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ABSTRACT

Comparing Micro-Evidence on Rent Sharing from Two Different Econometric Models*

Researchers contributing to the empirical rent-sharing literature have typically resorted to estimating the responsiveness of workers' wages on firms' ability to pay in order to assess the extent to which employers share rents with their employees. This paper compares rent-sharing estimates using such a wage determination regression with estimates based on a productivity regression that relies on standard firm-level input and output data. We view these two regressions as reduced-form equations stemming from, or at least compatible with, a variety of underlying theoretical structural models. Using a large matched firm-worker panel data sample for French manufacturing, we find that the industry distributions of the rent-sharing estimates based on them are significantly different on average, even if they slightly overlap and are correlated. Precisely, if we only rely on the firm-level information, we find that the median of the relative and absolute extent of rent-sharing parameters amount roughly to 0.40 and 0.30 for the productivity regression and to 0.20 and 0.16 for the wage determination regression. When we also take advantage of the worker-level information to control for unobserved worker ability in the model of wage determination, we find that these parameters further reduce as expected and have a median value of only about 0.10.

JEL Classification: C23, D21, J31, J51

Keywords: rent sharing, wage equation, production function, matched employer-employee data

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1 Introduction

Contrary to the Walrasian labor market model, various non-competitive models predict a positive relationship between wages of comparable workers and the performance of their firms. Collective bargaining, optimal labor contract and search-theoretic models of the labor market share this theoretical conjecture, and consider different channels through which employer's ability to pay might affect wages.

We can view the wage determination equations specifying the expected positive wage-performance link as reduced-form models stemming from, or at least compatible with, such an underlying variety of theoretical structural models. Many empirical studies have estimated these reduced-form wage equations on firm data to test the rent-sharing hypothesis.[1] They have confirmed without exception that changes in firm performance feed through into changes in wages. In general, the estimated elasticities between wages and rents or profits per employee range between 0.05, even less, and 0.20, depending in particular on the quality of the instruments used to control for the endogeneity of profits. Following the seminal contribution of Abowd *et al.* (1999), more recent studies using matched employer-employee datasets, are able to include separately in the wage equations firm and worker effects that take into account the non-random sorting of high-ability (and thus high-wage) workers into high-profit firms. Compared to studies based on firm-level data only, these studies typically obtain, as expected, smaller estimates of wage-profit elasticities ranging from 0.01 to 0.10.[2]

Even more recently, a small set of productivity studies have extended the more standard productivity framework with imperfect competition in the product market to encompass two polar models of wage determination in imperfect labor markets.[3] These studies have also been able to provide estimates of relative and absolute extent of rent sharing between firms and workers, and more specifically estimates of the corresponding wage-profit elasticities which are higher, in the [0.10-0.50] range.[4]

Our contribution to the empirical rent-sharing literature in this paper is to compare the rent-

[1] See in particular Barth *et al.* (2016) for the US; Abowd and Lemieux (1993) for Canada; Teal (1996) for Ghana; Van Reenen (1996) and Hildreth (1998) for the UK; Goos and Konings (2001) and Brock and Dobbelaere (2006) for Belgium; and Blanchflower *et al.* (1990), Nickell *et al.* (1994) and Hildreth and Oswald (1997) for a sample of European countries.

[2] See in particular Margolis and Salvanes (2001) for France and Norway; Kramarz (2003) and Fakhfakh and FitzRoy (2004) for France; Bronars and Famulari (2001) for the US; Arai (2003), Nekby (2003), Arai and Hayman (2009) and Carlsson *et al.* (2014) for Sweden; Bagger *et al.* (2014) for Denmark, Rycx and Tojerow (2004) and Du Caju *et al.* (2011) for Belgium; Guertzgen (2009) for Germany; Card *et al.* (2014) for Italy; and Cardoso and Portela (2009), Martins (2009) and Card *et al.* (2016) for Portugal.

[3] This extension of the econometric productivity model to take into account imperfect labor markets has been developed in Dobbelaere and Mairesse (2013), after a first extension by Crépon *et al.* (2005), and following the revival of the empirical literature on productivity with imperfect product markets (Hall, 1988). Both extensions of econometric productivity analyses with imperfectly competitive product and labor markets find their historical roots in Marschak and Andrews (1944).

[4] Dobbelaere and Vancauteren (2014) use firm-level data for Belgium and the Netherlands, Dobbelaere *et al.* (2015) for France, Japan and the Netherlands, Dobbelaere *et al.* (2016) for Chile and France, Dobbelaere and Kiyota (2017) for Japan, Nesta and Schiavo (2017) for France and Felix and Portugal (2017) for Portugal. Dobbelaere (2004), Abraham *et al.* (2009), Boulhol *et al.* (2011) and Ahsan and Mitra (2014) implement the extension of the econometric productivity model developed in Crépon *et al.* (2005).

sharing estimates obtained in the case of French manufacturing for a large matched firm-worker panel data sample by relying on the wage determination and the productivity models. It is also to suggest potential explanations for the estimated discrepancies and to assess the advantages and shortcomings of both types of models.

The plan of the paper is as follows. Section 2 presents the two econometric models while Section 3 describes the data and explains the method of estimation. Section 4 compares and discusses estimates of relative and absolute extent of rent sharing that we obtain from estimating the productivity and wage equations. Section 5 provides potential explanations of discrepancies between these estimates while Section 6 concludes.

2 Estimating rent sharing from two econometric models

We present in this Section the econometric reduced-form productivity and wage determination models as they have been usually specified in the literature and as we take them here to the data to better compare the estimates of extent of rent sharing they entail.

2.1 Reduced-form model of productivity

The specification of the reduced-form productivity equation we estimate is the following log-linear regression:

$$q_{it} = \mu \left[s_{Nit} \left(n_{it} - k_{it} \right) + s_{Mit} \left(m_{it} - k_{it} \right) \right] + \psi [s_{Nit} \left(k_{it} - n_{it} \right)] + \lambda k_{it} + \omega_{it} + \alpha_i + \alpha_t + \epsilon_{it} \qquad (1)$$

where i is a firm subscript and t a year subscript. The variables q_{it}, n_{it}, m_{it} and k_{it} are respectively for each year the logarithms of output Q_{it}, labor N_{it}, material input M_{it} and capital K_{it}. s_{Nit} and s_{Mit} are for each year the shares of labor costs and material costs in total revenue. The parameters μ, ψ and λ are respectively the parameters of price-cost markup, joint product and labor market imperfections and elasticity of scale. ω_{it} is an index of "true" total factor productivity, or productivity for short, possibly observed by the firm at t when input choices are made, but unobserved to the econometrician. α_i is a firm-specific effect proxying for firm unobserved heterogeneity such as managerial ability differences, α_t is a year effect proxying for changes in firms' industrial environment, and ϵ_{it} is an idiosyncratic error term including non-predictable output shocks and potential measurement error in output and inputs.

As explained in Section 1 of the online supplementary material, we can distinguish six combinations or regimes of imperfect and "perfect or nearly perfect" competition in product and labor markets, which are based on the respective values of the price-cost mark-up and joint market imperfections parameters μ and ψ. We differentiate imperfect and nearly perfect product market settings on the basis of a price-cost mark-up μ higher than 1.1. Similarly, we separate the two settings of imperfect competition in the labor market, efficient bargaining and monopsony, from nearly perfect competition in the labor market on the basis of a joint market imperfections parameter ψ respectively positive and higher than 0.1 or negative and smaller than -0.1. These threshold values, although conventional, are empirically reasonable. They also have the practical advantage of characterizing the different regimes as subsets of dimension 2 in the space of the two parameters μ and ψ (with $\mu \geq 1$), and they thus put the different regimes on a par when estimating their probability and testing that an industry or a selected group of firms belongs to a particular regime. The six regimes that we can thus consider are shown in Graph 1 in the two-dimensional space of the parameters μ and ψ.

More precisely, they are the following:

- $1 \leq \mu \leq 1.1$ and $-0.1 \leq \psi \leq 0.1$, or PC-PR, corresponding to perfect or "nearly perfect" competition in the product market, and perfect or "nearly perfect"competition or right-to-manage bargaining in the labor market.
- $1 \leq \mu \leq 1.1$ and $\psi > 0.1$, or PC-EB, corresponding to perfect or "nearly perfect" competition in the product market, and efficient bargaining in the labor market.
- $1 \leq \mu \leq 1.1$ and $\psi < -0.1$, or PC-MO, corresponding to perfect or "nearly perfect" competition in the product market, and monopsony in the labor market.
- $\mu > 1.1$ and $-0.1 \leq \psi \leq 0.1$, or IC-PR, corresponding to imperfect competition in the product market, and perfect or "nearly perfect"competition or right-to-manage bargaining in the labor market.
- $\mu > 1.1$ and $\psi > 0.1$, or IC-EB, corresponding to imperfect competition in the product market, and efficient bargaining in the labor market.
- $\mu > 1.1$ and $\psi < -0.1$, or IC-MO, corresponding to imperfect competition in the product market, and monopsony in the labor market.

<Insert Graph 1 about here>

Here, for the sake of comparison, we focus our analysis on the set of industries in which we expect that rent sharing is likely to prevail (IC-EB) on the basis of descriptive statistics as well as previous econometric studies where the estimates we found for the parameter of joint market imperfections ψ were positive. The parameters of main interest are the relative and absolute extent of rent sharing γ and ϕ, given by:

$$\gamma = \frac{\psi}{\mu} = \frac{\phi}{1-\phi} \quad \text{and} \quad \phi = \frac{\psi}{\mu+\psi} = \frac{\gamma}{1+\gamma} \tag{2}$$

2.2 Reduced-form model of wage determination

The specification of the reduced-form wage determination equation is a log-log regression model that slightly differs depending on whether we estimate it on firm or matched firm-worker data. It can be written as Eq. (3) in the case of firm data:

$$w_{it} = \beta_0 + \beta_1 \overline{w}_{it} + \beta_2 (\pi_{it} - n_{it}) + \beta_3 (k_{it} - n_{it}) + \alpha_i + \alpha_t + \epsilon_{it} \tag{3}$$

and as Eq. (4) in the case of matched firm-worker data:

$$w_{j(i)t} = \beta_0 + \beta_1 \overline{w}_{it} + \beta_2 (\pi_{it} - n_{it}) + \beta_3 (k_{it} - n_{it}) + \alpha_{j(i)} + \alpha_i + \alpha_t + \epsilon_{it} \tag{4}$$

where i is a firm subscript and t a year subscript and $j(i)$ a subscript of worker j in firm i. The variables w_{it}, $w_{j(i)t}$, $\overline{w}_{it}$, π_{it}, k_{it} and n_{it} are respectively for each year the logarithms of the firm labor cost per worker or average wage W_{it}, the net earnings of worker j in firm i or the net wage $W_{j(i)t}$, the average workers' alternative wage or reservation wage $\overline{W}_{it}$, the firm profit or more generally economic rents Π_{it}, the firm capital K_{it}, and the firm number of employees N_{it}. The parameters β_1, β_2 and β_3 are the elasticities of wages with respect to the reservation wage, profit per employee and capital per employee, respectively. α_i is the firm effect, $\alpha_{j(i)}$ the worker-firm effect, α_t the year effect and ϵ_{it} an idiosyncratic error.

In the empirical literature, Eqs. (3) and (4) are commonly specified as a log-log regression in which case the relative extent of rent sharing γ is a varying parameter equal to the wage-profit elasticity β_2 multiplied by $Ratio_{it} = \frac{W_{it} \times N_{it}}{\Pi_{it}}$, the ratio of the firm wage bill to its profits.[5] For our purpose of comparison, we compare γ as estimated in the productivity regression (Eq. (1)) with its sample average values as estimated in the wage regressions (Eqs. (3) and (4)): $\gamma = \beta_2 \times \overline{Ratio}$ with $\overline{Ratio} = \text{mean}\left(\frac{W_{it} \times N_{it}}{\Pi_{it}}\right)$. The log specification of the wage regressions has econometric advantages, in particular by normalizing the wage distributions which are skewed to the right and display long right tails (Neal and Rosen, 2000; Martins, 2007). Adopting a log specification of both the productivity and wage equations is also appropriate in our case since it allows us to control for a potential source of discrepancy in the corresponding estimates of extent of rent sharing.

In practice, Eqs. (3) and (4) usually do not include the capital intensity variable and we also consider an estimation variant without it. We think it is preferable to take it here into account to control at least partly for differences in firms' labor skill composition and the possibility that rent sharing is relatively higher in capital-intensive firms. Skill-intensive firms will also be capital-intensive in industries where capital and skilled labor are complements (Griliches, 1969; Bronars and Famulari, 2001; Duffy *et al.*, 2004). This implies that the wage-profit elasticity estimates will be upwardly biased for lack of suitable skill composition data but less so if we control for firm capital intensity.

[5] Note that if Eqs. (3) and (4) were specified as *linear* regressions, the parameter β_2 would simply be the parameter of relative extent of rent sharing, conditional on considering collective bargaining, among the various interpretative schemes, to be the main theoretical engine establishing a positive relationship between profitability and pay. This can be clearly seen from Eq. (20) in the online supplementary material. We elaborate on this in Section 5.

Note, in a related way, that such skill bias is likely to be largely controlled for when we take into account the non-random sorting of high-ability (hence high-wage) workers into high-productivity (hence high-profit) firms by relying on matched firm-worker data. We thus expect that the wage-profit elasticity will be less upwardly biased (hence smaller) when estimated in regression (4) than in regression (3).

3 Data description and econometric identification

3.1 Comparative analysis sample and measurement of variables

We have constructed an unbalanced panel of French manufacturing firms over the period 1984-2001, based on confidential databases maintained by INSEE (the French "Institut National de la Statistique et des Etudes Economiques"): mainly firm accounting information from EAE ("Enquête Annuelle d'Entreprise"), supplemented by matched firm-worker data drawn from the DADS (the administrative database of "Déclarations Annuelles des Données Sociales"). We first trimmed the data to eliminate outliers and anomalies for our main variables: firm output and input growth rates, firm input shares in total revenue, firm average wages and profits, and worker net earnings. We then only kept firms with consecutive observations for at least four years and retained workers who remained in the same firms ("stayers"), worked twelve months per year and with consecutive observations for at least two years. We also retained the subset of 25 industries where we expect rent sharing to be predominant, chosen among the full set of 52 manufacturing industries defined on the basis of the 2- and 3-digit level of the French industrial classification ("Nomenclature économique de synthèse"). This subset amounts to 66% of the firms and 58% of employment in total manufacturing.

We thus end up with a matched firm-worker panel data sample, consisting at the firm level of 109,199 observations for 9,849 firms over the 18 years 1984-2001, with a median number of observations per firm of 11, and at the worker-firm level of 382,501 observations for 60,294 workers in the 9,849 firms, with a median number of 9 workers per firm.

