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## **Estimating price cost margins, scale economies and workers' bargaining power at the firm level**

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**Abstract**

This paper presents a model for estimating price cost margins, scale economies and the workers' bargaining power from a panel of firm level data. The model extends Hall's framework, based on the « Solow residual » under imperfect competition on the product markets, to allow for the possibility that wages are bargained off the labor demand curve, according to an efficient bargaining model. One interesting aspect of our methodology is that it does not require to measure the opportunity cost of labor for the estimation of the union bargaining power as in the case of most studies about negotiation models.

Our model is estimated on a panel of French manufacturing firms using the Chamberlain II matrix framework. We find substantial imperfections in both the product and labor markets in French manufacturing. We also show that the lack of explicit consideration of labor market imperfection results in a significant underestimation in markups, due to the omission of the part of product rents captured by workers. Our estimate of the workers' bargaining power is of an order of 0.25 on a scale going from 0 to 1, while our mark-up estimate is of about 1.6, as compared with 1.3 when ignoring workers' bargaining power.

**Keywords** : Market power, scale economies, bargaining power, industry price deflators, panel data, Chamberlain II matrix.

**Résumé**

Cet article présente un modèle permettant d'estimer simultanément le mark-up, les rendements d'échelle et le pouvoir de négociation des salariés sur données d'entreprises. Notre modèle élargit la méthode d'estimation des markups développée par Hall à partir du « résidu de Solow » en supposant que le salaire et l'emploi font l'objet d'un marchandage entre firme et syndicat (modèle de négociation du type contrat efficace). En outre, il présente l'avantage majeur de ne pas nécessiter le calcul du salaire externe pour l'estimation du pouvoir de négociation du syndicat, contrairement à la plupart des études qui cherchent à identifier ce paramètre.

Nous estimons ce modèle à partir d'un panel d'entreprises industrielles françaises en utilisant la méthode d'estimation dite de Chamberlain. Nous montrons l'existence d'un fort degré d'imperfection à la fois sur le marché des produits et le marché du travail. Nous montrons également qu'ignorer la présence d'imperfections sur le marché du travail conduit à une sous évaluation importante du mark-up. Selon nos estimations, le pouvoir de négociation des employés est de 0.25 sur une échelle allant de 0 à 1, tandis que le mark-up des entreprises est de l'ordre de 1.6 comparé à 1.3 en l'absence de pouvoir syndical.

**Mots-clés** : Pouvoir de marché, rendements d'échelle, pouvoir de négociation des salariés, déflateurs sectoriels, données de panel, matrice II de Chamberlain.

## Introduction

Imperfect competition on the product markets typically leads to an inefficient allocation of output in the economy. In particular a low degree of competition allows firms to raise prices above marginal costs, reducing output below its optimal level.

The detection and measurement of imperfect competition has been extensively studied at both the macro and micro level. One approach is to measure the gap between prices and marginal costs, i.e. price cost margins or markups . However, this literature generally ignores the existence of imperfect competition in the labor market. Using a panel of French manufacturing firms, we show that the lack of explicit consideration of labor market imperfection causes a significant underestimation in markups, due to the omission of the part of product rents captured by workers.

One very influential development in recent years is the approach proposed by Hall (1986, 1988 and 1990), which in turn draws on Solow's (1957) famous article on estimating total factor productivity as a measure of technical change. Under perfect competition and returns to scale, Solow shows that total factor productivity can be measured from observed data directly as the difference between the rate of growth of output and an average of the factor inputs weighted by their respective output shares. This difference has come to be known as the « Solow residual ». In his series of papers, Hall looks at the implications of relaxing the assumption of perfect competition for the derivation of the Solow residual. Allowing for price cost margins, he shows that the Solow residual is no longer equal to the rate of technical progress, as in the case of perfect competition, but can be decomposed into two components : the rate of technical change and a mark-up of price over marginal cost factor. Using this relationship, Hall estimates margins from highly aggregated data on U.S. manufacturing industries. Most studies following Hall are based on industry level data<sup>1</sup>. Klette (1994) is one of the very few notable exceptions and is the starting point of our work here<sup>2</sup>.

