

Compensation Structure and Product Market Competition

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Abstract

The inability to measure the opportunity cost of labor has plagued analyses of firm-level compensation policies for many years. Using a newly constructed data set of French workers and firms, we estimate the opportunity cost of the employees' time based on a measure of the person-effect in the wage equations (derived from Abowd, Kramarz and Margolis 1994). We then make direct calculations of the quasi-rent per worker at each firm and the conditions within that firm's product market, as measured by international prices, using a representative sample of private French firms. We find that quasi-rents per worker are only mildly related to the structure of the French product market. The systematic variation in our quasi-rents is related to international market prices and work force structure, however, producing an estimate of bargaining power for the employees of about 0.4. This estimate, while slightly larger than other estimates, may be quite reasonable for the workers in an economy in which the vast majority of jobs are covered by industry-level collective bargaining agreements.

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1. Introduction

This paper considers the determinants of the average annual employment cost per employee in private French industry. Virtually all jobs in this economy are covered by industry-wide collective bargaining agreements that set lower bounds for the wage rates that can be paid to employees (both production and supervisory) at firms within the industry.¹ A substantial number of these jobs are also covered by firm-level agreements (Abowd and Kramarz 1993). In this context, it is natural to try to model the extent to which quasi-rents generated by the firms through their product market operations are transmitted to the employees through the results of these negotiations. Such an inquiry must immediately address the question of the opportunity wage of the employees. Until now, researchers have had to model this opportunity wage without much insight into the characteristics of the employees at the firm. Using matched longitudinal data on employees and employers developed by Abowd, Kramarz and Margolis (1994) for a representative sample of French workers and firms, we are able to get a firm-specific measure of the opportunity cost of the workers. We use these measures to improve the specification of a simple “efficient contracts” wage bargaining model in which the quasi-rents per worker are assumed to originate from the firm’s product market operations. Within the context of such a model, we show that the workers have substantial average bargaining power, about 0.4, whether or not we include the opportunity cost of fixed capital in the quasi-rent measure.

Section 2 provides a basic model of quasi-rent division. Section 3 describes our data sources and methods. Section 4 lays out the econometric specification. Section 5 discusses the results. Finally, we conclude in section 6.

¹ See Margolis (1993) and Abowd and Kramarz (1993) for a fuller description of the economic bargaining environment in France.

2. A Model of Quasi-Rent Division

The models estimated in this paper follow closely those developed in Brown and Ashenfelter (1986), Abowd (1989), Abowd and Kramarz (1993) and Abowd and Lemieux (1993).² In particular, under strong-form efficient contracting the wage rate is determined by the solution to the problem:

$$\max_{w,L} [Lw + (\bar{L} - L)x - \bar{L}x]^g [q F(L, \bar{K}) - wL - r\bar{K}]^{(1-g)} \quad (1)$$

where $F(L, K)$ is the firm's revenue generating function up to a scalar multiple q , w is the negotiated wage rate, x is the opportunity cost of the workers' time, r is the competitive return on capital with comparable risk, L is the level of employment, \bar{L} is the maximum level of employment (members of the negotiating unions), \bar{K} is the (fixed) capital stock (valued at current breakup value) and g is the unions' bargaining power. The solution for w is given by:

$$w = x + g \left(\frac{q F(L^0(x, \bar{K}), \bar{K})}{L^0(x, \bar{K})} - x - r \frac{\bar{K}}{L^0(x, \bar{K})} \right) \quad (2)$$

and the solution for L is given by:

$$q F_1(L^0(x, \bar{K}), \bar{K}) = x \quad (3).^3$$

As is well-known, the solution given by equations (2) and (3) implies that fully efficient resource allocation decisions are made with respect to the quantity of labor used and that the division of the resulting quasi-rent allocates a "pie" that optimally exploits the fixed capital stock \bar{K} . Abowd and Kramarz (1993) and Abowd and Lemieux (1993) derive alternative versions of equation (2) in which the resulting bargaining outcome does not allocate an optimal quasi-rent per

² The basic models can be found in Leontif (1948) and MacDonald and Solow (1981).

³ Abowd (1989) shows that the same solution arises from present value maximization over horizons determined by the length of the collective bargaining agreement. The parameter g in that case is interpreted as bargaining power over the present value of the quasi-rents.

worker. The optimal value of the quasi-rent per worker appears on the right hand side of their wage settlement equations; however, the bargaining power parameter has the interpretation of a lower bound on the bargaining power used to divide the sub-optimal quasi-rent per worker.