The eleven variables involved in our regression analyses are defined and measured in the following way. Output (Q_{it}) is defined as current production deflated by the two-digit producer price index. Labor (N_{it}) refers to the average number of employees in each firm for each year. Material input (M_{it}) is defined as intermediate consumption deflated by the two-digit intermediate consumption price index. The capital stock (K_{it}) is measured by the gross book value of tangible fixed assets at the beginning of the year and adjusted for inflation. The shares of labor (s_{Nit}) and material input (s_{Mit}) are constructed by dividing respectively the firm total labor cost and intermediate consumption by the firm current production and by taking the average of these ratios over adjacent years. The firm average wage per worker (W_{it}) is computed as the wage bill divided by the average number of employees. The worker net wage ($W_{j(i)t}$) is the yearly net earnings of worker j in firm i and the number of workers $\left(N_{j(i)t}\right)$ refers to the number of individual workers observed for firm

i in the matched firm-worker sample. The firm profits (Π_{it}) is simply the widely used measure of gross operating profit computed as value added minus labor costs, smoothed over four or five years if possible from year $t-3$ or $t-4$ to current year t (taking advantage of the availability of three year pre-sample accounting firm observations when necessary). Such smoothing, often done in practice, is useful to control for the high volatility of profits. Finally, we rely on the matched firm-worker data to propose a measure of the average workers' alternative wage ($\overline{W}_{it}$) for the two wage regressions. In particular, we proxy the alternative wage by the 5^{th} percentile of the workers' wage distribution but also consider an estimation variant in which it is measured by the 1^{st} percentile.

<Insert Table 1 about here>

Table 1 reports descriptive statistics for all our variables: mean, standard deviation, and first quartile, median and third quartile. The median number of employees is 49 and the mean number 123, while the median number of individual workers observed per firm is 9 and the mean number 21. The average yearly growth rate over the period 1984-2001 of firm output, number of employees, materials and capital are respectively 2.6%, 0.9%, 4.4% and 0.3%. The average shares of labor and materials in total revenue are of 33% and 49%. The median and mean are both of about 27,000 Euros for the workers' wage per year and respectively about 13,500 and 16,000 Euros for their net earnings, while they amount to about 13,500 and 20,000 Euros per year for smoothed profits per employee.

3.2 Econometric identification and estimation

In the reduced-form productivity regression (Eq. (1)), we cannot assume that the input factor variables n_{it}, m_{it} and k_{it} are exogenous, even when we control for firm effects, and we cannot in general rely on ordinary least squares (OLS) estimation, even if we control for firm fixed effects by relying on the time dimension of the panel (i.e., the first-difference or within-firm dimension of the data). The crux of the identification problem inherent in estimating Eq. (1) is that a firm's choice of inputs (n_{it}, m_{it}, k_{it}) will likely depend on realized firm-specific productivity ω_{it}, which only the firm observes. Hence, we have to use an instrumental variable (IV) estimation method (as emphasized in the econometric production function literature since Marshak and Andrews, 1944; see also Griliches and Mairesse, 1998; Ackerberg *et al.*, 2015). Similarly, we cannot assume that in the wage regressions (Eqs. (3) and (4)), the right-hand-side variables, in particular the profit-per-employee variable $(\pi_{it} - n_{it})$, are exogenous. Hence, they need to be instrumented. The endogeneity of profits is due to two sources of reverse causality. First, the wage-profit elasticity (the parameter β_2 in Eqs. (3) and (4)) might be underestimated due to the accounting relationship between wages and profits, implying that higher wages lead to lower profits. Second, theories of incentive pay and efficiency wages (Shapiro and Stiglitz, 1984; Akerlof and Yellen, 1986) predict that higher wages might lead to higher profits, which could generate an upward bias in wage-profit elasticities.

In order to get consistent estimates of the parameters in the productivity and wage equations, we apply the system generalized method of moments (SYS-GMM) estimation method, developed by Arellano and Bover (1995) and Blundell and Bond (1998), which is designed for panels with relatively small time and large cross-sectional dimensions, covariates that are not strictly exogenous, unobserved heterogeneity, heteroscedasticity and within-firm autocorrelation. This method extends the first-differenced GMM estimation method of Arellano and Bond (1991), by relying on a richer set of orthogonality conditions, which are obtained not only by using lagged variables in levels to instrument the equation written in first-differences, but also by using the lagged variables in first-differences to instrument the original equation in levels. Actually, to avoid instrument proliferation, we only exploit the orthogonality conditions entailing as instruments the 2- and 3-year lags of variables in levels and the 1-year lag of the first-differenced variables. We also use the two-step SYS-GMM estimator which is asymptotically more efficient than the one-step SYS-GMM estimator and robust to heteroscedasticity, and the finite-sample correction to the two-step covariance matrix developed by Windmeijer (2005).[6]

Data limitations precluded us from using exogenous firm demand shifters as a source of variation in input demands to obtain consistent estimates of the parameters in the reduced-form productivity equation (Eq. (1)). We follow a common instrumentation strategy in the literature, which is using lagged internal values. More explicitly, we use suitable past levels and differences of input factors as instruments for current inputs. This instrumentation strategy can be theoretically justified through adjustment costs generating dependence of current input levels on past realizations of productivity shocks (see Bond and Söderbom, 2005). Similarly, we lack exogenous firm demand shifters as a source of variation of profits that does not impact directly upon wages. Therefore, we follow common practice and use lagged values of firm profitability as instruments (see e.g. Blanchflower *et al.*, 1996, Hildreth and Oswald, 1997), which in our case are suitable past levels and differences of the smoothed profits-per-employee variable.

We restrict estimation of Eq. (4) to individuals working in the same firms across different years, i.e. we exclude worker mobility. Our motivation is twofold. First, we are primarily interested in obtaining consistent estimates of the wage-profit elasticity (β_2), rather than separately identifying unobserved worker and firm heterogeneity ($\alpha_{j(i)}$ and α_i, respectively) themselves. Therefore, $\theta_s = \alpha_{j(i)} + \alpha_i$ is defined as the unobserved spell effect for worker-firm spell s (Abowd *et al.*, 1999; Andrews *et al.*, 2006). Second, although we have data for several years and for several individuals in the firm, we could have chosen to control for unobserved worker heterogeneity as well as unobserved firm heterogeneity in a single fixed-effects estimation. The problem is, however, that separate identification of both types of unobserved heterogeneity relies on workers who move between employers. This identification strategy is only valid if workers' employer switches are exogenous and random, which is not likely to be the case (see Gibbons and Katz, 1992) and impossible to verify without having information on the reason of mobility.

[6] As the validity of GMM crucially hinges on the assumption that the instruments are exogenous, we use the Sargan and Hansen test statistics for the joint validity of the overidentifying restrictions. In addition to the Hansen test evaluating the entire set of overidentifying restrictions/instruments, we provide difference-in-Hansen statistics to test the validity of subsets of instruments. Details on testing for instrument exogeneity are provided in Section 3 in the online supplementary material.

4 Results of comparative analysis

We compare and discuss in this Section the industry-level estimates of relative and absolute extent of rent sharing $\widehat{\gamma}$ and $\widehat{\phi}$ that we obtain from the productivity and two wage regressions (Eq. (1), Eqs. (3) and (4), respectively), and that we label $\widehat{\gamma}_I^{prod}$, $\widehat{\gamma}_I^{wage,f}$ and $\widehat{\gamma}_I^{wage,w}$, and $\widehat{\phi}_I^{prod}$, $\widehat{\phi}_I^{wage,f}$ and $\widehat{\phi}_I^{wage,w}$, where subscript I varying from 1 to 25 stands for the different industries of our matched firm-worker panel. The standard errors of $\widehat{\gamma}_I^{prod}$ and $\widehat{\phi}_I^{prod}$ are computed using the Delta Method (Wooldridge, 2002).[7] Details on estimates of output elasticities, wage-profit elasticities and other parameter estimates are relegated to Section 3 in the online supplementary material.

Table 2 reports these estimates ranked by increasing order of $\widehat{\gamma}_I^{prod}$ and $\widehat{\phi}_I^{prod}$. We see that while they vary between a minimum of about 0.10 and a maximum of about respectively 1.15 and 0.55, $\widehat{\gamma}_I^{wage,f}$ and $\widehat{\phi}_I^{wage,f}$ vary between negative or zero values in three industries (-0.10, -0.05 and -0.00) and a maximum of about respectively 0.85 and 0.45, and $\widehat{\gamma}_I^{wage,w}$ and $\widehat{\phi}_I^{wage,w}$ vary between negative and a value of less than 0.05 in ten industries and a maximum of about respectively 0.85 and 0.45. A visual representation of the sampling distribution of the rent-sharing estimates is given in Graph 2. These box plots summarize well the average overall picture by abstracting from "outlier" industry estimates. They show that the three sets of estimates differ clearly in average, although they tend to overlap slightly. In the case of the productivity regression, we find median industry estimates of relative and absolute extent of rent sharing of respectively 0.41 and 0.29 to be compared to 0.19 and 0.16 in the case of the firm-level wage regression and 0.09 and 0.08 in the case of the worker-firm wage regression. The evidence is roughly that of a difference of 0.1 between the estimates from the two wage equations, and of 0.2 or 0.3 between them and the ones from the productivity equation.

<Insert Table 2 & Graph 2 about here>

Beyond their overall differences, Tables 3 and 4 provide a comprehensive view of the similarity of the sampling distributions of the three sets of industry estimates of rent sharing. Table 3 shows that the correlations between $\widehat{\gamma}_I^{wage,f}$ and $\widehat{\gamma}_I^{wage,w}$ and between $\widehat{\phi}_I^{wage,f}$ and $\widehat{\phi}_I^{wage,w}$ are high and statistically significant at the 10% level of confidence. These correlations are about 0.35 for the usual Spearman's rank correlation coefficients and respectively 0.28 and 0.41 for the robust "bi-weight mid-correlation" or Wilcox (2012) coefficients. They are also sizeable for the correlations between $\widehat{\gamma}_I^{prod}$ and $\widehat{\gamma}_I^{wage,f}$ and between $\widehat{\phi}_I^{prod}$ and $\widehat{\phi}_I^{wage,f}$. They are about 0.25 for both the Spearman and Wilcox coefficients and statistically significant at the 5% or 10% level of confidence for the latter. However, the corresponding correlations between $\widehat{\gamma}_I^{prod}$ and $\widehat{\gamma}_I^{wage,w}$ and between $\widehat{\phi}_I^{prod}$ and $\widehat{\phi}_I^{wage,w}$ are small, even negative of about -0.05, for the Spearman coefficients, and they are positive and sizeable of about 0.30 and 0.20, if not statistically significant, for the Wilcox coefficients. This is a

[7] Dropping subscripts, $(\sigma_{\widehat{\gamma}})^2 = \left(\frac{s_M}{s_N+s_M-1}\right)^2 \frac{\left(\widehat{\varepsilon}_M^Q\right)^2\left(\sigma_{\widehat{\varepsilon}_N^Q}\right)^2 - 2\,\widehat{\varepsilon}_N^Q\,\widehat{\varepsilon}_M^Q\left(\sigma_{\widehat{\varepsilon}_N^Q,\widehat{\varepsilon}_M^Q}\right) + \left(\widehat{\varepsilon}_N^Q\right)^2\left(\sigma_{\widehat{\varepsilon}_M^Q}\right)^2}{\left(\widehat{\varepsilon}_M^Q\right)^4}$ and $\left(\sigma_{\widehat{\phi}}\right)^2 = \frac{(\sigma_{\widehat{\gamma}})^2}{(1+\widehat{\gamma})^4}$ where $\widehat{\varepsilon}_N^Q$ and $\widehat{\varepsilon}_M^Q$ are the estimated output elasticities with respect to labor and material input, respectively.

mixed picture, but not a bad one if we take into consideration that these correlations are computed for distributions of 25 estimates only, and they concern a subset of very diverse and heterogeneous industries.

<Insert Table 3 about here>

Table 4 gives the mean, first quartile Q_1, median Q_2 and third quartile Q_3 of the three sets of industry estimates of rent sharing. It shows that the differences between them in the mid-range of their distribution, from Q_1 to Q_3, are roughly the same as already mentioned for the median: of 0.1 between the estimates from the two wage equations, and of 0.2 or 0.3 between them and the ones for the productivity equation. The first quartile value of $\widehat{\gamma}_I^{wage,w}$ is the only noteworthy exception to such nearly constant shift. By itself, it suggests that a common omitted variable misspecification, namely workers' skill, could be a potential explanation to the extent that it would affect the three sets of rent-sharing estimates differentially. This is what we try to substantiate among other a priori sources of discrepancies in the next Section.

<Insert Table 4 about here>

5 Potential sources of discrepancies between rent-sharing estimates

We can a priori distinguish three large categories of reasons or sources of discrepancies that we find between the distributions of the industry rent-sharing parameters as estimated on the basis of the productivity and wage determination regressions (Eqs. (1), (3) and (4)).

A first category is economic specification errors, which involve omitted relevant variables as well as poor measurement of included available variables. An important case, for the wage regressions, particularly for regression (3), is the omission of a variable or group of variables of workers' skills because of the lack of suitable skill composition data at the firm level. We expect that rent sharing is higher in skill-intensive firms, and hence that wage-profit elasticities will be upwardly biased in the absence of skill variables in the two wage regressions. Actually, the omission of skill variables is the most likely source of the smaller estimates of rent sharing found with regression (4) than with regression (3). As already explained, the specification of these two regressions is basically the same, their main difference being that they are estimated at the worker-firm level and firm-level of our matched firm-worker panel data sample. At the worker-firm level, we can expect that the worker-firm effect is positively correlated with the worker's skills. We know in fact that the assortative matching of firms and workers is non-random, and that high-skilled (and thus high-wage) workers tend to be selected into high-productive (and thus high-profit) firms (Abowd *et al.*, 1999; Card *et al.*, 2014).

As already mentioned, the introduction of the capital-per-employee variable in the two wage regressions is largely to proxy for the omission of skill variables. As capital-intensive firms will also be skill-intensive in industries where capital and skilled labor are complements, we expect that wage-profit elasticity estimates will be less upwardly biased for lack of skill variables when the capital-per-employee variable is included in the wage regressions. This is indeed confirmed if we estimate them without this variable. We find that the mean (or median) of the industry-level absolute extent of rent-sharing estimates $\widehat{\phi}_I^{wage,f}$ and $\widehat{\phi}_I^{wage,w}$ increase respectively from 0.17 to 0.25 (0.16 to 0.23) and from 0.10 to 0.14 (0.08 to 0.15), that is, in average by about respectively 50% and 40% (by about respectively 45% and 90%). In terms of comparison with the productivity regression industry estimates, when we do not include the capital-per-employee variable in the two wage regressions, the differences between the mean (or median) industry-level absolute extent of rent-sharing estimates $\widehat{\phi}_I^{prod}$ and respectively $\widehat{\phi}_I^{wage,f}$ and $\widehat{\phi}_I^{wage,w}$ decrease in average by about respectively 65% and 20% (by about respectively 55% and 35%).

A second category of potential sources of discrepancies between our reduced-form regression estimates of extent of rent sharing, which is closely related to the first category, concerns estimation methods, in particular the instrumentation strategy. Estimation of the productivity and the wage determination equations is based on exploiting different moment conditions for identification. Since data limitations precluded us from relying on external a priori exogenous instruments, we followed, as we explained, the common method of using past differences and levels of the regression variables themselves to construct such moment conditions. Since these variables are rather similar for the productivity and wages regressions, and hence the moment conditions based on their lagged differenced and level values are close, and since we have been attentive to check for their validity, it seems actually unlikely that estimation methods could be a significant source of discrepancies between our rent-sharing estimates.