Imperfect competition in the labor market has also received a great attention. Several papers examine the effects of the firm profitability on wages, producing through this relationship an estimate of the bargaining power for the workers. The estimated effects are controversial. Some researchers find a very small bargaining power of just a few percents, while others obtain much higher values ranging from 0.2 to 0.4 on a scale going from 0 to 1<sup>3</sup>. One interpretation of the low results is that the authors have failed to control for the endogeneity of profits. In the present paper, we show how the mark-up and the bargaining power parameters can be simultaneously estimated. We extend Hall's framework to allow for the possibility that wages are bargained off the labor demand curve, according to an efficient bargaining model. We show that it adds an additional term in Hall equation which permits the identification of workers' bargaining power. One interesting aspect of our methodology is that it does not require to measure the opportunity cost of labor for the estimation of the union bargaining power as in the case of the studies mentioned above.

In this study, we take advantage of a rich body of firm level panel data to estimate our parameters. The use of micro data has some benefits but also raises specific issues. It permits, for example, to avoid the important problem of aggregation by implementing the model at the level for which it is constructed. However, the lack of detailed price data at this level and the use of nominal output measures instead of real output measures lead to a misinterpretation of the estimated parameters. As in Klette and Griliches (1996), the

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1 See among others Domowitz and al. (1988), Roeger (1995), Martins and al. (1996).

2 See also Harrison (1994) and Levinsohn (1993).

3 See for example Blanchflower, Oswald and Sanfey (1994), Hildreth and Oswald (1993), Denny and Machin (1991) and Christofides and Oswald(1992 for low estimates. See Abowd and Lemieux (1993), Abowd and Kramarz (1993), Abowd and Allain (1996) or Cahuc, Gianella and Zylberberg (1998) for higher results.

identification issue is solved by adding a sectoral macro variable in the model. The model is then estimated on French manufacturing firms over the period 1986-1992 using the Chamberlain framework<sup>4</sup>. The results reveal that ignoring imperfect competition in the labor market can lead to an omitted variable bias in markup estimates. They suggest that the workers' bargaining power is of an order of about 0.25, while the mark-up is around 1.6 compared with 1.3 when ignoring workers' bargaining power.

We begin in section 2 by providing a simple theoretical framework. In section 3, we describe the data with explanations on sample construction and variables measurement. This leads to the discussion of the econometric method and the presentation of the results in section 4. A brief conclusion follows in section 5.

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<sup>4</sup> The Chamberlain method is asymptotically equivalent to the Generalized Method of Moments (GMM).

## Theoretical considerations

### Price-cost margins and scale economies

Let us consider a production function in which, for the  $i^{\text{th}}$  firm in period  $t$ , output  $Q$  is produced from capital  $K$ , labor  $L$  and materials  $M$  according to :

$$(1) \quad Q_{it} = A_{it} F(K_{it}, L_{it}, M_{it})$$

where  $A_{it}$  is a productivity factor and  $F$  is homogeneous of degree  $\lambda_{it}$  in all factor inputs.

Letting  $q_{it}$ ,  $k_{it}$ ,  $l_{it}$ ,  $m_{it}$  and  $a_{it}$  be the logarithms of  $Q_{it}$ ,  $K_{it}$ ,  $L_{it}$ ,  $M_{it}$  and  $A_{it}$ , we can write the logarithmic differentiation of the production function (1) as :

$$(2) \quad \Delta q_{it} = \Delta a_{it} + e_{it}^{Q,K} \Delta k_{it} + e_{it}^{Q,L} \Delta l_{it} + e_{it}^{Q,M} \Delta m_{it}$$

where  $e_{it}^{Q,K}$ ,  $e_{it}^{Q,L}$ ,  $e_{it}^{Q,M}$  denote respectively the elasticity of output to capital ( $\mathcal{J}q_{it}/\mathcal{J}k_{it}$ ), labor ( $\mathcal{J}q_{it}/\mathcal{J}l_{it}$ ) and materials ( $\mathcal{J}q_{it}/\mathcal{J}m_{it}$ ). In what follows we will replace the time derivatives by year to year changes<sup>5</sup>.