Product market conditions enter the solution to the strong form efficient bargain, and the other bargaining models with the same structure as equation (2), through their effect on the revenue shifter q . To model this dependence define the quasi-rent per worker as:

$$q \equiv \frac{\mathbf{q} F(L^0(x, \bar{K}), \bar{K})}{L^0(x, \bar{K})} - x - r \frac{\bar{K}}{L^0(x, \bar{K})} \quad (4)$$

If we let z represent product market conditions, and other control variables that enter the quasi-rent per worker equation by virtue of the expression (4), we can decompose q into a part related to product market conditions and an orthogonal component \mathbf{h} which we may consider either as measurement error or as firm-specific factors determining quasi-rents per worker. Our basic equation for q , then, becomes:

$$q = z\mathbf{b} + \mathbf{h}$$

In the pure, cooperative Nash game described by equation (1), the bargaining power parameter, \mathbf{g} , is predetermined. In our empirical specification, we want to allow for the possibility that bargaining power depends upon the size of the quasi-rent per worker and, possibly because the outcome is the solution to a noncooperative industry game, upon product market conditions. Thus we specify \mathbf{g} as:

$$\mathbf{g} = \mathbf{g}_0 + \mathbf{g}_1 q + \mathbf{g}_2 z \quad (5)$$

If bargaining power is not heterogenous, then $\mathbf{g}_1 = 0$ and if noncooperative factors do not enter the solution then $\mathbf{g}_2 = 0$.

3. Sources of Data for Implementing the Model

In this section we describe the firm- and individual-level data that we used to construct our analysis data set. The basic data on the French firms were derived from two annual surveys of enterprises: the Bénéfices industriels et commerciaux (BIC, see INSEE, 1990b) and the Enquête sur la structure de l'emploi (ESE, see INSEE 1990c). The BIC is the basic source for firm level data used in formulating the national income and product accounts. A research sample, called the échantillon d'entreprises, of approximately 20,000 firms was created at INSEE as a stratified random sampling of the BIC universe (see INSEE 1990a). The research sample covers the period 1978 to 1988. The ESE data describe the skill structure of the firms by detailed occupational categories. Abowd and Kramarz (1993) created a version of these data with the basic BIC variables and a simple classification of employees by skill groups. We used an updated version of this analysis file created by Abowd, Kramarz and Margolis (1994, AKM hereafter) that also included variables computed from the Déclaration Annuelle des Salaires (DAS). The sample is representative of French private industry. It excludes the government sector and the large government-owned industrial and transport companies.

Average annual employment (employment at December 31 prior to 1984), L_{jt} , is the reported average number of salaried and hourly employees (saliariés) at the firm over the course of the calendar year. The average real wage within one of our sample firms, w_{jt} , is defined as the total wage and benefit bill (frais de personnel y.c. charges sociales) divided by the product of average annual employment and the consumer price index (1980=1.00). Real value added per worker, v_{jt} , is defined as value added (valeur ajoutée brut des coûts de facteurs) divided by the product of average employment and the product shipment price index (1980=1.00). Real assets

per worker, k_{jt} is defined as total assets (actif total) divided by the product of average annual employment and the industry capital price index (1980=1.00).

The measurement of the opportunity cost of time for workers in each firm, x_{jt} , is based upon the analysis of the Déclaration Annuelle des Salaires (DAS) performed by AKM. The analysis sample from the DAS consists of over one million French nongovernmental workers followed from 1976 to 1987. The longitudinal data identify both the individual and the employer permitting specification of a model like:

$$\ln(w_{it}) = \mathbf{m} + \mathbf{a}_i + \mathbf{f}_{J(i,t)} + x_{it} \mathbf{b} + u_{it} \quad (6)^4$$

where w_{it} is individual i 's annualized wage rate during year t ; the effect \mathbf{a}_i is specific to the individual, the effect $\mathbf{f}_{J(i,t)}$ is specific to the firm given by the function:

$$J(i,t) \equiv j \text{ employs } i \text{ in year } t$$

the effect $x_{it} \mathbf{b}$ represents time-varying controls in equation (6), \mathbf{m} is the grand mean, and the effect u_{it} represents a statistical error term, orthogonal to all variables on the right-hand side of equation (6). Given their estimates of the individual and firm effects, AKM construct firm-level estimates of the average individual effect in the firm:

$$\mathbf{a}_j \equiv \frac{\sum_{\{i,t\} \in \{J(i,t)=j\}} \mathbf{a}_i}{N_j} \quad (7)$$

where

$$N_j \equiv \text{Count}(\{i,t\} \in \{J(i,t)=j\}) \quad .$$

⁴ AKM actually estimate a more complicated equation than this involving firm-specific seniority slopes; however, we have aggregated all of their firm effects into the effect \mathbf{f} in our equation (6).