A third category relates to different underlying theoretical structural models, which are themselves specifically or loosely related to various interpretative schemes. As stressed from the outset, both the econometric productivity and wage determination regressions are reduced-form models. Given that our main interest is in the assessment and comparison of the firm-worker rent-sharing parameters, the reduced-form regressions provide satisfactory results if the first and second categories of discrepancies remain unimportant, that is, if they are appropriately specified and estimated. At the same time, we cannot and do not analyze the theoretical structural models which are possibly underlying these reduced-form models and are at least compatible with them. A consequence is that we are not able to decide between different interpretative schemes of our results, nor are we in a position to pin down the economic mechanisms and channels of rent sharing between firms and their workers.

In the online supplementary material, we present one theoretical structural model behind the reduced-form productivity regression, in which case the interpretative scheme is collective bargaining. We also present three potential theoretical structural models which can substantiate the expected positive pay-performance link of the wage determination regressions: collective bargaining models, an optimal labor contract model and a search-theoretic model of the labor market.[8] In collective bargaining models, the existence and strength of workers' bargaining power, which can correspond to different practices, institutionalized or not, is central.[9] In optimal contract models in which both workers and firms are risk-averse, the pay-performance link depends on the ratio of both parties' relative risk aversion parameters.[10] In two-sided search models with wage posting, the main source of rent sharing is competition between firms to attract workers. Firms have an incentive to hire more workers, thereby reducing search costs.[11] This incentive is particularly pronounced for higher-productivity firms because they face larger opportunity costs of search.

Although the three structural models can be developed analytically, their econometric analyses, in particular so that they could be compared together as well as with a structural productivity model with imperfections in product and labor markets, would be a formidable endeavor, if only because of multiple data constraints. To give two examples, one could estimate the coefficient of relative risk aversion from data on labor supply, but this would entail estimating wage and income elasticities, which could be done on the condition of having data on exogenous variation in unearned income and wages due to tax changes or lottery winnings. Similarly, one could attempt to quantify the extent to which search costs may drive a positive pay-performance link on the condition of having data on differential hiring activities across firms.

6 Conclusion

The basic objective of this paper is to compare as closely as possible rent-sharing estimates based on a reduced-form wage determination model adopted in a large empirical literature on firm-worker rent-sharing with rent-sharing estimates based on a reduced-form productivity model developed more recently, which we consider as largely complementary and which we think should provide reconcilable estimates. Grounded on a large matched firm-worker panel data sample, our main finding is that industry distributions of rent-sharing estimates are well correlated and overlap, but are nonetheless significantly different on average. Precisely, looking at the average industry estimates of the parameter of absolute extent of rent sharing, we obtain an estimate of 0.29 for the productivity regression and 0.17 for the wage determination regression if we rely only on firm-level information. If we also take advantage of the worker-level information to control for unobserved worker ability in the model of wage determination, thereby accounting for non-random sorting of high-ability (and thus high-wage) workers into high-profit firms, we find as expected a lower average value of 0.10.

[8] Note that an expected positive pay-performance link can be derived from at least two other models. One is a modified version of the competitive labor market model with temporary frictions and a positively-sloped labor supply schedule (see Blanchflower *et al.*, 1996). The other is the efficiency wage model in which increased productivity arises from reduced shirking and thus generates a positive wage-profitability correlation (Shapiro and Stiglitz, 1984).

[9] In these models, the pay-performance relationship depends on the relative strengths of the bargaining parties (see Eq. (20) in the online supplementary material).

[10] See Eq. (27) in the online supplementary material.

[11] See the combination of Eqs. (33) and (34) in the online supplementary material.

There are a priori three large categories of reasons or potential sources of discrepancies that we find between the three types of estimates: economic specification errors, which involve omitted relevant or poorly measured variables; estimation methods, particularly instrumentation strategy; and different underlying theoretical structural models related to a variety of interpretative schemes. The idea of addressing all these potential sources of discrepancies in an encompassing model would be a formidable challenge, if only because of specific data requirements.

Renouncing to consider it, we can think of two interesting routes for future research. The first is to analyze and test separately the potential sources of discrepancies between the econometric reduced-form productivity and wage determination models, for example, by trying to take explicitly into account different workers' skills and by considering, more generally, that heterogeneity of firms and workers, of markets and industries is likely to be a dominant driving source of the discrepancies in our present estimates. The latter could be investigated on various sets of specific detailed datasets, corresponding to different periods, countries, industries, labor and product markets.

A complementary route of research is to empirically and specifically relate the reduced-form productivity and wage regressions to their underlying structural models by econometrically specifying and testing them in a multi-equation framework. There already exist many attempts in such direction (e.g. Bughin 1993, 1996; Jaumandreu and Mairesse, 2010; Forlani *et al.*, 2016, Peters *et al.*, 2017), but they still raise numerous difficulties. Actually, in the case of the reduced-form productivity regression, this endeavor brings us back to the paradigm of Marschak and Andrews (1944). As such, it involves framing a structural model composed of a production function, a demand function, a pricing rule, cost share equations for variable input factors, potentially taking into account some type of worker heterogeneity and separate wage equations for different types of workers.

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Table 1: Descriptive statistics: Comparative analysis sample, 1984-2001

Variables	mean	sd	Q_1	Q_2	Q_3	N
Real firm output growth rate (Δq_{it})	0.026	0.150	-0.058	0.022	0.108	96,508
Labor growth rate (Δn_{it})	0.009	0.126	-0.042	0.000	0.060	96,508
Materials growth rate (Δm_{it})	0.044	0.194	-0.061	0.039	0.145	96,508
Capital growth rate (Δk_{it})	0.003	0.154	-0.072	-0.018	0.067	96,508
Labor share in nominal output (s_{Nit})	0.328	0.136	0.231	0.314	0.407	109,199
Materials share in nominal output (s_{Mit})	0.494	0.150	0.401	0.502	0.599	109,199
Profits per employee $\left(\frac{\Pi}{N}\right)_{it}$	19,392	24,491	6,790	12,678	23,309	109,199
Smoothed profits per employee $\widetilde{\left(\frac{\Pi}{N}\right)}_{it}$	19,734	22,939	7,958	13,415	23,512	109,199
Firm average number of employees (N_{it})	123	255	32	49	116	109,199
Firm average wage per worker (W_{it})	27,381	7,612	21,944	26,667	31,907	109,199
Wage premium ($W_{it} - \overline{W}_{it}$)	8,103	6.283	3.662	7,023	11,372	109,199
Number of employees $\left(N_{j(i)t}\right)$	21	42	3	9	22	382,501
Average wage per worker ($W_{j(i)t}$)	15,919	8,882	10,807	13,690	18,046	382,501

Note: $\overline{W}_{it}$ is proxied by the 5^{th} percentile value of the workers' wage distribution, $\widetilde{\left(\frac{\Pi}{N}\right)}_{it}$ is defined as $\frac{1}{5}\sum_{k=t-4}^{t}\left(\frac{\Pi}{N}\right)_{ik}$ if $\left(\frac{\Pi}{N}\right)_{it-4}$ is not missing, otherwise equal to $\frac{1}{4}\sum_{k=t-3}^{t}\left(\frac{\Pi}{N}\right)_{ik}$ (taking advantage of the availability of three year pre-sample accounting firm observations when necessary).

Table 2: Reduced-form models of productivity and wage determination:

Industry-specific relative $\left(\widehat{\gamma}_I^{prod}, \widehat{\gamma}_I^{wage,f}, \widehat{\gamma}_I^{wage,w}\right)$ and absolute $(\widehat{\phi}_I^{prod}, \widehat{\phi}_I^{wage,f}, \widehat{\phi}_I^{wage,w})$ extent of rent-sharing parameters

		Reduced-form model of productivity		Reduced-form model of wage determination			
				Dep. var.: Firm wage w_{it}		Dep. var.: Worker wage $w_{j(i)t}$	
Ind. I	Name	$\widehat{\gamma}_I^{prod}$	$\widehat{\phi}_I^{prod}$	$\widehat{\gamma}_I^{wage,f}$	$\widehat{\phi}_I^{wage,f}$	$\widehat{\gamma}_I^{wage,w}$	$\widehat{\phi}_I^{wage,w}$
17	Articles of paper and paperboard	0.115 (0.196)	0.103 (0.158)	-0.037 (0.056)	-0.039 (0.060)	0.058 (0.050)	0.054 (0.045)
19	Plastic products	0.141 (0.138)	0.124 (0.106)	-0.101 (0.135)	-0.112 (0.167)	0.199 (0.089)	0.166 (0.062)
8	Metal products for construction	0.210 (0.372)	0.173 (0.254)	0.517 (0.608)	0.341 (0.264)	0.849 (0.440)	0.459 (0.129)
13	Earthenware products and construction material	0.231 (0.129)	0.188 (0.085)	0.187 (0.088)	0.158 (0.062)	0.124 (0.062)	0.111 (0.049)
4	Publishing, (re)printing	0.255 (0.157)	0.203 (0.099)	0.210 (0.203)	0.174 (0.139)	-0.170 (0.113)	-0.204 (0.164)
12	Mining of metal ores, other mining n.e.c.	0.286 (0.115)	0.223 (0.069)	0.106 (0.142)	0.096 (0.116)	0.086 (0.072)	0.079 (0.061)
21	Production of non-ferrous metals	0.291 (0.279)	0.225 (0.168)	0.041 (0.093)	0.039 (0.086)	0.007 (0.058)	0.007 (0.057)
16	Pulp, paper and paperboard	0.316 (0.354)	0.240 (0.204)	0.137 (0.134)	0.120 (0.104)	0.252 (0.094)	0.202 (0.060)
11	Medical and surgical equipment and orthopaedic appliances	0.317 (0.578)	0.241 (0.333)	0.387 (0.472)	0.279 (0.245)	0.333 (0.267)	0.250 (0.150)
20	Basic iron and steel	0.319 (0.220)	0.242 (0.127)	0.004 (0.225)	0.004 (0.224)	-0.053 (0.052)	-0.056 (0.058)
1	Other food products	0.369 (0.150)	0.269 (0.080)	0.224 (0.151)	0.183 (0.101)	0.089 (0.085)	0.082 (0.072)
3	Leather goods and footwear	0.373 (0.278)	0.272 (0.147)	0.378 (0.122)	0.274 (0.064)	0.142 (0.097)	0.124 (0.075)
18	Rubber products	0.411 (0.341)	0.291 (0.171)	0.279 (0.118)	0.218 (0.072)	0.001 (0.045)	0.001 (0.045)
6	Shipbuilding, construction of railway rolling stock, bicycles, motorcycles, transport equipment n.e.c.	0.421 (0.519)	0.296 (0.257)	0.607 (0.160)	0.378 (0.062)	0.297 (0.149)	0.229 (0.089)
7	Aircraft and spacecraft	0.469 (0.577)	0.319 (0.267)	0.116 (0.504)	0.104 (0.405)	-0.202 (0.105)	-0.253 (0.165)
5	Furniture	0.478 (0.231)	0.323 (0.106)	0.189 (0.176)	0.159 (0.125)	0.249 (0.135)	0.199 (0.087)
25	Electronics	0.479 (0.300)	0.324 (0.137)	0.425 (0.348)	0.298 (0.171)	0.710 (0.191)	0.415 (0.065)
22	Ironware	0.482 (0.220)	0.325 (0.100)	0.171 (0.122)	0.146 (0.089)	0.013 (0.085)	0.013 (0.083)
10	Other special purpose machinery	0.550 (0.405)	0.355 (0.169)	0.200 (0.326)	0.167 (0.226)	-0.006 (0.172)	-0.006 (0.174)
9	Ferruginous and steam boilers	0.599 (0.292)	0.374 (0.114)	0.462 (0.547)	0.316 (0.256)	-0.060 (0.196)	-0.064 (0.222)
15	Knitted and crocheted fabrics	0.657 (0.321)	0.397 (0.117)	0.284 (0.287)	0.221 (0.174)	-0.054 (0.149)	-0.057 (0.167)
24	Metal fabrication	0.685 (0.140)	0.406 (0.049)	0.124 (0.076)	0.110 (0.060)	0.034 (0.073)	0.033 (0.068)
14	Spinning and weaving	0.809 (0.256)	0.447 (0.078)	0.124 (0.158)	0.110 (0.125)	0.290 (0.113)	0.225 (0.068)
23	Industrial service to metal products	0.810 (0.147)	0.447 (0.045)	-0.005 (0.176)	-0.005 (0.178)	0.085 (0.136)	0.078 (0.116)
2	Clothing and skin goods	1.130 (0.223)	0.531 (0.049)	0.831 (0.215)	0.454 (0.064)	0.622 (0.190)	0.383 (0.072)

Notes: The standard errors in parentheses measure the dispersion of the rent-sharing parameters at the level of firms making up the industry.
The standard errors of the average rent-sharing estimates are obtained by dividing the reported standard errors by the square root of the number of industry observations.
$\widehat{\phi}_I^{prod} = \frac{\widehat{\gamma}_I^{prod}}{1+\widehat{\gamma}_I^{prod}}$, $\widehat{\gamma}_I^{wage,f} = \left(\widehat{\beta}_2\right)_I^{wage,f} \times \left(\overline{Ratio}\right)_I$ with $\widehat{\beta}_2$ the estimated wage-profit elasticity and $\overline{Ratio} = \text{mean}\left(\frac{W_{it} \times N_{it}}{\Pi_{it}}\right)$, $\widehat{\phi}_I^{wage,f} = \frac{\widehat{\gamma}_I^{wage,f}}{1+\widehat{\gamma}_I^{wage,f}}$.
Similar formulas apply if the dependent variable is the worker wage $w_{j(i)t}$. Industries are ranked according to $\widehat{\gamma}_I^{prod}$.

Table 3: Correlation of industry-specific relative and absolute extent of rent-sharing parameters across the reduced-form productivity model and the reduced-form model of wage determination

Relative extent of rent sharing	$\widehat{\gamma}_I^{prod}$	$\widehat{\gamma}_I^{wage,f}$	$\widehat{\gamma}_I^{wage,w}$
Model of productivity: $\widehat{\gamma}_I^{prod}$	1.000 [1.000]		
Model of wage determination, dep. var. = w_{it}: $\widehat{\gamma}_I^{wage,f}$	0.258 [0.253*]	1.000 [1.000]	
Model of wage determination, dep. var. = $w_{j(i)t}$: $\widehat{\gamma}_I^{wage,w}$	-0.074 [0.302]	0.350*[0.278*]	1.000 [1.000]
Absolute extent of rent sharing	$\widehat{\phi}_I^{prod}$	$\widehat{\phi}_I^{wage,f}$	$\widehat{\phi}_I^{wage,w}$
Model of productivity: $\widehat{\phi}_I^{prod}$	1.000 [1.000]		
Model of wage determination, dep. var. = w_{it}: $\widehat{\phi}_I^{wage,f}$	0.258 [0.266**]	1.000 [1.000]	
Model of wage determination, dep. var. = $w_{j(i)t}$: $\widehat{\phi}_I^{wage,w}$	-0.074 [0.198]	0.350*[0.410*]	1.000 [1.000]

Notes: $\widehat{\gamma}_I^{wage,f} = \left(\widehat{\beta}_2\right)_I^{wage,f} \times \left(\overline{Ratio}\right)_I$, with $\widehat{\beta}_2$ the estimated wage-profit elasticity and $\overline{Ratio} = \text{mean}\left(\frac{W_{it} \times N_{it}}{\Pi_{it}}\right)$, $\widehat{\phi}_I^{wage,f} = \frac{\widehat{\gamma}_I^{wage,f}}{1+\widehat{\gamma}_I^{wage,f}}$. Similar formulas apply if the dependent variable is the worker wage $w_{j(i)t}$. $\widehat{\phi}_I^{prod} = \frac{\widehat{\gamma}_I^{prod}}{1+\widehat{\gamma}_I^{prod}}$. Spearman's rank correlation is reported. Wilcox' robust correlation is reported in square brackets.