We assume that firms operate under imperfect competition in the output markets, while act as price takers in the input markets when choosing their factor inputs so as to maximize profit. We further assume that capital is the sole quasi-fixed input for firms while labor and materials are fully adjusted to their equilibrium value. Profit maximization with respect to labor and materials gives the two following first-order conditions :

$$(3) \quad \begin{cases} e_{it}^{Q,L} = \mu_{it} s_{it}^L \\ e_{it}^{Q,M} = \mu_{it} s_{it}^M \end{cases}$$

where  $\mu_{it}$  is the ratio of the price of output over marginal cost and  $s_{it}^j$  is the cost share of input  $j$  ( $j=\{K,L,M\}$ ) relative to total revenue<sup>6</sup>. Note that this parameter can also be interpreted as the inverse of the elasticity of total revenue with respect to output<sup>7</sup>. Equations (3) mean that the ratio of the input payment to output valued at marginal cost measures the elasticity of output with respect to this input. In other words, the share  $s^j$  is an exact measure of the elasticity when marginal price and cost are equal ( $\mu=1$ ), while underestimates it when marginal cost falls short of price ( $\mu>1$ ). Since the output elasticities for factors  $j$  sum up to the scale elasticity  $\lambda_{it}$  (Euler's theorem), we can compute the capital elasticity of output as the following difference<sup>8</sup> :

$$(4) \quad e_{it}^{Q,K} = 1_{it} - \mu_{it} s_{it}^L - \mu_{it} s_{it}^M$$

Inserting (3) and (4) into equation (2) and rearranging gives :

$$(5) \quad \Delta q_{it} = \mu_{it} \left\{ s_{it}^L (\Delta l_{it} - \Delta k_{it}) + s_{it}^M (\Delta m_{it} - \Delta k_{it}) \right\} + 1_{it} \Delta k_{it} + \Delta a_{it}$$

This equation is quite similar to Klette's econometric model which permits simultaneous estimation of price-cost margins and scale economies. Klette's crucial insight is to show

5 That is  $\Delta z_{it} = \ln z_{it} - \ln z_{i,t-1} = (z_{it} - z_{i,t-1}) / z_{i,t-1}$  where  $z_{it} = \{q_{it}, a_{it}, k_{it}, l_{it}, m_{it}\}$ .

6 Labor and materials are paid their marginal revenue that is  $R_L = w$  and  $R_M = v$  where  $R_L$  and  $R_M$  are respectively the marginal revenue of labor and materials,  $w$  is the wage and  $v$  is the cost of materials. To obtain relations (3), we use the fact that  $R_L = R_Q Q_L$ ,  $R_M = R_Q Q_M$  and  $R_Q = C_Q$  where  $Q_L$  and  $Q_M$  are respectively the marginal product of labor and materials,  $R_Q$  is the marginal revenue and  $C_Q$  is the marginal cost.

7 We have :  $\mu = P/C_Q = P/R_Q = 1/(R_Q Q/R)$ .

8 Note that this relation is very useful as it avoids the problematic computation of the shadow value of capital.

how Hall's approach to estimation of market power can be extended to account for scale economies.

**Price-cost margins and scale economies when output prices are unobserved and endogenous**

The previous equation is not, however, directly usable on firm level data because real output  $\Delta q_{it}$  is not generally observed at this micro level. In empirical practice, it is replaced by nominal sales which are deflated by a common industry price deflator. Then, the estimated model is :

$$(6) \quad \Delta y_{it} = m_{it} \left\{ s_{it}^L (\Delta l_{it} - \Delta k_{it}) + s_{it}^M (\Delta m_{it} - \Delta k_{it}) \right\} + I_{it} \Delta k_{it} + \Delta a_{it}$$

where the dependent variable now is  $\Delta y_{it}$  which represents the rate of growth of deflated sales.

However, the use of a common deflator may introduce a bias in the estimation of the production function parameters when there is a large amount of heterogeneity between firms within the industry and a significant price dispersion between them. This is so when firms compete in an environment with differentiated products and imperfect competition. In particular, Klette and Griliches (1996) show that the practice of using deflated sales as a measure of real output tends to create a downward bias in the scale estimate (and consequently in the markup estimate) obtained from production function regressions. Their argument is roughly as follows : if the variable that we observe is not growth in real output  $\Delta q_{it}$ , but growth in deflated sales  $\Delta y_{it} = \Delta q_{it} + \Delta p_{it} - \Delta p_{1t}$ , where  $\Delta p_{it} - \Delta p_{1t}$  is the growth in the firm's own price relative to the aggregate industry price index, then the model presented above (equation 6) suffers from the fact that the price differences are neglected. It follows that if the unobserved prices are correlated with the included variables in the model, an omitted variable bias will arise. Note that this problem can not be solved by a suitable choice of instrumental variables, since variables that are correlated with the changes in inputs (i.e. potentially useful instruments) will also be correlated with movements in the omitted price variable buried in the residual and therefore illegitimate as instruments.