We use the AKM estimates of \mathbf{a}_j and \mathbf{f}_j to construct a measure of the opportunity cost for the average worker in firm j .

$$x_{jt} = \max\left(\left(1 + (\mathbf{a}_j - \bar{\mathbf{a}}) + \mathbf{f}_{10}\right)\mathbf{m}, x_{\text{Min}}\right)$$

where $\bar{\mathbf{a}}$ is the average value of \mathbf{a} over firms, \mathbf{f}_{10} is the tenth decile of $\mathbf{f}_{j(i,t)}$ in the population of firms, \mathbf{m} is the average real wage in the firm sample, and x_{Min} is the value of the industrial minimum wage in 1980 (25,000FF).

We used all of the variables defined above to create two measures of quasi-rents per worker. Our first measure corresponds to the one used by Abowd and Lemieux except that we have a direct measure of material costs, which has been removed from firm production to calculate value added. Our second measure uses a real opportunity cost of capital of 3% per annum. The two measures are defined below:

$$\begin{aligned} \text{First definition (QR1): } q_{jt} &\equiv v_{jt} - x_{jt} \\ \text{Second definition (QR2): } q_{jt} &\equiv v_{jt} - x_{jt} - 0.03k_{jt} \end{aligned} \tag{8}$$

To provide measures of French product market conditions, we constructed sales-based (chiffres d'affaires) estimates of each firm's market share at the two-digit industry level (NAP 100). To provide measures of world product market conditions we merged export price indices at the two-digit level for French export classifications (NAP 100) and for US export classifications (2-digit 1987-based SIC). Table 1 shows the summary statistics for the firm-level variables used in our statistical analyses.

Table 1 Summary Statistics		
Variables	Mean	Standard Deviation
Annual Real Compensation (in thousands 1980FF)	86.23	(55.23)
Opportunity Cost of Time (in thousands 1980FF)	73.11	(59.08)
Quasi-Rent per Worker (1) (in thousands 1980FF)	34.55	(148.42)
Quasi-Rent per Worker (2) (in thousands 1980FF)	28.93	(141.26)
Profit per Worker (in thousands 1980FF)	107.67	(145.96)
Total Assets per Worker (in thousands 1980FF)	187.38	(732.38)
Market Share (proportion of national market)	0.0014	(0.02)
Price Index for French Exports (1890=100)	137.90	(66.09)
Price Index for U.S. Exports (1982-84 = 100)	82.131	(12.65)
Sources: Déclaration Annuelle des Salaires (DAS) and Bénéfices Industriels et Commerciaux (BIC).		
Notes: The sample size is 35,568 and the statistics have been weighted to be representative of firms.		

4. Econometric Specification of the Basic Equations

Our wage equations are based upon data for firm j in year t . The relation connecting wage rates and quasi-rents per worker as derived from equation (2) above, can be expressed as:

$$w_{jt} = x_{jt} + \mathbf{g}_{jt}q_{jt} + \mathbf{e}_{jt} \quad (9)$$

where x_{jt} is the firm-specific opportunity cost of the workers' time, q_{jt} is one of the two quasi-rent measures discussed in section 3, and \mathbf{e}_{jt} is a statistical error uncorrelated with either x_{jt} or q_{jt} . The instrumental equation for quasi-rents per worker is given by:

$$q_{jt} = z_{jt}\mathbf{b} + \mathbf{h}_{jt} \quad (10)$$

where z_{jt} is a vector of market structure variables as described in section 3 plus some controls for the structure of the workforce. The potential heterogeneity in the bargaining power parameter is modeled as:

$$\mathbf{g}_{jt} = \mathbf{g}_0 + \mathbf{g}_1(q_{jt} - \bar{q}) + \mathbf{g}_2(z_{jt} - \bar{z}) \quad (11)$$

where an overbar on the variable indicates its sample average over firms j and years t . The parameter \mathbf{g}_1 , as in Abowd and Lemieux, allows for heterogeneous bargaining power as a function of the size of the quasi-rent per worker while the parameter \mathbf{g}_2 allows for heterogeneity related to product market conditions. Both bargaining power heterogeneity parameters are constructed so that the basic parameter \mathbf{g}_0 may be interpreted as the bargaining power at the population average values of quasi-rents per worker and product market conditions. Substituting equation (11) into equation (9) yields the basic estimating equation for the wage rate:

$$w_{jt} = x_{jt} + \mathbf{g}_0 q_{jt} + \mathbf{g}_1 q_{jt} (q_{jt} - \bar{q}) + \mathbf{g}_2 q_{jt} (z_{jt} - \bar{z}) + \mathbf{e}_{jt} \quad (12)$$