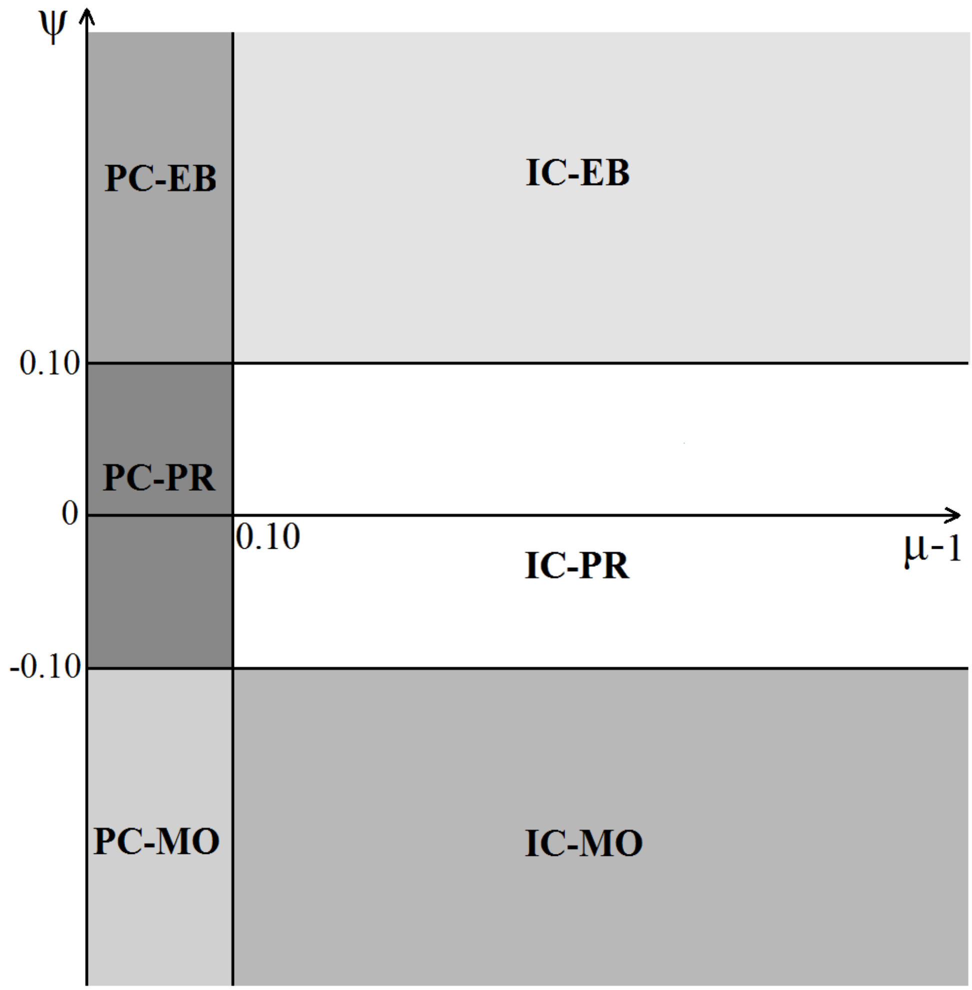
**Significant at 5%, *significant at 10%.

Table 4: Comparison of the distribution of relative and absolute extent of rent-sharing parameters across the reduced-form productivity model and the reduced-form model of wage determination

Reduced-form econometric model		mean	Q_1	Q_2	Q_3
	Relative extent of rent sharing				
Model of productivity	$\widehat{\gamma}_I^{prod}$	0.448	0.291	0.411	0.550
Model of wage determination, dep. var. = w_{it}	$\widehat{\gamma}_I^{wage,f}$	0.234	0.116	0.189	0.378
Model of wage determination, dep. var. = $w_{j(i)t}$	$\widehat{\gamma}_I^{wage,w}$	0.156	0.001	0.086	0.252
	Absolute extent of rent sharing				
Model of productivity	$\widehat{\phi}_I^{prod}$	0.293	0.225	0.291	0.355
Model of wage determination, dep. var. = w_{it}	$\widehat{\phi}_I^{wage,f}$	0.168	0.104	0.159	0.274
Model of wage determination, dep. var. = $w_{j(i)t}$	$\widehat{\phi}_I^{wage,w}$	0.099	0.001	0.079	0.202

Notes: $\widehat{\gamma}_I^{wage,f} = \left(\widehat{\beta}_2\right)_I^{wage,f} \times \left(\overline{Ratio}\right)_I$, with $\widehat{\beta}_2$ the estimated wage-profit elasticity and $\overline{Ratio} = \text{mean}\left(\frac{W_{it} \times N_{it}}{\Pi_{it}}\right)$, $\widehat{\phi}_I^{wage,f} = \frac{\widehat{\gamma}_I^{wage,f}}{1+\widehat{\gamma}_I^{wage,f}}$. Similar formulas apply if the dependent variable is the worker wage $w_{j(i)t}$. $\widehat{\phi}_I^{prod} = \frac{\widehat{\gamma}_I^{prod}}{1+\widehat{\gamma}_I^{prod}}$.

Graph 1: Comparative analysis sample: IC-EB regime



Notes: Product market settings: PC refers to perfect or "nearly perfect" competition and IC to imperfection competition, labor market settings: PR refers to perfect or "nearly perfect" competition or right-to-manage bargaining, EB to efficient bargaining and MO to monopsony. μ: price-cost mark-up, ψ: joint market imperfections parameter.

PC-PR: $1 \leq \mu \leq 1.1$ and $-0.1 \leq \psi \leq 0.1$

PC-EB: $1 \leq \mu \leq 1.1$ and $\psi > 0.1$

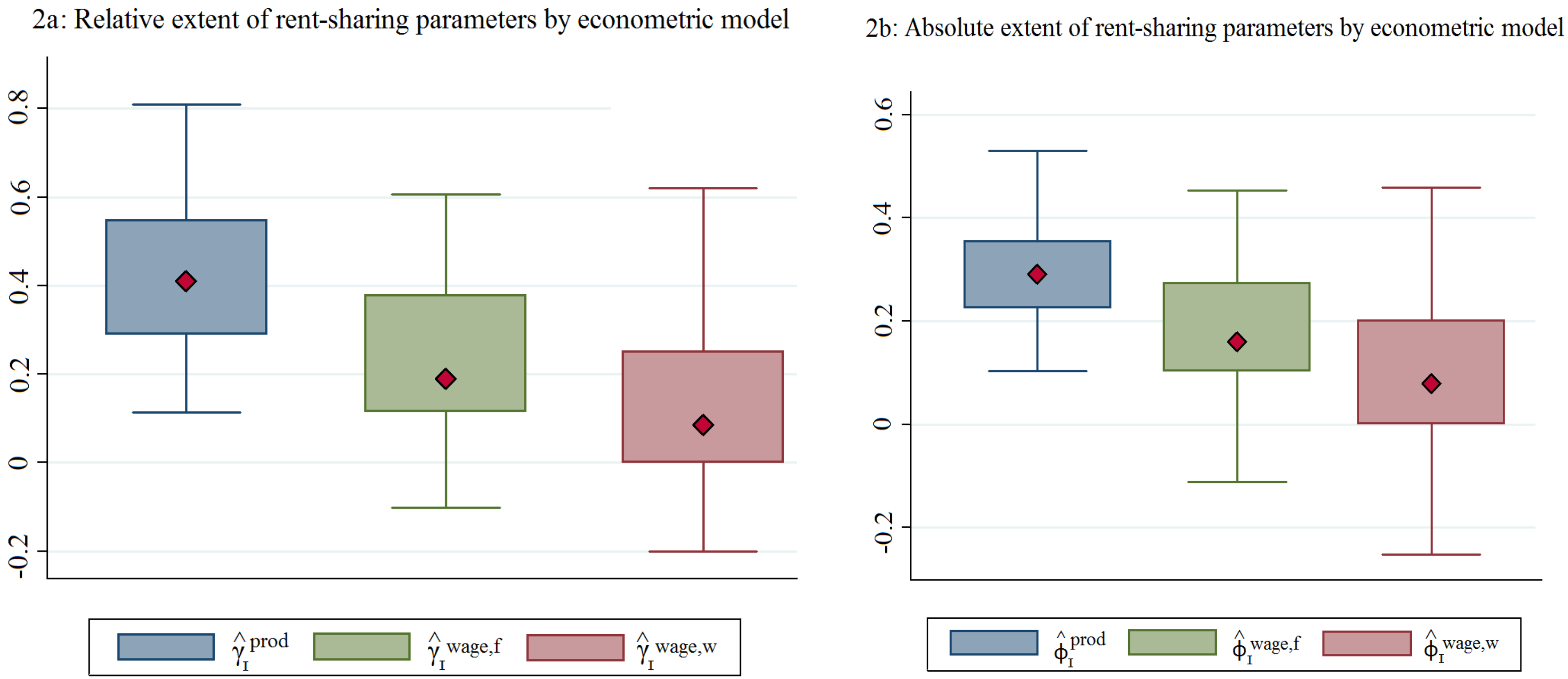
PC-MO: $1 \leq \mu \leq 1.1$ and $\psi < -0.1$

IC-PR: $\mu > 1.1$ and $-0.1 \leq \psi \leq 0.1$

IC-EB: $\mu > 1.1$ and $\psi > 0.1$

IC-MO: $\mu > 1.1$ and $\psi < -0.1$

Graph 2: Relative and absolute extent of rent sharing parameters by econometric model



Notes: The box plots provide a summary of the sampling distributions of industry estimates of rent sharing. The upper and lower limits of the boxes represent the first and third quartiles of extent of rent-sharing parameter estimates while the median is represented by the diamond.

Subscript "prod" denotes rent-sharing estimates obtained from the reduced-form model of productivity.

Subscript "wage,f" denotes rent-sharing estimates obtained from the reduced-form model of wage determination using the firm average wage as the dependent variable.

Subscript "wage,w" denotes rent-sharing estimates obtained from the reduced-form model of wage determination using the worker's wage as the dependent variable.

Online supplement to: Comparing micro-evidence on rent sharing from two different econometric models

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Abstract

This supplement to our paper "Comparing micro-evidence on rent sharing from two different econometric models" presents (*i*) in Sections 1 and 2 theoretical structural models with which our econometric reduced-form models of productivity and wage determination are compatible and (*ii*) in Section 3 detailed estimates and diagnostic tests that we obtain from estimating the reduced-form models of productivity and wage determination.

In *Section 1*, we present one theoretical structural model behind the econometric reduced-form productivity model that we are able to derive explicitly and which enables us to go from the derived theoretical relationship to the empirical reduced-form productivity equation based on our data.

There are various interpretative schemes behind the expected positive pay-performance link, i.e. behind the wage-profit elasticity in the reduced-form model of wage determination, which stem from various underlying theoretical structural models, as noted in Section 1 "Introduction" and Section 5 "Potential sources of discrepancies between rent-sharing estimates" in the main text. In *Section 2* of this online supplement, we elaborate on three different interpretations of such pay-performance relationship which are compatible with three different theoretical structural models: collective bargaining models, an optimal labor contract model and a search-theoretic model of the labor market. Intuitively, central to collective bargaining models is the existence of workers' bargaining power allowing them to appropriate part of the firm's surplus. In these models, the pay-performance relationship depends on the relative strengths of the bargaining parties. In optimal contract models in which both workers and firms are risk-averse, the pay-performance link depends on the ratio of both parties' relative risk aversion parameters. In two-sided search models with wage posting, the main source of rent sharing is competition between firms to attract workers. Firms have an incentive to hire more workers, thereby reducing search costs. This incentive is particularly pronounced for

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higher-productivity firms because they face larger opportunity costs of search. Although the three structural models can be developed analytically, we are not able to estimate them econometrically because of data constraints as this would require having more detailed worker and firm characteristics. As such, we are not in a position to distinguish between the three potential interpretative schemes empirically.

In *Section 3*, we present detailed estimates that we obtain from estimating the reduced-form models of productivity and wage determination using the system generalized method of moments (SYS-GMM) estimation method. We also report two diagnostic tests: tests on overidentifying restrictions (instrument exogeneity tests) and a test on lack of second-order serial correlation in the differenced residuals (model specification test).

1 A theoretical structural productivity model

A firm i at time t produces output using the following production technology:

$$Q_{it} = Q_{it}(N_{it}, M_{it}, K_{it}) \tag{1}$$

with (N_{it}, M_{it}) a vector of static inputs in production free of adjustment costs (labor and intermediate inputs) and K_{it} capital treated as a dynamic input in production (predetermined in the short run).

We assume that (i) $Q_{it}(\cdot)$ is continuous and twice differentiable with respect to its arguments, (ii) a firm takes the input price of materials as given, (iii) firms produce in a homogeneous good industry and compete in quantities (play Cournot)[1] and (iv) producers active in the market are maximizing short-run profits.

Let us turn to the oligopolistic firm's short-run profit maximization problem. Firm i's short-run profits, Π_{it}, are given by:

$$\Pi_{it} = R_{it} - W_{it}N_{it} - J_{it}M_{it} \tag{2}$$

with $R_{it} = P_t Q_{it}$ an increasing and concave revenue function, P_t the price of the homogenous good at time t, and W_{it} and J_{it} the firm's input prices for N and M, respectively, at time t.

Firm i must choose the optimal quantity of output and the optimal demand for intermediate inputs and labor. The optimal output choice Q_{it} satisfies the following first-order condition:

$$\frac{P_t}{(C_Q)_{it}} = \left(1 + \frac{s_{it}}{\eta_t}\right)^{-1} = \mu_{it} \tag{3}$$

with $(C_Q)_{it} = \frac{\partial C_{it}}{\partial Q_{it}}$ the marginal cost of production, $s_{it} = \frac{Q_{it}}{Q_t}$ the market share of firm i, $\eta_t = \frac{\partial Q_t}{\partial P_t}\frac{P_t}{Q_t}$ the own-price elasticity of industry demand and μ_{it} firm i's price-cost markup.

[1] This assumption is consistent with only observing a domestic industry-wide output price index and not firm-specific output prices.

