.

The introduction of unions, while decreasing the heterogeneity of wedges within a labor

[47] In the extreme case where workers have all of the bargaining power, i.e. $\varphi_b = 1$ for all b, the allocation would be the same as the one with perfect competition and the productivity gains would be the same.

[48] This argument holds even in cases with constant returns to scale, where $1-\alpha_b-\beta_b = 0$.

market, can still distort employment across sectors when bargaining powers are heterogeneous. This can be seen from the *Bargain* counterfactual with slightly lower output gains than the one without wedges. The counterfactuals show that unions might not be the best tool to fight the misallocation effects from heterogeneous firm market power and increase aggregate output. Compared to the *Oligopsony* counterfactual, the output gains from the *Monopsony* counterfactual—an scenario without unions but with infinitesimal firms—suggests that increasing competitors in an oligopsonistic labor market might be a more effective way of increasing output than incorporating unions, but the worker welfare gains are smaller.

5.3 The importance of labor mobility

We check three additional cases to locate the output changes in an environment with mobility costs. These cases differ in their mobility restrictions, where we allow mobility to happen only within sector, sector-occupation and local labor market. Table 4 compares the free mobility case with the restricted mobility cases for different counterfactuals. Comparing the output changes in column 3 across the different scenarios, we find that restricting mobility reduces the output gains from removing the labor wedges. In the *Oligopsony* counterfactual, when labor is constrained to remain in the local labor market, output does not decrease as much as in the free mobility case. However, in the other two cases, *Fixed sector* and *Fixed sector-occupation*, the output losses are greater. Comparing the free mobility counterfactuals to the ones with restricted labor mobility we see 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 without labor wedges. Restricting workers to stay in their particular local labor market in the counterfactual without labor wedges output gains are 0.49%, which constitute only 30% of the gains under free mobility without wedges. In the oligopsonistic competition counterfactual, fixing employment across sectors but allowing for geographical mobility exacerbates the output losses. Restricting employment to move only within a local labor market would contain output losses as productivity losses are reduced by more than 60%.

These results underscore the importance of free mobility of labor to counteract the output losses from the misallocation coming from heterogeneous wedges. The left panel of Figure 4 shows the percentage change of manufacturing employment in the free mobility case in the

Table 4: Counterfactuals: Limited Mobility

		LS (%)	ΔY (%)	Δ Prod (%)	Contribution ΔY (%)		
					GE	Productivity	Labor
Oligopsony	Free mobility	38.57	-0.48	-0.95	-20	200	-80
	Fixed sector	38.57	-0.94	-0.95	-1	101	0
	Fixed sector-occ	38.56	-0.94	-0.97	-2	102	0
	Fixed local market	38.05	-0.37	-0.38	-3	103	0
No wedge	Free mobility	72.26	1.62	1.33	9	83	8
	Fixed sector	72.26	1.32	1.33	-1	101	0
	Fixed sector-occ	72.26	1.33	1.35	-2	102	0
	Fixed local market	72.26	0.49	0.49	-2	102	0
Monopsony	Free mobility	48.95	1.82	1.33	-7	74	33

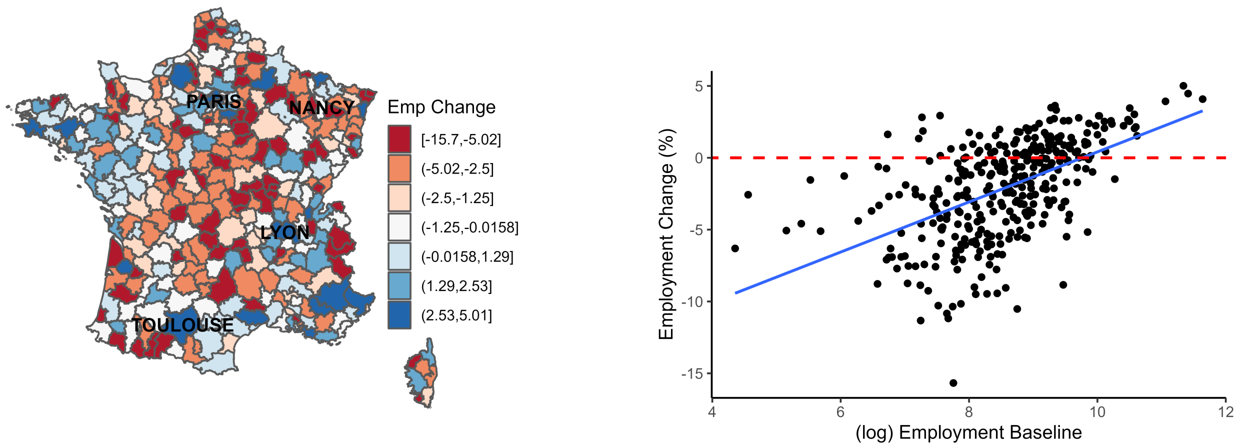
Notes: Results are in percentages. The first column is the counterfactual type. *Oligopsony*: no unions but oligopsonistic competition, *No wedges*: no labor wedges (perfect competition), *Monopsony*: no unions but monopsonistic competition (infinitesimal firms). The second column is the mobility type of the counterfactual. *Free mobility*; without mobility restrictions, *Fixed sector*: mobility only within sector, *Fixed sector-occ*: fixes employment at the sector-occupation so mobility across locations and across 3-digit sub-industries, and *Fixed local market*: mobility only within local labor markets. Last three columns present the contribution to output gains. *LS*: labor share, ΔY: aggregate output change relative to the baseline, Δ *Prod*: aggregate productivity change from decomposition (18).