When product market conditions do not affect the bargaining power of the parties, the parameter \mathbf{g}_2 is zero and the equation (12) specializes to the form in Abowd and Lemieux (1993):

$$w_{jt} = x_{jt} + \mathbf{g}_0 q_{jt} + \mathbf{g}_1 q_{jt} (q_{jt} - \bar{q}) + \mathbf{e}_{jt} \quad (13)$$

There are two empirical issues to consider before considering the direct estimation of equation (12). First, following Abowd and Lemieux, we will use export prices as a measure of international product market conditions. Our original plan was to use both US and French export prices, arguing that French export prices are better adapted to the market definitions used in the French industries but might be endogenous whereas US export prices, although based on US sectoral definitions, are genuinely exogenous to the French economy. Table 2 shows that there is very little independent variation between the US and French export prices. US export prices do

an excellent job of predicting French export prices ($R^2 = 0.65$) with very little prediction bias (estimated coefficient = 1.026).

Table 2	
Prediction of French Export Prices Using US Export Prices	
Intercept	46.727 (29.982)
US Export Prices	1.026 (0.405)
Year=1980	-21.007 (4.275)
Year=1981	-17.889 (3.541)
Year=1982	-6.535 (4.285)
Year=1983	5.771 (4.130)
Year=1984	18.026 (4.430)
Year=1985	a –
Year=1986	25.542 (5.670)
Year=1987	24.588 (6.213)
Year=1988	23.49 (7.560)
Standard Error of Equation	18.06
R^2	0.649
Sources: Déclaration Annuelle des Salaires (DAS) and Bénéfices Industriels et Commerciaux (BIC)	
Notes: Sample size is 35,568. The reported results are least squares coefficients with standard errors allowing for arbitrary heteroscedasticity and within industry correlation. The reference year is 1985. Results are weighted to be representative of firms.	

The second statistical issue to consider is the quality of the reduced form predicting quasi-rents per worker as a function of the exogenous international and labor market factors. Table 3 reports a simplified reduced form (equation 10) in which the exogenous variables enter linearly. In the actual structure discussed below, the instruments enter in full quadratic form, as in Abowd and Lemieux. The results shown in Table 3 do not differ materially from the full reduced form but are easier to interpret. Notice that both the opportunity cost of time (a direct component of the quasi-rent measures) and the US export prices are strongly related to the quasi-rent per worker measures with signs consistent with the theoretical model laid out above. Notice also that, as in the Abowd and Lemieux Canadian analysis, the reduced form explains only a small percentage of the variation in measured quasi-rents per worker. We interpret this result as showing, once again, the importance of using international product market conditions, which are exogenous to the firms in the analysis, to eliminate excess variability in the measured quasi-rents per worker.⁵

⁵ We experimented with many different lag structures and nonlinearities for the relation between international prices and quasi-rents per worker. In all cases, as in the results shown in the text, we maintained the hypothesis that US export prices were statistically exogenous. The structure of the relation between the international prices and the quasi-rents was essentially the same as in the simple specification. We elected to report only the simplest specifications. The equations do not change if French export prices are also introduced as an exogenous variable, although these prices are not always statistically exogenous.

Table 3		
Simplified Reduced Form Estimates for the Quasi-Rent per Worker		
Dependent Variable:	Quasi-Rent per Worker, no Opportunity Cost of Capital	Quasi-Rent per Worker, including Opportunity Cost of Capital
Intercept	44.085 (8.824)	45.603 (7.906)
Opportunity Cost of Time	-0.631 (0.063)	-0.666 (0.056)
US Export Prices	0.451 (0.107)	0.392 (0.095)
Year Effects	Yes	Yes
Standard Error of Equation	65.75	62.16
R ²	0.078	0.090
Sources: Déclaration Annuelle des Salaires (DAS) and Bénéfices Industriels et Commerciaux (BIC)		
Notes: Sample size is 35,568. The reported results are least squares coefficients with standard errors allowing for arbitrary heteroscedasticity and within industry correlation. Results are weighted to be representative of firms.		