Klette and Griliches propose to add a model of product demand to the model of producer behavior. This may allow one to express the omitted price variable  $\Delta p_{it} - \Delta p_{1t}$  in terms of observable. This can be illustrated using the simple demand system in Klette and Griliches:

$$(7) \quad \Delta q_{it} - \Delta q_{1t} = h_{it} (\Delta p_{it} - \Delta p_{1t}) + \Delta u_{it}$$

where  $\Delta q_{it} - \Delta q_{1t}$  is the firm's output growth relative to industry output,  $\Delta p_{it} - \Delta p_{1t}$  is the price variable discussed above,  $\eta_{it}$  ( $< 0$ ) is the elasticity of demand with respect to the firm's output price and  $\Delta u_{it}$  is a disturbance term which represents demand shifters for the products of the firm. Equation (7) is just a logarithmic differentiation of a model in which the firm's market share is determined by substitution effects across products within the industry. Combining  $\Delta y_{it} = \Delta q_{it} + \Delta p_{it} - \Delta p_{1t}$  and equation (7), and defining  $m_{it}^h = h_{it} / (h_{it} + 1)$ , the monopolistic mark-up, one finds that the omitted price variable can be expressed as :

$$(8) \quad \Delta p_{it} - \Delta p_{1t} = (1 - m_{it}^h) (\Delta y_{it} - \Delta q_{1t} - \Delta u_{it})$$

Using this expression, we can substitute out the price variable and rewrite equation (5) with deflated sales as the dependent variable as :

$$(9) \quad \Delta y_{it} = \frac{m_{it}}{m_{it}^h} \left\{ s_{it}^L (\Delta l_{it} - \Delta k_{it}) + s_{it}^M (\Delta m_{it} - \Delta k_{it}) \right\} + \frac{I_{it}}{m_{it}^h} \Delta k_{it} + \frac{m_{it}^h - 1}{m_{it}^h} \Delta q_{1t} + \Delta v_{it}$$

where  $\Delta v_{it}$  is an error term which captures both demand and productivity shocks

( $\Delta v_{it} = \frac{1}{m_{it}^h} \Delta a_{it} + \frac{m_{it}^h - 1}{m_{it}^h} \Delta u_{it}$ ). Notice, from (9), that price-cost margins and scale

economies obtained from estimating the production function in equation (6) are likely to be inconsistent, as they do not account for the bias due to the omitted price variable. In particular, we would expect the markup  $\mu_{it}$  and the scale elasticity  $\lambda_{it}$  to be biased downward by the factor  $1/m_{it}^h$ . Note that the mark-up from equation (6) should be biased towards unity if the two markups are the same in equation (9) i.e.  $m_{it} = m_{it}^h$ . We will not impose this latter restriction but rather test it from model (9). Adding growth in industry output as an additional regressor ensures in principle a consistent estimation of markups and scale economies.

To summarize, we will focus on the two models presented in equations (6) and (9). Clearly, the first follows common practice and uses deflated sales as a proxy for real output in equation (5). We have seen that this practice will tend to create biases in the estimates. The second model carries the analysis a step further by trying to solve the bias problems created by the omission of the price differences. Including changes in industry output in the equation will provide consistent estimates of the parameters.

Before we proceed, note that model (6) can be rewritten as :

$$(10) \quad SR_{it} = (m_{it} - 1) \left\{ s_{it}^L (\Delta I_{it} - \Delta K_{it}) + s_{it}^M (\Delta m_{it} - \Delta k_{it}) \right\} + (I_{it} - 1) \Delta k_{it} + \Delta a_{it}$$

while model (9) can take the following expression :

$$(11) \quad SR_{it} = \left( \frac{m_{it}}{m_{it}^h} - 1 \right) \left\{ s_{it}^L (\Delta I_{it} - \Delta K_{it}) + s_{it}^M (\Delta m_{it} - \Delta k_{it}) \right\} + \left( \frac{I_{it}}{m_{it}^h} - 1 \right) \Delta k_{it} + \frac{m_{it}^h - 1}{m_{it}^h} \Delta q_{it} + \Delta v_{it}$$

where the left-hand side SR is the difference between the year-to-year growth rate of output and a weighted average of the factor inputs, based on the respective output shares :