The first-order condition for the optimal choice of intermediate inputs is given by setting the marginal revenue product of intermediate inputs equal to the price of intermediate inputs:

$$(Q_M)_{it} = \frac{J_{it}}{P_t}\left(1 + \frac{s_{it}}{\eta_t}\right)^{-1} \tag{4}$$

Inserting Eq. (3) in Eq. (4) and multiplying both sides by $\frac{M_{it}}{Q_{it}}$ yields:

$$(\varepsilon_M^Q)_{it} = \mu_{it} s_{Mit} \tag{5}$$

From Eq. (5), it follows that profit maximization implies that optimal demand for intermediate inputs is satisfied when a firm equalizes the output elasticity with respect to intermediate inputs, denoted by $(\varepsilon_M^Q)_{it} = \frac{\partial Q_{it}}{\partial M_{it}} \frac{M_{it}}{Q_{it}}$, to the price-cost mark-up μ_{it} multiplied by the share of intermediate input expenditure in total sales, denoted by $s_{Mit} = \frac{J_{it} M_{it}}{P_t Q_{it}}$.

Firm i's optimal demand for labor depends on the characteristics of its labor market. We distinguish three labor market settings (LMS): perfect competition or right-to-manage bargaining (PR), strongly efficient bargaining (EB) and static partial equilibrium monopsony (MO).

Under PR, labor is unilaterally determined by firm i from short-run profit maximization, which implies the following first-order condition:

$$(\varepsilon_N^Q)_{it} = \mu_{it} s_{Nit} \tag{6}$$

with $(\varepsilon_N^Q)_{it} = \frac{\partial Q_{it}}{\partial N_{it}} \frac{N_{it}}{Q_{it}}$ the output elasticity with respect to labor and $s_{Nit} = \frac{W_{it} N_{it}}{P_t Q_{it}}$ the share of labor expenditure in total sales.

In a *perfectly competitive labor market model*, a firm takes the exogenously-determined market wage as given. A profit-maximizing firm always chooses employment such that the marginal revenue product of labor equals the wage (Eq. (6)). In the *right-to-manage bargaining model*, the firm and its workers bargain over any surplus in order to determine the wage (Nickell and Andrews, 1983). The firm continues to choose the number of workers it wishes to employ once wages have been determined by the bargaining process, which implies the same static first-order condition for labor as in the perfectly competitive labor market model. The following first-order condition with respect to wages must hold at an interior optimum:

$$W_{it} = \overline{W}_{it} + \gamma_{it}\left[\frac{R_{it} - W_{it} N_{it} - J_{it} M_{it}}{N_{it}}\right] \tag{7}$$

where $\overline{W}_{it}$ represents the worker's alternative wage, $\gamma_{it} = \frac{\phi_{it}}{1-\phi_{it}}$ the relative extent of rent sharing with $\phi_{it} \in [0,1]$ the part of economic rents going to the workers.[2]

[2] Eq. (7) results from maximizing a generalized Nash product, the product of the weighted net gains to the firm and its workers, $\Omega_{RTM} = \left\{N_{it}(W_{it})W_{it} + \left(\overline{N}_{it} - N_{it}(W_{it})\right)\overline{W}_{it} - \overline{N}_{it}\overline{W}_{it}\right\}^{\phi_{it}} \left\{R_{it} - W_{it}N_{it}(W_{it}) - J_{it}M_{it}\right\}^{1-\phi_{it}}$ with respect to the wage rate subject to $(R_N)_{it} = W_{it}$, with R_N the marginal revenue product of labor and $\overline{N}$ the competitive employment level.

Under *strongly efficient bargaining* (EB), the risk-neutral firm and its risk-neutral workers negotiate simultaneously over wages and employment in order to maximize the joint surplus of their economic activity (McDonald and Solow, 1981). An efficient wage-employment pair is obtained by maximizing a generalized Nash product[3] with respect to the wage rate and labor. The first-order condition for wages is given by Eq. (7). The first-order condition for labor is given by:

$$W_{it} = (R_N)_{it} + \phi_{it}\left[\frac{R_{it} - (R_N)_{it}N_{it} - J_{it}M_{it}}{N_{it}}\right] \tag{8}$$

with $(R_N)_{it} = \frac{\partial R_{it}}{\partial N_{it}}$ the marginal revenue product of labor.

An efficient wage-employment pair is given by solving simultaneously the first-order conditions with respect to the wage rate and labor. As such, the equilibrium condition is given by:

$$(R_N)_{it} = \overline{W}_{it} \tag{9}$$

Eq. (9) traces out the locus of efficient wage-employment pairs, known as the contract curve. Given that $\mu_{it} = \frac{P_t}{(R_Q)_{it}}$ in equilibrium, with $(R_Q)_{it} = \frac{\partial R_{it}}{\partial Q_{it}}$ the marginal revenue, we obtain the following expression for the output elasticity with respect to labor by combining Eqs. (7) and (9):

$$(\varepsilon_N^Q)_{it} = \mu_{it}s_{Nit} - \mu_{it}\gamma_{it}(1 - s_{Nit} - s_{Mit}) \tag{10}$$

So far, we have assumed that there is a potentially infinite supply of employees wanting a job in the firm. A small wage cut by the employer will result in the immediate resignation of all existing workers. However, the *static partial equilibrium monopsony model* (MO) postulates that the labor supply facing an individual employer might be less than perfectly elastic because workers might have heterogeneous preferences over workplace environments of different potential employers (Manning, 2003). Such heterogeneity in e.g. firm location or job characteristics (corporate culture, starting times of work) makes workers to view employers as imperfect substitutes. This in turn gives employers non-negligible market power over their workers.

Let us assume that the monopsonist firm is constrained to set a single wage for all his workers and faces labor supply $N_{it}(W_{it})$, which is an increasing function of the wage W. Both $N_{it}(W_{it})$ and the inverse of this relationship $W_{it}(N_{it})$ are referred to as the labor supply curve of this firm. The monopsonist firm's objective is to maximize its short-run profit function $\Pi_{it} = R_{it} - W_{it}(N_{it})N_{it} - J_{it}M_{it}$, taking the labor supply curve as given. Maximizing this profit function with respect to labor gives the following first-order condition:[4]

$$(R_N)_{it} = (W_N)_{it}N_{it} + W_{it}(N_{it}) \tag{11}$$

[3] The generalized Nash product is written as: $\Omega_{EB} = \left\{N_{it}W_{it} + \left(\overline{N}_{it} - N_{it}\right)\overline{W}_{it} - \overline{N}_{it}\overline{W}_{it}\right\}^{\phi}\left\{R_{it} - W_{it}N_{it} - J_{it}M_{it}\right\}^{1-\phi_{it}}$.

[4] From Eq. (11), it follows that profit maximization implies that the optimal demand for labor is satisfied when a firm equalizes the marginal revenue product of labor to the marginal cost of labor. The latter is higher than the wage paid to the new worker $W_{it}(N_{it})$ by the amount $(W_N)_{it}N_{it}$ because the firm has to increase the wage paid to all workers it already employs whenever it hires an extra worker.

Rewriting Eq. (11) gives:

$$W_{it} = \beta_{it}(R_N)_{it} \tag{12}$$

with $\beta_{it} = \frac{W_{it}}{(R_N)_{it}} = \frac{(\varepsilon_W^N)_{it}}{1+(\varepsilon_W^N)_{it}}$. $\beta_{it} \leq 1$ represents the wage markdown and $(\varepsilon_W^N)_{it} = \frac{\partial N_{it}(W_{it})}{\partial W_{it}} \frac{W_{it}}{N_{it}} \in \Re_+$ the wage elasticity of the labor supply curve that firm i faces, measuring the degree of wage-setting power that firm i possesses.[5]

Rewriting Eq. (12) and using that $(R_N)_{it} = \frac{P_t(Q_N)_{it}}{\mu_{it}}$ with $(Q_N)_{it}$ the marginal product of labor, gives the following expression for the elasticity of output with respect to labor:

$$(\varepsilon_N^Q)_{it} = \mu_{it} s_{Nit} \left(1 + \frac{1}{(\varepsilon_W^N)_{it}}\right) \tag{13}$$

Using the first-order condition for intermediate inputs, we obtain an expression for firm i's price-cost markup (μ_{it}) and using the first-order conditions for intermediate inputs and labor, we define firm i's joint market imperfections parameter (ψ_{it}) as follows:

$$\mu_{it} = \frac{(\varepsilon_M^Q)_{it}}{s_{Mit}} \tag{14}$$

$$\begin{aligned}
\psi_{it} &= \frac{(\varepsilon_M^Q)_{it}}{s_{Mit}} - \frac{(\varepsilon_N^Q)_{it}}{s_{Nit}} && (15)\\
&= 0 \quad \text{if LMS=PR} && (16)\\
&= \mu_{it}\gamma_{it}\left[\frac{1 - s_{Nit} - s_{Mit}}{s_{Nit}}\right] > 0 \quad \text{if LMS=EB} && (17)\\
&= -\mu_{it}\frac{1}{(\varepsilon_W^N)_{it}} < 0 \quad \text{if LMS=MO} && (18)
\end{aligned}$$

In order to make this model empirically implementable, we specify two additional assumptions. First, we consider production functions with a scalar Hicks-neutral productivity term and constant technology parameters across a set of producers, i.e. we assume a Cobb-Douglas production technology (where the elasticity of substitution among inputs is equal to one): $Q_{it} = \Omega_{it} N_{it}^{\varepsilon_N^Q} M_{it}^{\varepsilon_M^Q} K_{it}^{\varepsilon_K^Q}$. Second, we assume constant gaps between the output elasticities of labor and materials and their revenue shares, respectively. Taken together, these assumptions imply that the revenue shares for labor and materials are constant across firms. This constancy of revenue shares is motivated from theory as well as data specificities (practical considerations). In particular, we opt to take out sources of variability that our static theoretical model does not explain: firm-year variations in profits and in adjustment costs which are temporary in nature, i.e. related to the business cycle. Denoting the logs of Q_{it}, N_{it}, M_{it}, K_{it} and Ω_{it} by q_{it}, n_{it}, m_{it}, k_{it} and ω_{it}, respectively, this theoretical

[5] Perfect competition corresponds to the case where $(\varepsilon_W^N)_{it} = \infty$, hence $(R_N)_{it} = W_{it}$. Under monopsony, $(\varepsilon_W^N)_{it}$ is finite and the labor supply curve that firm i faces is upward sloping, hence, the firms sets $W_{it} < (R_N)_{it}$. As such, the degree of firm i's wage-setting power decreases in the wage elasticity of its labor supply curve.

structural model of productivity implies the following reduced-form model of productivity:

$$\begin{aligned} q_{it} &= \varepsilon_N^Q n_{it} + \varepsilon_M^Q m_{it} + \varepsilon_K^Q n + \omega_{it} \\ &= \mu \left[s_N \left(n_{it} - k_{it} \right) + s_M \left(m_{it} - k_{it} \right) \right] + \psi [s_N \left(k_{it} - n_{it} \right)] + \lambda k_{it} + \omega_{it} \\ &= \mu \left[s_N \left(n_{it} - k_{it} \right) + s_M \left(m_{it} - k_{it} \right) \right] + \mu\gamma [s_N \left(k_{it} - n_{it} \right)] + \lambda k_{it} + \omega_{it} \end{aligned} \tag{19}$$

2 Three theoretical structural wage-determination models

2.1 Collective bargaining models

In collective bargaining models, rents arise from institutions that artificially restrict competition in the labor market, such as some form of employee representation (either trade unions or works councils). Essentially, wages are determined by maximizing a generalized Nash product, which is the weighted product of the firm's and the workers' net gain from reaching an agreement with the weights represented by the party's bargaining power. Independently of the exact nature of the employment function, the following first-order condition with respect to wages must hold at an interior optimum:

$$W = \overline{W} + \gamma \left[\frac{R - WN - jM}{N} \right] \tag{20}$$

where $\overline{W}$ represents the worker's alternative wage and $\Pi = R - WN - JM$ are short-run profits. $R = PQ$ is total revenue where P is the output price and output Q equals $\Omega F(N, M, K)$, with N labor, M material input, K capital and Ω the revenue-shifting parameter being a function of the production technology and the demand for the final good. The prices of labor and material input are denoted by W and J, respectively and $\gamma = \frac{\phi}{1-\phi}$ represents the relative extent of rent sharing with $\phi \in [0, 1]$.

Eq. (20) shows that, to a first-order approximation, the equilibrium wage is determined by the worker's alternative market wage in the event of a breakdown in bargaining $\overline{W}$, the relative bargaining strength of the two parties γ and the firm's ability to pay $\frac{\Pi}{N}$. As such, the existence of collective bargaining power is predicting a positive pay-performance link $\left(\frac{dW}{d(\frac{\Pi}{N})} = \gamma > 0 \right)$. This equilibrium relationship is compatible with worker-firm negotiations that differ in bargaining scope. Bargaining issues might involve (i) wages and employment (efficient bargaining, McDonald and Solow, 1981), (ii) wages and working practices (labor hoarding, Haskel and Martin, 1992) or only wages (right-to-manage bargaining, Nickell and Andrews, 1983).

As discussed in Section 1, the *strongly efficient bargaining* model (EB) assumes that the workers and the firm negotiate simultaneously over wages and employment in order to maximize the joint surplus of their economic activity. The bounds of the bargaining range are given by the minimum acceptable utility levels for both parties. In the absence of an agreement, both parties receive their fallback utility. It is the objective of the workers to maximize $U(W, N) = NW + (\overline{N} - N)\overline{W}$, where

$\overline{N}$ is the competitive employment level ($0 < N \leq \overline{N}$). Consistent with capital quasi-fixity, it is the firm's objective to maximize its short-run profit function: $\Pi = R - WN - JM$. In the absence of an agreement, the representative worker receives the alternative wage. If no revenue accrues to the firm when bargaining breaks down, the firm's short-run profit equals zero in which case the firm has to bear only the fixed costs of capital. Hence, the generalized Nash product is written as:

$$\Omega_{EB} = \left\{NW + \left(\overline{N} - N\right)\overline{W} - \overline{NW}\right\}^{\phi} \{R - WN - JM\}^{1-\phi} \tag{21}$$

The *labor hoarding model* (LH) is based on two key assumptions. First, there exists overhead labor at the firm, denoted by N_O, which can either be interpreted as a proportion of the workers' time that is paid for but unproductive to the firm due to e.g. illicit shirking, set-up of machinery or coffee breaks, or the proportion of the workforce (rather than the hour) that is paid for but unproductive due to generous crew sizes or overmanning. Second, workers value on-the-job leisure and their preferences are represented by the following objective function: $V(W, N_O) = (W - \overline{W})\left(\frac{N_O}{N_P} - \overline{\left(\frac{N_O}{N_P}\right)}\right)$, with N_P productive labor, $\frac{N_O}{N_P}$ the degree of overmanning and $\overline{\left(\frac{N_O}{N_P}\right)}$ the alternative overhead labor ratio. The workers and the firm negotiate simultaneously over wages and overhead labor while productive labor is unilaterally chosen by the firm at the profit-maximizing level. Assuming that both types of labor are paid the same, the generalized Nash product is now written as:

$$\Omega_{LH} = \left\{(W - \overline{W})\left(\frac{N_O}{N_P} - \overline{\left(\frac{N_O}{N_P}\right)}\right)\right\}^{\phi} \{R - W(N_O + N_P) - JM\}^{1-\phi} \tag{22}$$

The *right-to-manage model* (RTM) postulates that the workers negotiate with the firm over wages while the firm chooses its profit-maximizing employment level. The generalized Nash product to be maximized now becomes:

$$\Omega_{RTM} = \left\{N(W)W + \left(\overline{N} - N(W)\right)\overline{W} - \overline{NW}\right\}^{\phi} \{R - WN(W) - JM\}^{1-\phi} \tag{23}$$

where $N(W)$ represents the optimal employment level chosen by the firm given the level of the bargained wage.