oligopsonistic competition counterfactual. Each block is the aggregation of local labor markets to the commuting zone. In the absence of unions, manufacturing employment in the rural areas would be reduced. The counterfactual reveals that there are a handful of rural productive establishments in concentrated local labor markets. In the baseline these have lower wage markdowns and lower employment that are further dampened without unions. Moving to the counterfactual, those are the ones with the biggest relative wage and employment losses. The right panel of Figure 4 shows a positive relationship between the logarithm of baseline employment at the commuting zone and employment gains in the oligopsonistic competition counterfactual without unions.[49] Rural areas or commuting zones with low employment levels in the baseline are the ones that benefit the most from the presence of unions.

We can use the aggregate production function and the relative sector output decompose the

[49]In the Supplemental Material we show the employment impact across the French geography of the counterfactual without labor wedges (perfect competition). The general idea remains the same: rural areas increase their wages and employment the most as they are the most concentrated markets in the baseline scenario.

Figure 4: Employment Change (%) in the Counterfactual: Oligopsonistic Competition



Notes: Left: commuting zone employment changes with respect to the baseline in *Oligopsony*. Right: employment change in the counterfactual versus the log of employment in the baseline, the blue line is fitted from an OLS.

source of output gains. The logarithm of the relative final output is:[50]

$$\ln \widehat{Y} = \underbrace{\sum_{b\in\mathcal{B}} \theta_b \ln \widehat{P}_b^{\frac{\alpha_b}{1-\alpha_b}}}_{\Delta\ \text{GE}} + \underbrace{\sum_{b\in\mathcal{B}} \theta_b \ln \widehat{\Omega}_b}_{\Delta\ \text{Productivity}} + \underbrace{\sum_{b\in\mathcal{B}} \theta_b \ln \widehat{L}_b^{1-\delta}}_{\Delta\ \text{Labor}} . \tag{18}$$

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 (or losses) from less (or more) misallocation relative to the baseline. This term suffers the most from labor market concentration as big productive firms are shrinking, therefore reducing overall productivity. The third term corresponds to how labor is allocated across sectors.

Columns 3 to 5 of Table 4 show the decomposition of relative changes of output.[51] The main source of output changes come from productivity because sector productivity is an employment weighted sum of establishment-occupation productivities (which are unchanged). The source of aggregate productivity and output losses without unions is therefore the reallocation of workers towards less productive establishments. Sectoral mobility dampens the negative productivity effects of removing unions under free mobility. When restricting mobil-

[50]See Online Appendix B for detailed derivations.

[51]We decompose $\ln \widehat{Y}$ and note that $\Delta Y = \widehat{Y} - 1 \approx \ln \widehat{Y}$. The share that comes from *Productivity* is $\frac{\sum_{b\in\mathcal{B}} \theta_b \ln \widehat{\Psi}_b}{\ln Y}$.

ity by keeping employment constant at the local labor market level, the misallocation effects are curbed and output changes to -0.37%. On the contrary, productivity gains in the free mobility *Monopsony* counterfactual are identical to the ones in the *No wedge* counterfactual but output gains are amplified in the former due to employment reallocation across sectors.

We show in the Supplemental Material that most significant productivity losses in the *Oligopsony* counterfactual happen outside urban areas. As a result, the largest losses relative to the baseline in wages and employment are in commuting zones that do not include big cities.

5.4 Additional exercises

Here we summarize the results from additional counterfactuals. Online Appendix D provides the details.

Urban-rural wage gap. The urban-rural wage gap is amplified from 36 to 50 percent in the oligopsonistic competition counterfactual, as unions disproportionately boost rural wages. Unions close by a third the urban-rural wage gap. In the counterfactual without labor wedges, the urban-rural wage gap is reduced to 23 percent.

Endogenous labor force participation. Introducing an endogenous labor force participation margin induces higher output responses than in the baseline where total employment is fixed. The counterfactual output change without unions is -1.42% as the total labor supply decreases by 0.98%.

Agglomeration. A model with agglomeration forces amplifies productivity losses from removing unions but those are counteracted by employment reallocation across sectors. This translates into milder output losses than without agglomeration.

6 Conclusion

Our model shows how unions partially counteract distortions from employer labor market power by extracting more rents from productive firms who hold more labor market power.

With rural labor markets with few productive employers, we find that unions sustain manufacturing employment in rural areas while improving the spatial allocation of workers. However, empowering unions can not completely correct for the inefficiencies caused by the employers' market power and could lead to some unmodeled adverse effects like reducing the entry of new establishments.

There are some potential insights for policy. Unions can be thought as a partial substitute to more competition in the labor market: the output gains are smaller, but workers' welfare gains are larger.

Hiring subsidies can implement the first-best allocation, which corresponds to an allocation with constant wedges. These subsidies would be establishment-occupation specific, and could be financed by uniform taxes on revenue. However, their implementation would be cumbersome and perhaps not realistic. So what could be a second-best alternative? Our paper offers a partial answer to this question: unions. By redistributing rents that come from employer labor market power, unions can improve the labor allocation and increase workers' welfare.

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