$SR_{it} = \Delta y_{it} - s_{it}^L \Delta I_{it} - s_{it}^M \Delta m_{it} - (1 - s_{it}^L - s_{it}^M) \Delta k_{it}$ . This statistic has come to be known as the « Solow residual ». Expressions (10) and (11) show that the Solow residual can be decomposed into a technological term, a markup component and a scale factor<sup>9</sup>. Model (10) is a direct transposition of Hall extended model on micro variables, while model (11) accounts for the problem created by the lack of information on firm individual prices.

### ***Bargaining power and price-cost margins***

We now look at the implications of relaxing the condition that labor is priced competitively for the derivation of the Solow residual. We adopt the conjecture that wages might be determined off the labor demand curve.

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9 Under the assumptions of competition and constant returns, equation (10) reduces to  $SR = \Delta a$ . This relationship was derived by Solow (1957) in his paper on « Technical Change and the Agregate Production Function ». He recommended evaluating the left side SR (without materials) to measure the rate of productivity growth  $\Delta a$ . Relaxing the condition that price equals marginal cost, Hall shows that the Solow residual cannot be totally attributed to technical progress as in the case of perfect competition but can be decomposed into a markup and a technological factor :  $SR = (\mu - 1) s^L (\Delta I - \Delta K) + \Delta a$ . Using this relationship, Hall estimates margins from highly aggregated data on U.S. manufacturing industries over the 1953-1984 period by an instrumental variable approach.

More precisely, we consider that the labor share can be written as a linear function of the labor elasticity of output  $\varepsilon^{Q,L}$  :

$$(12) \quad s_{it}^L = q_{it} + (1 - q_{it}) \frac{1}{m_{it}} e_{it}^{Q,L}$$

with  $\theta$  ( $\in [0,1]$ ) the workers' bargaining power and  $\mu$  the inverse of the revenue elasticity with respect to output. We show below how the  $\mu$  parameter can be interpreted as a mark-up parameter. Note that relation (12) gives  $s_{it}^L = \frac{1}{m_{it}} e_{it}^{Q,L}$  (see equations (3)) if workers do not

affect the labor share ( $\theta=0$ ). This is consistent with perfect competition in the labor market but also with a bargaining situation in which the firm and the union bargain over the wage rate, while the firm unilaterally determines its employment level (a right-to-manage bargaining model). Note also that the labor share reduces to unity if workers have all the bargaining power ( $\theta=1$ ).

Relation (12) can be derived as the solution of an efficient bargaining model, in which firms and workers bargain simultaneously over both wages and employment. In that case, the  $\mu$  parameter can be interpreted as a mark-up which is evaluated at the alternative market wage and not at the negotiated wage (see Appendix A for further details)<sup>10</sup>. By reshuffling the left- and the right-hand variables in this equation, we obtain a new expression of the labor elasticity of output with the workers' bargaining power, which allows us to propose an extension of our models. Equations (10) and (11) then become :

$$(13) \quad \begin{aligned} SR_{it} = & (m_{it} - 1) \left\{ s_{it}^L (\Delta l_{it} - \Delta k_{it}) + s_{it}^M (\Delta m_{it} - \Delta k_{it}) \right\} + (I_{it} - 1) \Delta k_{it} \\ & + m_{it} \frac{q_{it}}{1 - q_{it}} (s_{it}^L - 1) (\Delta l_{it} - \Delta k_{it}) + \Delta a_{it} \end{aligned}$$

$$(14) \quad \begin{aligned} SR_{it} = & \left( \frac{m_{it}}{m_{it}^h} - 1 \right) \left\{ s_{it}^L (\Delta l_{it} - \Delta k_{it}) + s_{it}^M (\Delta m_{it} - \Delta k_{it}) \right\} + \left( \frac{I_{it}}{m_{it}^h} - 1 \right) \Delta k_{it} \\ & + \frac{m_{it}}{m_{it}^h} \frac{q_{it}}{1 - q_{it}} (s_{it}^L - 1) (\Delta l_{it} - \Delta k_{it}) + \frac{m_{it}^h - 1}{m_{it}^h} \Delta q_{it} + \Delta v_{it} \end{aligned}$$