Eq. (20) results from maximization of (*i*) Eq. (21) with respect to the wage rate, (*ii*) Eq. (22) with respect to the wage rate subject to $R_{N_P} = W$, with R_{N_P} the marginal revenue of productive labor and $N = N_O + N_P$, or (*iii*) Eq. (23) with respect to the wage rate subject to $R_N = W$, with R_N the marginal revenue of labor.

2.2 Optimal labor contract model

In a labor contract model with unverifiable effort, the principal (or employer) does not know a priori and with certainty what effort the agent (or employee) has undertaken to achieve the observable performance. The principal is, hence, confronted with a problem of moral hazard. The remuneration rule should depend on observable outcomes that are associated with effort in order to create incentives for the employee to exert the desired level of effort. This remuneration rule will arrive at a compromise between the motives of insurance and incentives. Building on Holmström (1979), we consider a single agent who is contracting with a single principal.

The agent's utility function is given by: $U(W, e) = u(W) - c(e)$, with W the wage he receives, $u(\cdot)$ an increasing and strictly concave function ($u' > 0, u'' < 0$), $e \in \mathbb{R}_+$ his action (effort) and $c(\cdot)$ an increasing and strictly convex cost function ($c' > 0, c'' > 0$). Let $\overline{U}$ denote the reservation utility of the agent, representing the minimum amount that he will require for accepting the employment contract.

The action that the agent takes, affects his performance (output). Denote output by $Q = Q(e, \vartheta)$ where $\vartheta \in \mathbb{R}$ represents the state of nature, and hence the source of risk against which the agent wishes to be insured. Assume that $Q_e = \frac{\partial Q}{\partial e} > 0$. Denote $v(\pi)$ the von Neumann-Morgenstern utility function of the principal with $v(.)$ a strictly concave function of profits ($v' > 0, v'' < 0$) and $\Pi = Q - W$.

A contract specifies the remuneration of the agent. It is a mapping $W : \Delta \rightarrow \mathbb{R}$, with Δ the set of observable and contractible events. Δ only includes the output performance Q, hence, feasible contracts are of the form $W(Q)$. This principal-agent model focuses on the behavior of a principal and an agent whose decisions unfold in the following sequence. The principal offers a contract W. The agent accepts or rejects the contract. If he rejects, he receives his reservation utility $\overline{U}$. If the agent accepts, he chooses effort e. Nature draws ϑ (a random event) that affects the result of the agent's effort $Q(e, \vartheta)$. The principal and the agent observe the result Q. The principal remunerates the agent according to the terms of the contract.

The principal's problem boils down to determining how the payoff $Q(e, \vartheta)$ would be shared optimally between the principal and the agent. He chooses the contract that maximizes his utility, anticipating the action that the agent will choose.

Let us suppress ϑ and view Q as a random variable with a distribution parameterized by the agent's effort. Denote $F(Q|e)$ the distribution of outcomes Q as a function of the effort level e, assuming that F is twice continuously differentiable and $F_e(Q|e) < 0$. The latter, which is implied by $Q_e > 0$, assumes that an increase in e leads to a first-order stochastic-dominant shift in F. Letting λ and φ be the multipliers associated with respectively the participation constraint and the incentive compatibility constraint where the latter is replaced by the first-order condition of the agent, the Lagrangian of the principal's problem is written as:

$$\min_{\lambda,\varphi} \max_{W(Q),e} \mathcal{L} = \int \{v(Q - W(y)) + \lambda[u(W(Q)) - c(e) - \overline{U}] + \varphi[u(W(Q))\frac{f_e(Q|e)}{f(Q|e)} - c'(e)]f(Q|e)dQ\} \quad (24)$$

Pointwise optimization of the Lagrangian yields the following characterization of a second-best sharing rule:

$$\frac{v'(y - W(Q))}{u'(W(Q))} = \lambda + \varphi \frac{f_e(Q|e)}{f(Q|e)} \quad \forall Q \tag{25}$$

The conditions reduce to Borch's (1962) rule for first-best risk sharing if the incentive compatibility constraint is slack ($\varphi = 0$). If $\varphi \neq 0$, the incentive compatibility constraint is binding and there is an incentive-insurance trade-off. Hence, the optimal contract is second best. Intuitively, $\frac{f_e(Q|e)}{f(Q|e)}$ measures how strongly the principal is drawing inferences about the agent's effort choice e from the realizations of Q. The characterization in Eq. (25) states that penalties or bonuses expressed in terms of deviations from optimal risk sharing should be paid in proportion to this measure.

Eq. (25) defines an implicit function linking profits and wages. Differentiating Eq. (25) gives:

$$\frac{dW(Q)}{d\Pi} = \frac{v''(\Pi)}{u''(W)} \frac{1}{\lambda + \varphi \frac{f_e(Q|e)}{f(Q|e)}} \quad \forall Q \tag{26}$$

If a high-output realization is good news about the agent's effort, which corresponds to the statistical assumption of the distribution of outcomes conditional on the agent's action choice satisfying the monotone likelihood ratio property $\left(\frac{d\left[\frac{f_e(Q|e)}{f(Q|e)}\right]}{dQ} > 0 \right)$, the agent's remuneration is increasing in his performance $\left(\frac{dW(Q)}{dQ} > 0 \right)$ and $\frac{dW(Q)}{d\Pi} > 0$ (Bolton and Dewatripont, 2005).

Combining Eqs. (26) and (25) gives:

$$\varepsilon_{\Pi}^{W(Q)} = \frac{r_f}{r_w} \quad \forall Q \tag{27}$$

with $r_f = -\Pi \frac{v''(\Pi)}{v'(\Pi)}$ and $r_w = -W \frac{u''(W)}{u'(W)}$ denoting the firm's and the worker's relative risk aversion, respectively. Eq. (27) shows that the pay-performance link depends on the ratio of parties' relative risk aversion.

2.3 Search-theoretic model of the labor market: Wage posting and directed search

We present a competitive search model which considers an environment where employers post wages ex ante and unemployed workers direct their search to the most attractive workers (Moen, 1997). In this model, frictions in the labor market cause firms to pay higher wages in order to increase the flow of workers and to reduce search costs. Paying higher wages as an optimal response to the frictions in the labor market is particularly pronounced for high-productivity firms since they face higher opportunity costs of search.[6]

[6] An alternative search-theoretic model could be one in which competition among wage setters (employers) is driving the positive wage-performance correlation: an extension of the Burdett-Mortensen (1998) model with heterogeneous firms which considers an environment where wages are posted ex ante and search is purely random. In such model, firms that pay higher wages both increase the inflow and reduce the outflow of workers in order to lower search costs. In equilibrium, higher-productivity firms pay higher wages, and hence, are more likely to hire and less likely to lose any worker.

Following Rogerson *et al.* (2005), we consider a static version of the competitive search model. At the beginning of the period, there are a large number of unemployed workers (u) and vacancies (v). For simplicity, let us assume that the number of vacancies is fixed. Let $q^* = \frac{u}{v}$ denote the economywide queue length. There is a sunk cost $c \geq 0$ associated with the opening of a vacancy. Any match within the period $m(u, v)$ produces output Q, which is divided between the worker and the firm according to the posted wage. The matching function m is assumed to be continuous, nonnegative and increasing in both arguments with $m(u, 0) = m(0, v) = 0\ \forall (u, v)$ and is assumed to display constant returns to scale. At the end of the period, unmatched workers get $\overline{W}$, while unmatched vacancies get 0. Then the model ends.

Let us first define the behavior of the workers. Consider a worker facing a menu of different wages. U is the highest value that he can get by applying for a job at some firm. A worker is willing to apply to a particular job offering a wage $W \geq \overline{W}$ only if the arrival rate of jobs to workers $\alpha_W(q) = \frac{m(u,v)}{u}$ is sufficiently large, such that:

$$\alpha_W(q)W + (1 - \alpha_W(q))\overline{W} \geq U \tag{28}$$

In equilibrium, workers are indifferent about where to apply. Therefore, q adjusts to satisfy Eq. (28) with equality.

Let us now define the strategy of the firm. Eq. (28) describes how a change in his wage affects his queue length q. Therefore, the firm's problem is written as:

$$V = \max_{W,q}\{-c + \alpha_e(q)(Q - W)\} \tag{29}$$

$$\text{s.t. } \alpha_W(q)W + (1 - \alpha_W(q))\overline{W} \geq U \tag{30}$$

with $\alpha_e(q) = \frac{m(u,v)}{v}$ the arrival rate of workers to vacant jobs. Eliminating W using Eq. (28) at equality and using $\alpha_e(q) = q\alpha_W(q)$, the firm's problem is written as:

$$V = \max_{q}\{-c + \alpha_e(q)(Q - \overline{W}) - q(U - \overline{W})\} \tag{31}$$

The first-order condition is given by:

$$\alpha_e'(q)(Q - \overline{W}) = U - \overline{W} \tag{32}$$

Since each employer assumes that he cannot affect U, Eq. (32) implies that all employers choose the same q, which in equilibrium must equal the economywide q^*. Hence, Eq. (32) characterizes the equilibrium value of U, and the arrival rates α_W and α_e. Substituting the value of U from Eq. (32) in Eq. (28) at equality gives the market wage W^*:

$$W^* = \overline{W} + \varepsilon_q^{\alpha_e}(q^*)(Q - \overline{W}) \tag{33}$$

with $\varepsilon_q^{\alpha_e}(q^*) = \frac{q^*\alpha_e'(q^*)}{\alpha_e(q^*)}$ the elasticity of $\alpha_e(q^*)$. $\varepsilon_q^{\alpha_e}(q^*) \in [0,1]$ by the assumptions of the matching function m.

From Eq. (33), it follows that the wage rule operates as if the worker and the firm bargained over the rents in the employment relationship $(Q - \overline{W})$, with the worker's share given by the elasticity of $\alpha_e(q^*)$. Intuitively, competition among wage setters incentivizes firms to post high wages in order to attract many workers. This incentive is particularly true for higher productivity firms as they face larger opportunity costs of search.

Substituting Eq. (33) into Eq. (29) determines the number of vacancies, which is equivalent to the firm's profits (Π) under the assumption of a fixed number of vacancies:

$$V = -c + [\alpha_e(q^*) - q^*\alpha_e'(q^*)](Q - \overline{W}) \tag{34}$$

Combining Eqs. (33) and (34) establishes a positive link between wages and profits: $\frac{dW^*}{d\Pi} = \frac{\varepsilon_q^{\alpha_e}(q^*)}{\alpha_e(q^*) - q^*\alpha_e'(q^*)} > 0$.

3 Detailed estimates from the reduced-form productivity and wage determination models

Our comparative analysis sample is based on confidential databases maintained by INSEE (the French "Institut National de la Statistique et des Etudes Economiques"): firm accounting information from EAE ("Enquête Annuelle d'Entreprise"), supplemented by matched firm-worker data drawn from the DADS (the administrative database of "Déclarations Annuelles des Données Sociales"). We end up with a matched firm-worker panel data sample, consisting at the firm level of 109,199 observations for 9,849 firms over the 18 years 1984-2001, and at the worker-firm level of 382,501 observations for 60,294 workers in the 9,849 firms. The comparative analysis sample is broken into 25 manufacturing industries defined on the basis of the 2- and 3-digit level of the French industrial classification ("Nomenclature économique de synthèse"). These are industries where we expect rent sharing to be predominant. They amount to 66% of the firms and 58% of employment in total manufacturing. This high prevalence might be explained by the fact that the government often extends the terms of industry-level bargaining agreements to all employers, implying that collective bargaining coverage is very high (around 95%), making a comparative rent-sharing analysis particularly relevant. Table 1 presents the number of firms and the number of observations for each industry in the comparative analysis sample.

<Insert Table 1 about here>

In order to get consistent estimates of the parameters in the reduced-form productivity and wage determination models, we apply the system generalized method of moments (SYS-GMM) estimation method. As mentioned in the main text, this method is designed for panels with relatively small time and large cross-sectional dimensions, covariates that are not strictly exogenous, unobserved heterogeneity, heteroscedasticity and within-firm autocorrelation. We build sets of instruments following the Holtz-Eakin *et al.* (1988)-approach which avoids the standard two-stage least squares trade-off between instrument lag depth and sample depth by including separate instruments for each time period and substituting zeros for missing observations. To avoid instrument proliferation, we only use 2- and 3-year lags of the instrumented variables as instruments in the first-differenced equation and the 1-year lag of the first-differenced instrumented variables as instruments in the original equation. We use the two-step SYS-GMM estimator which is asymptotically more efficient than the one-step SYS-GMM estimator and robust to heteroscedasticity, and the finite-sample correction to the two-step covariance matrix developed by Windmeijer (2005).

The consistency of the SYS-GMM estimator depends on the validity of the instruments and the absence of serial correlation in the error term. To address these concerns, we report two diagnostic tests suggested by Arellano and Bond (1991): tests on the validity of the instruments and a test on lack of second-order serial correlation in the first-differenced residuals.

The validity of GMM crucially hinges on the assumption that the instruments are exogenous. We report both the Sargan and Hansen test statistics for the joint validity of the overidentifying restrictions since the Sargan tests do not depend on an estimate of the optimal weighting matrix and are hence not so vulnerable to instrument proliferation. On the other hand, they require homoskedastic errors for consistency which is not likely to be the case. As documented by Andersen and Sørensen (1996) and Bowsher (2002), instrument proliferation might weaken the Hansen test of instrument validity to the point where it generates implausibly good p-values (see Roodman, 2009 for a discussion). In addition to the Hansen test evaluating the entire set of overidentifying restrictions/instruments, we provide difference-in-Hansen statistics to test the validity of subsets of instruments.

The assumption that there is no serial correlation in the error terms of the levels equation can be tested by testing for serial correlation in the first-differenced residuals. If the error terms of the levels equation are not serially correlated, the first-differenced residuals should exhibit negative first-order serial correlation but no second-order serial correlation. The reported *m1*- and *m2*-tests test for respectively first-order and second-order serial correlation in the first-differenced error terms.