5. Quasi-Rent Division in French Firms

Table 4 summarizes the results for both of our quasi-rent per worker definitions. In this table we note that the estimate of the average worker bargaining power in the French economy (g_0 , the coefficient on quasi-rent per worker variable) is about 0.2 in the straightforward least squares specification for either quasi-rent definition.⁶ The least squares estimates indicate that bargaining power is not a function of quasi-rents per worker ($g_1 = 0$) or, when capital costs are included in the quasi-rent measure, that this relation is very weak. Hausman-Wu tests, however, do not support the exogeneity of the quasi-rent per worker measures. Hence, we prefer our IV

⁶ The estimated effect is somewhat smaller if this specification is augmented with unrestricted industry effects. Because of difficulties in computing the robust standard errors when all industry effects are included in the model, we have not displayed those results. The results presented in Table 4 are similar in both magnitude and precision to results of other specifications that involve unrestricted time and industry effects.

estimates, which indicate that the average bargaining power is on the order of 0.37 (no capital costs in the quasi-rent measure) to 0.45 (including capital's opportunity cost in the quasi-rent per worker measure). There is clear evidence of bargaining power heterogeneity in the IV estimates since the coefficients on the quasi-rent quadratic term are all positive and significant. There is also clear evidence of product market importance in determining the bargaining power since the interaction of the market structure variable with the quasi-rent per worker is significant in both definitions.

Table 4				
Least Squares and Instrumental Variables Estimates of the Compensation per Worker As a Function of Quasi-Rents per Worker and Market Structure				
Method:	OLS		IV	
Quasi-Rent Measure:	Quasi-Rent per Worker, no Opportunity Cost of Capital	Quasi-Rent per Worker, including Opportunity Cost of Capital	Quasi-Rent per Worker, no Opportunity Cost of Capital	Quasi-Rent per Worker, including Opportunity Cost of Capital
Intercept	54.859 (3.021)	54.576 (2.483)	25.982 (8.221)	21.047 (8.285)
Opportunity Cost of Time	0.330 (0.025)	0.344 (0.022)	0.554 (0.151)	0.632 (0.127)
Quasi-Rent per Worker	0.194 (0.026)	0.202 (0.023)	0.367 (0.103)	0.452 (0.094)
Quasi-Rent per Worker (quadratic term, see notes)	0.004 (0.004)	0.007 (0.003)	0.102 (0.041)	0.096 (0.035)
Market Share x100	3.197 (0.993)	3.121 (0.889)	34.312 (66.226)	26.614 (59.267)
Quasi-Rent, Market Share (interaction, see notes)	-1.572 (0.609)	-1.601 (0.538)	-63.112 (34.133)	-63.176 (30.753)
Standard Error of Equation	20.82	20.93	—	—
R ²	0.332	0.325	—	—

Sources: Déclaration Annuelle des Salaires (DAS) and Bénéfices Industriels et Commerciaux (BIC).
Notes: Sample size is 35,568. The reported results are least squares coefficients with standard errors allowing for arbitrary heteroscedasticity and within industry correlation. Results are weighted to be representative of firms. The quadratic term in the equations is the product of the quasi-rent measure and the same measure deviated from its mean. The quasi-rent, market share interaction is the product of the quasi-rent measure and the deviation of market share from its mean. The instruments include year effects, the opportunity cost of time, its square, US export prices, its square, and the interaction of opportunity cost of time and export prices.

6. Conclusion

We have demonstrated that although the relation between firm-level quasi-rents per worker and the product market conditions we measure is not strong, the systematic part of that relation is statistically important in explaining firm-level heterogeneity in average compensation per employee. We have further demonstrated that firm-specific measures of the opportunity cost of time permit the specification and estimation of the structure of strong form bargaining models in a manner that avoids many earlier problems. For our sample of French firms, average employee bargaining power is large, about 0.4 whether or not we allow for an opportunity cost to fixed capital. This is perhaps not surprising in an economy where the vast majority of jobs are covered by industry-level collective bargaining agreements and more than one-third by an additional firm-level agreement. In our preferred specification, worker bargaining power increases as the quasi-rent per worker increases and decreases as the firm's market share increases.

The analysis using French workers and firms is fully consistent with the analysis using Canadian workers and firms in Abowd and Lemieux. The similarity of the two sets of compensation analyses suggests that the use of international market prices to extract the component of quasi-rents per worker that underlies the bargaining model discussed above is a useful and statistically valid method of modeling the product market determinants of compensation outcomes.

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