Note that these specifications allow one to test the right-to-manage versus the efficient bargaining union model. For example, one can interpret the reject of the assumption  $\theta=0$  as evidence against the right-to-manage model in favor of the efficient bargaining model. Note also that our methodology to estimate workers bargaining power is particularly interesting in so far as it does not need the measurement of the opportunity wage of the workers as in the case of most studies about negotiation models<sup>11</sup>.

10 In the efficient bargaining model, marginal revenue is no longer equal to marginal cost. It is thus difficult to interpret the inverse of the revenue elasticity for output as a mark-up. In appendix A, we show that it is possible to do it but we have to evaluate the mark-up at the competitive wage.

11 See Aboowd and Allain (1996) for an interesting way to measure the opportunity cost of labor. Using matched data on employees and employers developed by Aboowd, Kramarz and Margolis (1994), they obtain a firm specific measure of the opportunity cost of the workers.

## The Data

We estimate our models on a balanced panel data set of 1026 french manufacturing firms over the seven years, 1986-1992. It has been constructed from the data base SUSE (« Système Unifié des Statistiques d'Entreprises ») of INSEE, the French National Institute for Statistics and Economic Studies, and more precisely from the year files known as « échantillon », which concerns a subsample of firms for which detailed information on balance sheets and product accounts is collected.

We took out « leaving » firms, the ones which stopped answering the survey from 1986 to 1992 (because they ceased their activities, went to bankrupt or were taken over). We also left « entering » firms, which began reporting during this period (because they went into business during the period). In parallel, we « cleaned » the data set from observations which can be seen as erroneous or which were clearly outliers. We dropped out firms with missing values for the main variables and we trimmed outliers in both levels and growth rates. More precisely, we eliminated firms with extreme outliers in the distribution of a few important ratios (computed from the main variables in levels, such as value added per person and capital per person). We also cleaned out firms exhibiting huge rates of increase or decrease in the main variables.

Table 1 gives simple statistics for our key variables for the overall sample. The key variables are the production of the firm ( $Q_{it}$ ), its three input factors : capital ( $K_{it}$ ), labor ( $L_{it}$ ), and materials ( $M_{it}$ ), the factor costs' share in the value of total output ( $s_{it}^L$  and  $s_{it}^M$ ) and the industry production ( $Q_{it}$ ), which is an industry variable. All these variables are taken in growth rates in our model (except for the shares).

Our firm's output measure is gross production deflated by the national accounts price indexes at the 'level 100' of the French industrial classification (NAP 100 in the « Nomenclature des activités et produits »). The physical capital stock of the firm is computed as the fixed assets gross bookvalue, approximately adjusted for inflation on the basis of an estimated average age of fixed assets derived from the net to gross book value ratio. Labor is represented by the total number of employees (average over the year). Intermediate inputs are calculated by subtracting the value added from the value of production. They are simply deflated by the manufacturing sector level materials deflator. The share of inputs are calculated by dividing the labor cost and the cost of the intermediate inputs by the value of production. They are constructed as the average share for the two years used to construct the growth rates. Note that the average wage, used to calculate the compensation to labor, is defined as the total wage and benefit bill divided by the total number of employees. Finally, industry output is retrieved from the national accounts at the 'level 100'.



## Estimation and results

We estimate our models assuming that markups, scale economies and the workers' bargaining power are constant over time and across individuals. This amounts to assume that the heterogeneity and instability in these parameters are independent from explanatory variables, which permits the estimation of the average values of the parameters. Further work using a broader dataset will examine these interesting questions.

### *Estimation technique*

Estimation is difficult since productivity and demand shocks might be correlated with changes in factor inputs<sup>12</sup>. This might create a correlation between the error term and the right hand side variables in our models that can bias the Ordinary Least Squares (OLS) estimates.

One way to solve the endogeneity problem is to use the Chamberlain II matrix framework, which is asymptotically equivalent to the more popular Generalized Method of Moments (henceforth, GMM). The estimation method is detailed in Appendix B.