3.1 Estimates from a reduced-form model of productivity

We estimate the following reduced-form model of productivity for each industry $I \in \{1, \ldots, 25\}$: $q_{it} = \mu\left[s_N\left(n_{it} - k_{it}\right) + s_M\left(m_{it} - k_{it}\right)\right] + \mu\gamma[s_N\left(k_{it} - n_{it}\right)] + \lambda k_{it} + \omega_{it} + \alpha_i + \alpha_t + \epsilon_{it}$, where i is a firm subscript and t a year subscript. The variables q_{it}, n_{it}, m_{it} and k_{it} are respectively for each year the logarithms of output Q_{it}, labor N_{it}, material input M_{it} and capital K_{it}. s_N and s_M are the average shares of labor costs and material costs in total revenue. The parameters μ, $\gamma = \frac{\phi}{1-\phi}$ and λ are respectively the parameters of price-cost markup, relative extent of rent sharing and elasticity of scale. ω_{it} is an index of "true" total factor productivity, or productivity for short, α_i a firm-specific effect, α_t a year effect and ϵ_{it} an idiosyncratic error term.

Table 2 reports the computed input shares, estimates of output elasticities $\left(\widehat{\varepsilon}_N^Q, \widehat{\varepsilon}_M^Q, \widehat{\varepsilon}_K^Q\right)$ and scale elasticities, joint market imperfection parameters $\left(\widehat{\psi} = \widehat{\mu\gamma}\right)$, price-cost markups and extent of rent sharing, and diagnostic tests generated by the reduced-form productivity model using the SYS-GMM estimator. We denote the relative and absolute extent of rent-sharing parameters $\left(\widehat{\gamma} \text{ and } \widehat{\phi}, \text{ respectively}\right)$ obtained by the reduced-form productivity regression by superscript "*prod*". The industries in Table 2 are ranked according to $\widehat{\gamma}_I^{prod}$.

Data limitations precluded us from using exogenous firm demand shifters as a source of variation in input demands. We follow a common instrumentation strategy in the literature, which is using lagged internal values. More specifically, we use the 2- and 3-year lags of the inputs as instruments in the first-differenced equation and the 1-year lag of the first-differenced inputs as instruments in the original equation for identification. Table 2 shows that the Sargan test statistic fails to confirm the joint validity of the moment restrictions, which might be due to the existence of heteroscedasticity. In 5 out of the 25 industries (ind. $I = 2, 4, 5, 19, 23$), the Hansen test also rejects the joint validity of the identifying restrictions. For industry $I = 2, 5, 23$, the difference-in-Hansen tests reject the exogeneity of the 1-year lagged first-differenced inputs as instruments in the levels equation.

<Insert Table 2 about here>

3.2 Estimates from a reduced-form model of wage determination

We recover two sets of rent-sharing estimates from a reduced-form model of wage determination for each industry $I \in \{1, \ldots, 25\}$. The *first* set is obtained by estimating the regression model $w_{it} = \beta_0 + \beta_1 \overline{w}_{it} + \beta_2 (\pi_{it} - n_{it}) + \beta_3 (k_{it} - n_{it}) + \alpha_i + \alpha_t + \epsilon_{it}$, where i is a firm subscript and t a year subscript. The variables w_{it}, $\overline{w}_{it}$, π_{it}, k_{it} and n_{it} are respectively for each year the logarithms of the firm labor cost per worker or average wage W_{it}, the average workers' alternative wage or reservation wage $\overline{W}_{it}$, the firm profits Π_{it}[7], the firm capital K_{it}, and the firm number of employees N_{it}. α_i is the firm effect, α_t the year effect and ϵ_{it} an idiosyncratic error. In this specification, we do not take into account that high-profit firms may pay higher wages because they employ high-skilled workers, not because their wages are higher for workers of a given ability. We only indirectly control for differences in firms' labor composition through including capital intensity as a regressor.

The *second* set is obtained by estimating the regression model $w_{j(i)t} = \beta_0 + \beta_1 \overline{w}_{it} + \beta_2 (\pi_{it} - n_{it}) + \beta_3 (k_{it} - n_{it}) + \alpha_{j(i)} + \alpha_i + \alpha_t + \epsilon_{it}$, where $j(i)$ is a subscript of worker j in firm i. The variable $w_{j(i)t}$

[7] The firm profits (Π_{it}) is simply the widely used measure of gross operating profit computed as value added minus labor costs, smoothed over four or five years if possible from year $t-3$ or $t-4$ to current year t (taking advantage of the availability of three year pre-sample accounting firm observations when necessary). Such smoothing, often done in practice, is useful to control for the high volatility of profits.

is for each year the logarithm of the net earnings of worker j in firm i or the net wage $W_{j(i)t}$, and $\alpha_{j(i)}$ is the worker-firm effect. In this specification, we control for interfirm differences in workers' skills.

The parameter of interest in both regression models is β_2, which is the elasticity of wages with respect to profit per employee. In addition to this estimated elasticity, Table 3 also reports estimated elasticities of wages with respect to (i) the alternative wage $\left(\widehat{\beta}_1\right)$ and (ii) capital intensity $\left(\widehat{\beta}_3\right)$, and diagnostic tests generated by the reduced-form models of wage determination. In Table 3, we denote the estimated elasticities obtained by the first regression model by superscript "*wage,f*" (see first part of Table 3) and the ones obtained by the second regression model by superscript "*wage,w*" (see second part of Table 3). We use the same ranking as in Table 2, i.e. the industries are ranked according to $\widehat{\gamma}_I^{prod}$.

Similar to the reduced-form model of productivity, we lack exogenous firm demand shifters as a source of variation of profits that does not impact directly upon wages. Therefore, we also follow common practice and use lagged values of firm profitability as instruments. More specifically, we use the 2- and 3-year lags of the smoothed profits-per-employee variable as instruments in the first-differenced equation and the 1-year lag of the first-differenced smoothed profits-per-employee variable as instruments in the original equation for identification. Table 3 shows that for both sets of estimates, the Sargan test rejects the null of exogeneity of the instruments in all industries.

Focusing on the first set of estimates (using w_{it} as the dependent variable) reveals that the Hansen test only fails to confirm the joint validity of the identifying restrictions in 3 out of the 25 industries (ind. $I = 12, 13, 19$). The difference-in-Hansen tests suggest that the 1-year lagged first-differenced smoothed profits per employee as instruments in the levels equation may be to blame (exogeneity rejected).

Focusing on the second set of estimates (using $w_{j(i)t}$ as the dependent variable) shows that the Hansen test rejects the joint validity of the moment conditions in 23 out of the 25 industries. For 3 out of these 23 industries (ind. $I = 14, 21, 25$), the difference-in-Hansen tests reject the exogeneity of the 1-year lagged first-differenced smoothed profits-per-employee variable as instruments in the levels equation. The difference-in-Hansen tests additionally reject the validity of (i) the 2-year lags of the smoothed profits-per-employee variable as instruments in the first-differenced equation for 2 industries (ind. $I = 5, 24$), (ii) the 3-year lags of the smoothed profits-per-employee variable as instruments in the first-differenced equation for 2 industries (ind. $I = 17, 18$) and (iii) the 2- and 3-year lags of the smoothed profits-per-employee variable as instruments in the first-differenced equation for 7 industries (ind. $I = 1, 4, 7, 10, 13, 19, 20$). For 6 out of these 23 industries (ind. $I = 2, 6, 9, 11, 22, 23$), only the use of the 2- and 3-year lags of the smoothed profits-per-employee variable as instruments in the first-differenced equation does not prove informative.

<Insert Table 3 about here>

Table 1: Industry repartition in comparative analysis sample

Ind. I	Code	Name	# firms (# obs.)	% firms	# workers (# obs.)	% workers
1	B05-B06	Other food products	767 (8,346)	5.14	5,095 (29,986)	4.90
2	C11	Clothing and skin goods	790 (7,665)	5.29	4,245 (23,999)	4.08
3	C12	Leather goods and footwear	312 (3,422)	2.09	1,876 (12,555)	1.80
4	C20	Publishing, (re)printing	1,037 (10,936)	6.95	5,367 (31,459)	5.16
5	C41	Furniture	505 (5,658)	3.38	3,173 (20,979)	3.05
6	E11-E12, E14	Shipbuilding, construction of railway rolling stock, bicycles, motorcycles, transport equipment n.e.c.	96 (996)	0.64	808 (5,099)	0.78
7	E13	Aircraft and spacecraft	63 (658)	0.42	1,923 (11,917)	1.85
8	E21	Metal products for construction	216 (2,360)	1.45	1,040 (6,425)	0.10
9	E22	Ferruginous and steam boilers	398 (4,365)	2.67	1,965 (12,118)	1.89
10	E27-E28	Other special purpose machinery	361 (3,990)	2.42	2,027 (13,832)	1.95
11	F34	Medical and surgical equipment and orthopaedic appliances	96 (941)	0.64	489 (2,629)	0.47
12	F11-F12	Mining of metal ores, other mining n.e.c.	237 (2,883)	1.59	973 (6,024)	0.94
13	F14	Earthenware products and construction material	528 (6,109)	3.54	3,586 (22,679)	3.45
14	F21	Spinning and weaving	374 (4,014)	2.51	2,748 (16,415)	2.64
15	F23	Knitted and crocheted fabrics	126 (1,313)	0.84	1,341 (8,391)	1.29
16	F32	Pulp, paper and paperboard	82 (935)	0.55	1,007 (6,979)	0.97
17	F33	Articles of paper and paperboard	362 (4,358)	2.43	2,633 (18,624)	2.53
18	F45	Rubber products	123 (1,488)	0.82	1,403 (9,866)	1.35
19	F46	Plastic products	877 (10,010)	5.88	4,899 (32,192)	4.71
20	F51	Basic iron and steel	102 (1,243)	0.68	1,806 (12,327)	1.74
21	F52	Production of non-ferrous metals	67 (738)	0.45	923 (5,649)	0.89
22	F53	Ironware	188 (2,253)	1.26	1,394 (10,165)	1.34
23	F54	Industrial service to metal products	1,301 (14,949)	8.72	4,620 (9,970)	0.44
24	F55	Metal fabrication	663 (8,024)	4.44	3,748 (26,112)	3.60
25	F62	Electronics	159 (1,545)	1.07	1,152 (6,110)	1.11
Total			9,849 (109,199)	100.0	60,294 (382,501)	100.0

Table 2: Reduced-form productivity model: Industry-specific input shares (s_{NI}, s_{MI}, s_{KI}), output elasticities $\left(\left(\widehat{\varepsilon}_N^Q\right)_I, \left(\widehat{\varepsilon}_M^Q\right)_I, \left(\widehat{\varepsilon}_K^Q\right)_I\right)$, scale elasticity $\left(\widehat{\lambda}_I\right)$, joint market imperfections parameter $\left(\widehat{\psi}_I\right)$, and corresponding price-cost markup $(\widehat{\mu}_I)$ and relative and absolute extent of rent sharing $\left(\widehat{\gamma}_I^{prod}\right.$ and $\left.\widehat{\phi}_I^{prod}\right.$, respectively$\left.\right)$

Comparative analysis sample

Ind. I	s_{NI}	s_{MI}	s_{KI}	$(\widehat{\varepsilon}_N^Q)_I$	$(\widehat{\varepsilon}_M^Q)_I$	$(\widehat{\varepsilon}_K^Q)_I$	$\widehat{\lambda}_I$	$\widehat{\psi}_I$	$\widehat{\mu}_I$	$\widehat{\gamma}_I^{prod}$	$\widehat{\phi}_I^{prod}$	*Sargan*	*Hansen*	*Dif-Hansen (lev)*	*Dif-Hansen (L2-dif)*	*Dif-Hansen (L3-dif)*	*m1*	*m2*
17	0.249	0.538	0.212	0.251 (0.035)	0.602 (0.035)	0.109 (0.063)	0.962 (0.011)	0.109 (0.192)	1.118 (0.066)	0.115 (0.196)	0.103 (0.158)	0.000	0.057	0.108	0.580	0.571	-3.87	-6.84
19	0.269	0.558	0.174	0.280 (0.021)	0.639 (0.020)	0.070 (0.035)	0.989 (0.009)	0.104 (0.105)	1.146 (0.037)	0.141 (0.138)	0.124 (0.106)	0.000	0.025	0.540	0.130	0.430	-1.53	-12.23
8	0.276	0.593	0.131	0.281 (0.045)	0.670 (0.039)	0.005 (0.069)	0.955 (0.020)	0.112 (0.204)	1.129 (0.066)	0.210 (0.372)	0.173 (0.254)	0.000	0.877	1.000	0.852	0.655	-1.27	-7.11
13	0.290	0.485	0.225	0.294 (0.028)	0.600 (0.024)	0.082 (0.045)	0.975 (0.014)	0.222 (0.131)	1.236 (0.050)	0.231 (0.129)	0.188 (0.085)	0.000	0.065	0.543	0.378	0.600	-1.05	-9.40
4	0.336	0.483	0.181	0.344 (0.023)	0.571 (0.020)	0.075 (0.040)	0.989 (0.009)	0.162 (0.105)	1.183 (0.042)	0.255 (0.157)	0.203 (0.099)	0.000	0.038	0.306	0.348	0.200	-2.08	-12.95
12	0.267	0.502	0.231	0.254 (0.025)	0.634 (0.028)	0.119 (0.047)	1.007 (0.010)	0.313 (0.137)	1.264 (0.056)	0.286 (0.115)	0.223 (0.069)	0.000	0.714	0.830	0.992	0.997	-0.52	-7.38
21	0.191	0.612	0.197	0.154 (0.058)	0.707 (0.045)	0.098 (0.080)	0.959 (0.033)	0.346 (0.345)	1.154 (0.073)	0.291 (0.279)	0.225 (0.168)	0.000	1.000	1.000	1.000	1.000	-0.12	-3.61
16	0.204	0.599	0.197	0.179 (0.077)	0.758 (0.056)	0.042 (0.125)	0.979 (0.023)	0.387 (0.460)	1.265 (0.093)	0.316 (0.354)	0.240 (0.204)	0.000	1.000	1.000	1.000	1.000	-1.23	-3.53
11	0.395	0.370	0.235	0.476 (0.143)	0.550 (0.080)	0.030 (0.200)	1.055 (0.052)	0.280 (0.548)	1.485 (0.215)	0.317 (0.578)	0.241 (0.333)	0.000	0.996	1.000	1.000	1.000	0.59	-3.25
20	0.230	0.598	0.172	0.200 (0.040)	0.683 (0.044)	0.070 (0.052)	0.953 (0.017)	0.272 (0.196)	1.142 (0.074)	0.319 (0.220)	0.242 (0.127)	0.000	1.000	1.000	1.000	1.000	0.67	-4.65
1	0.282	0.535	0.184	0.246 (0.025)	0.615 (0.023)	0.139 (0.042)	1.000 (0.013)	0.277 (0.120)	1.150 (0.043)	0.369 (0.150)	0.269 (0.080)	0.000	0.242	0.854	0.677	0.644	-1.57	-9.05
3	0.337	0.487	0.177	0.313 (0.040)	0.562 (0.039)	0.085 (0.071)	0.960 (0.015)	0.226 (0.182)	1.155 (0.080)	0.373 (0.278)	0.272 (0.147)	0.000	0.208	0.496	0.840	0.745	-0.54	-6.93
18	0.331	0.491	0.178	0.311 (0.058)	0.591 (0.052)	0.078 (0.082)	0.980 (0.022)	0.266 (0.237)	1.205 (0.106)	0.411 (0.341)	0.291 (0.171)	0.000	1.000	1.000	1.000	1.000	-1.47	-4.67
6	0.323	0.521	0.156	0.294 (0.064)	0.596 (0.071)	0.063 (0.119)	0.953 (0.021)	0.232 (0.310)	1.143 (0.137)	0.421 (0.519)	0.296 (0.257)	0.000	1.000	1.000	1.000	1.000	0.54	-4.42
7	0.384	0.456	0.161	0.395 (0.099)	0.583 (0.052)	0.010 (0.127)	0.988 (0.027)	0.251 (0.324)	1.279 (0.114)	0.469 (0.577)	0.319 (0.267)	0.000	1.000	1.000	1.000	1.000	-2.18	-3.66
5	0.309	0.532	0.159	0.296 (0.037)	0.675 (0.030)	0.010 (0.059)	0.980 (0.012)	0.311 (0.162)	1.268 (0.057)	0.478 (0.231)	0.323 (0.106)	0.000	0.045	0.052	0.073	0.402	-2.67	-10.28
25	0.364	0.473	0.163	0.334 (0.049)	0.553 (0.028)	0.101 (0.054)	0.988 (0.024)	0.252 (0.165)	1.169 (0.059)	0.479 (0.300)	0.324 (0.137)	0.000	0.923	0.898	0.929	0.991	-1.96	-3.80
22	0.337	0.500	0.163	0.330 (0.037)	0.639 (0.025)	0.005 (0.053)	0.975 (0.011)	0.298 (0.145)	1.278 (0.049)	0.482 (0.220)	0.325 (0.100)	0.000	0.430	0.651	0.284	0.874	-1.34	-7.41
10	0.360	0.489	0.151	0.327 (0.052)	0.577 (0.042)	0.082 (0.088)	0.985 (0.017)	0.273 (0.219)	1.180 (0.086)	0.550 (0.405)	0.355 (0.169)	0.000	0.118	0.098	0.048	0.323	0.05	-9.01
9	0.401	0.479	0.120	0.404 (0.031)	0.589 (0.023)	0.020 (0.048)	1.013 (0.013)	0.220 (0.115)	1.229 (0.047)	0.599 (0.292)	0.374 (0.114)	0.000	0.135	0.316	0.194	0.378	-0.66	-8.99
15	0.367	0.486	0.148	0.305 (0.039)	0.549 (0.040)	0.099 (0.068)	0.953 (0.019)	0.300 (0.164)	1.131 (0.082)	0.657 (0.321)	0.397 (0.117)	0.000	1.000	1.000	1.000	1.000	-2.03	-5.08
24	0.326	0.460	0.213	0.255 (0.033)	0.649 (0.029)	0.072 (0.056)	0.976 (0.013)	0.631 (0.153)	1.410 (0.063)	0.685 (0.140)	0.406 (0.049)	0.000	0.115	0.222	0.497	0.786	-2.25	-12.52
14	0.318	0.527	0.156	0.242 (0.042)	0.665 (0.028)	0.023 (0.065)	0.931 (0.013)	0.502 (0.177)	1.264 (0.054)	0.809 (0.256)	0.447 (0.078)	0.000	0.199	0.528	0.811	0.986	-2.62	-7.11
23	0.376	0.454	0.170	0.310 (0.025)	0.592 (0.018)	0.055 (0.039)	0.957 (0.009)	0.478 (0.100)	1.304 (0.040)	0.810 (0.147)	0.447 (0.045)	0.000	0.000	0.028	0.329	0.080	-3.17	-18.03
2	0.442	0.399	0.159	0.332 (0.039)	0.505 (0.019)	0.100 (0.045)	0.936 (0.018)	0.515 (0.114)	1.265 (0.047)	1.130 (0.223)	0.531 (0.049)	0.000	0.001	0.034	0.415	0.698	-3.06	-10.12

Notes: Robust standard errors in parentheses. Time dummies are included but not reported. *Sargan, Hansen, Dif-Hansen*: tests of overidentifying restrictions, asymptotically distributed as χ^2_{df}. p-values are reported. *Dif-Hansen (lev)* tests the validity of the 1-year lag of the first-differenced inputs as instruments in the levels equation while *Dif-Hansen (L2-dif)/(L3-dif)* test the validity of the 2-/3-year lags of the inputs as instruments in the first-differenced equation. *m1* and *m2*: tests for first-order and second-order serial correlation in the first-differenced residuals, asymptotically distributed as *N(0,1)*. Industries are ranked according to $\widehat{\gamma}_I^{prod}$.

Table 3: Reduced-form model of wage determination: Industry-specific elasticities of wages with respect to profits per employee $\left(\left(\widehat{\beta}_2\right)_I^{wage,f/w}\right)$, the reservation wage $\left(\left(\widehat{\beta}_1\right)_I^{wage,f/w}\right)$ and capital per employee $\left(\left(\widehat{\beta}_3\right)_I^{wage,f/w}\right)$

Comparative analysis sample										
Dep. var.	Firm wage w_{it}									
Ind. I	$\left(\widehat{\beta}_2\right)_I^{wage,f} = \left(\frac{\partial w_{it}}{\partial(\pi_{it}-n_{it})}\right)_I$	$\left(\widehat{\beta}_1\right)_I^{wage,f} = \left(\frac{\partial w_{it}}{\partial \overline{w}_{it}}\right)_I$	$\left(\widehat{\beta}_3\right)_I^{wage,f} = \left(\frac{\partial w_{it}}{\partial(k_{it}-n_{it})}\right)_I$	*Sargan*	*Hansen*	*Dif-Hansen (lev)*	*Dif-Hansen (L2-dif)*	*Dif-Hansen (L3-dif)*	*m1*	*m2*
17	-0.023 (0.034)	-0.063 (0.062)	0.145 (0.034)	0.00	0.493	0.690	0.219	0.181	-6.73	-1.12
19	-0.021 (0.029)	0.029 (0.054)	0.213 (0.042)	0.00	0.027	0.022	0.668	0.458	-10.49	-1.30
8	0.030 (0.035)	0.168 (0.071)	0.072 (0.049)	0.00	0.479	0.427	0.350	0.719	-5.63	-0.99
13	0.075 (0.035)	-0.031 (0.067)	0.048 (0.049)	0.00	0.001	0.007	0.339	0.068	-6.43	-0.25
4	0.042 (0.040)	-0.020 (0.040)	-0.184 (0.048)	0.00	0.102	0.106	0.901	0.874	-10.45	-1.87
12	0.048 (0.064)	-0.045 (0.071)	0.087 (0.047)	0.00	0.002	0.028	0.119	0.014	-3.66	-0.29
21	0.027 (0.061)	0.109 (0.120)	0.181 (0.072)	0.00	0.545	0.609	0.571	0.662	-2.33	1.34
16	0.047 (0.047)	0.007 (0.086)	0.139 (0.045)	0.00	0.416	0.621	0.391	0.281	-2.77	-0.37
11	0.047 (0.057)	0.064 (0.087)	-0.014 (0.074)	0.00	0.520	0.807	0.813	0.870	-3.73	0.51
20	0.001 (0.052)	0.052 (0.075)	0.077 (0.053)	0.00	0.852	0.526	0.897	0.877	-3.98	0.29
1	0.055 (0.037)	-0.012 (0.038)	0.125 (0.042)	0.00	0.154	0.680	0.083	0.265	-10.57	-2.99
3	0.095 (0.031)	0.070 (0.070)	0.100 (0.035)	0.00	0.274	0.354	0.207	0.234	-6.35	0.35
18	0.087 (0.037)	-0.053 (0.078)	0.047 (0.076)	0.00	0.619	0.454	0.560	0.640	-4.80	-1.30
6	0.124 (0.033)	-0.060 (0.082)	0.020 (0.055)	0.00	0.751	0.886	0.658	0.889	-3.15	-0.53
7	0.016 (0.070)	0.080 (0.090)	0.224 (0.063)	0.00	0.275	0.632	0.278	0.401	-2.91	-0.58
5	0.038 (0.035)	0.070 (0.058)	0.064 (0.043)	0.00	0.328	0.241	0.896	0.539	-8.62	-0.26
25	0.065 (0.053)	0.050 (0.099)	0.101 (0.050)	0.00	0.065	0.642	0.084	0.119	-4.43	-2.40
22	0.047 (0.033)	-0.026 (0.076)	0.082 (0.055)	0.00	0.549	0.433	0.116	0.131	-5.41	-2.24
10	0.031 (0.050)	0.153 (0.041)	0.094 (0.061)	0.00	0.764	0.888	0.385	0.736	-6.48	-0.95
9	0.057 (0.067)	0.025 (0.073)	-0.060 (0.045)	0.00	0.258	0.048	0.291	0.497	-6.17	-1.29
15	0.050 (0.050)	-0.007 (0.050)	0.204 (0.063)	0.00	0.483	0.381	0.750	0.775	-3.46	0.72
24	0.046 (0.028)	0.010 (0.051)	0.117 (0.040)	0.00	0.349	0.857	0.412	0.726	-9.34	-1.10
14	0.027 (0.035)	0.084 (0.045)	0.020 (0.035)	0.00	0.529	0.395	0.894	0.658	-6.90	-0.57
23	-0.001 (0.040)	0.192 (0.041)	0.050 (0.034)	0.00	0.726	0.668	0.740	0.836	-14.49	-3.70
2	0.142 (0.037)	0.106 (0.062)	0.082 (0.056)	0.00	0.586	0.734	0.523	0.688	-6.77	-0.41

Table 3 - Continued: Reduced-form model of wage determination: Industry-specific elasticities of wages with respect to profits per employee $\left(\left(\widehat{\beta}_2\right)_I^{wage,f/w}\right)$, the reservation wage $\left(\left(\widehat{\beta}_1\right)_I^{wage,f/w}\right)$ and capital per employee $\left(\left(\widehat{\beta}_3\right)_I^{wage,f/w}\right)$

Dep. var.	Worker wage $w_{j(i)t}$									
Ind. I	$\left(\widehat{\beta}_2\right)_I^{wage,w} = \left(\frac{\partial w_{j(i)t}}{\partial(\pi_{it}-n_{it})}\right)_I$	$\left(\widehat{\beta}_1\right)_I^{wage,w} = \left(\frac{\partial w_{j(i)t}}{\partial \overline{w}_{it}}\right)_I$	$\left(\widehat{\beta}_3\right)_I^{wage,w} = \left(\frac{\partial w_{j(i)t}}{\partial(k_{it}-n_{it})}\right)_I$	*Sargan*	*Hansen*	*Dif-Hansen (lev)*	*Dif-Hansen (L2-dif)*	*Dif-Hansen (L3-dif)*	*m1*	*m2*
17	0.035 (0.031)	0.108 (0.042)	0.127 (0.032)	0.00	0.000	0.000	0.107	0.001	-5.30	-1.53
19	0.042 (0.019)	0.087 (0.045)	0.080 (0.025)	0.00	0.000	0.008	0.008	0.001	-7.94	-2.53
8	0.049 (0.025)	0.109 (0.040)	0.001 (0.047)	0.00	0.004	0.807	0.414	0.151	-3.90	-0.04
13	0.050 (0.025)	0.155 (0.032)	0.043 (0.034)	0.00	0.000	0.000	0.040	0.000	-6.90	0.62
4	-0.034 (0.022)	0.125 (0.036)	-0.007 (0.033)	0.00	0.000	0.000	0.000	0.001	-7.85	0.82
12	0.039 (0.033)	0.065 (0.047)	0.053 (0.042)	0.00	0.001	0.141	0.410	0.244	-2.70	-1.10
21	0.005 (0.038)	0.288 (0.054)	0.127 (0.033)	0.00	0.000	0.003	0.130	0.255	-6.11	0.96
16	0.088 (0.033)	0.254 (0.055)	0.118 (0.027)	0.00	0.168	0.607	0.480	0.932	-5.38	-2.18
11	0.040 (0.032)	0.170 (0.059)	-0.007 (0.054)	0.00	0.006	0.097	0.007	0.003	-2.42	-1.09
20	-0.012 (0.012)	0.157 (0.047)	0.053 (0.013)	0.00	0.000	0.000	0.001	0.000	-4.62	-0.83
1	0.022 (0.021)	0.130 (0.043)	0.106 (0.031)	0.00	0.000	0.000	0.041	0.028	-8.33	-3.31
3	0.036 (0.025)	0.112 (0.038)	0.054 (0.031)	0.00	0.012	0.086	0.688	0.455	-7.76	-2.06
18	0.000 (0.014)	0.207 (0.051)	0.035 (0.021)	0.00	0.000	0.018	0.066	0.000	-4.85	-2.32
6	0.061 (0.031)	0.146 (0.061)	0.132 (0.057)	0.00	0.000	0.314	0.000	0.000	-4.09	-1.21
7	-0.028 (0.015)	0.417 (0.060)	0.095 (0.023)	0.00	0.000	0.000	0.000	0.000	-4.24	-2.88
5	0.049 (0.027)	0.142 (0.041)	0.160 (0.030)	0.00	0.000	0.000	0.009	0.063	-5.63	-2.29
25	0.109 (0.029)	0.123 (0.067)	-0.013 (0.041)	0.00	0.007	0.002	0.224	0.430	-3.85	0.20
22	0.003 (0.023)	0.178 (0.065)	0.091 (0.027)	0.00	0.000	0.100	0.000	0.000	-5.96	-1.65
10	-0.001 (0.027)	0.274 (0.044)	0.020 (0.031)	0.00	0.000	0.000	0.001	0.004	-5.84	-1.14
9	-0.007 (0.024)	0.204 (0.044)	-0.012 (0.026)	0.00	0.000	0.284	0.004	0.000	-7.57	-1.26
15	-0.009 (0.026)	0.090 (0.058)	0.084 (0.042)	0.00	0.414	0.331	0.701	0.498	-5.72	-1.59
24	0.013 (0.027)	0.249 (0.042)	0.013 (0.037)	0.00	0.000	0.032	0.046	0.159	-11.66	-1.18
14	0.064 (0.025)	0.123 (0.038)	0.042 (0.028)	0.00	0.000	0.044	0.478	0.605	-7.87	-3.07
23	0.019 (0.031)	0.479 (0.052)	0.079 (0.028)	0.00	0.000	0.074	0.000	0.004	-10.65	-3.81
2	0.106 (0.032)	0.179 (0.043)	0.016 (0.040)	0.00	0.005	0.189	0.030	0.002	-9.14	-4.28

Notes: Robust standard errors in parentheses. Time dummies are included but not reported. *Sargan, Hansen, Dif-Hansen*: tests of overidentifying restrictions, asymptotically distributed as χ^2_{df}. p-values are reported. *Dif-Hansen (lev)* tests the validity of the 1-year lag of the first-differenced smoothed profits-per-employee variable as instruments in the levels equation while *Dif-Hansen (L2-dif)/(L3-dif)* test the validity of the 2-/3-year lags of the smoothed profits-per-employee variable as instruments in the first-differenced equation. *m1* and *m2*: tests for first-order and second-order serial correlation in the first-differenced residuals, asymptotically distributed as *N(0,1)*. Industries are ranked according to $\widehat{\gamma}_I^{prod}$.