To estimate our models, we assume that the current random shocks are uncorrelated with the past values of firm level regressors (although they may affect the present and future values). We do not make any identifying restriction on the industry variable. We think that this latter variable is subject to important errors-in-variables, probably correlated through time, so that we do not want our parameter estimates to be based on this information. These assumptions amount to use past values of firm level regressors as instruments<sup>13,14,15</sup>.

### *Results*

Table 2 reports the results from estimating models without bargaining power. The first column refers to estimation of equation (10), which is the model proposed by Klette to simultaneously estimate price-cost margins and scale economies. Columns 2 and 3 present results obtained from equation (11), which is augmented by including the industry output variable into the regression (10). This macro variable permits the identification of a new parameter - the mark-up associated with the demand elasticity - which is assumed to be equal to the effective mark-up in column 2. The first part of table 2 gives the estimated values of the coefficients for the regressors entering the models : recall that their interpretations are different in the different columns. The second part presents the test of specification. The last part gives the structural parameters computed from the reduced form parameters reported in the first part.

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12 This is the case if shocks are anticipated before the firms choices of factor inputs. See for example Griliches and Mairesse (1998) for a discussion of the « transmission bias » problem.

13 We do not consider permanent shocks, as all variables are expressed in terms of growth rates.

14 One can think that these assumptions are more appropriate for the capital variable than for labor or materials factor inputs. Indeed, it seems likely that capital is less responsive to changes in productivity and demand, as compared to labor or materials. To deal with this issue, we also estimated our models with less identifying restrictions by excluding the first lag of variable inputs from the list of instruments. The estimated parameters were not much changed although less precise. Moreover, the comparison of the test statistics allowed us to accept the bigger set of restrictions.

15 Note that the instrument set used here is entirely different from Hall's. Hall tries to find instruments uncorrelated with productivity shocks and thus focuses on the search for instruments that reflect pure demand shocks. He finally chooses the price of crude oil, military purchases and a dummy variable for the party of the president (see for example Abbott, Griliches and Hausman (1988) for a criticism of these instruments). The choice of instruments is here more difficult because demand shocks are buried in the residuals. As discussed above, this is caused by replacing real output by deflated sales. In the present study, we decide to use lagged regressors as instruments (except for the macro variable).

The first column reveals small, but statistically significant market power (1.08) and moderate decreasing returns to scale with scale elasticity around 0.95. These results are very close to the estimates of Klette (1994) for Norwegian manufacturing industries. Using a model similar to equation (10) on a panel of plant level data, he obtains significant margins between price and marginal cost in most industries, varying from 1.05 (in Textiles) to 1.09 (in Metals) and constant or moderately decreasing returns to scale. Nevertheless, the markup and the scale estimates presented by Klette or in the first column of table 2 are inconsistent, as they do not account for the bias due to the omitted price variable. Following Klette and Griliches, we showed how the true mark-up and scale elasticity can be identified by adding growth in industry output to the previous model, which we have done in the models presented in columns 2 and 3.

If we consider the last column, we can notice that the coefficient for the index of the labor and materials factors of production is statistically significant with a value similar to the estimate in column 1. The coefficient of capital is also unaffected by the introduction of the macro variable. Their interpretations are not however as straightforward as in column 1. Indeed, the first row in column 3 reveals that there is a significant difference between the effective mark-up and the mark-up computed from the demand elasticity<sup>16</sup>. Column 3 also shows that the coefficient for the industry growth variable is not significant when introduced into the model. Accordingly, the two markups and the scale elasticity are imprecisely estimated. Their values are, as expected much higher, but not statistically different from unity, implying no market power and constant returns to scale. Their strong inaccuracy is due to the fact that the mark-up from the demand elasticity is only identified through the industry variable, which is weakly correlated with the instruments. The two markups are quite precise when the identification of the demand elasticity parameter lies on the capital variable. This is the case when constant returns to scale are imposed. The effective mark-up and the mark-up from the demand elasticity are then statistically significant with respective values of 1.14 and 1.06 (see column 3). This estimate of the effective mark-up is very comparable to the findings of Martins, Scarpetta and Pilat (1996) for French manufacturing (1.16). Compared with other work on industry level data such as Hall and Roeger for the U.S. economy, the estimate here is on the low side<sup>17</sup>. Hall results reveal statistically significant margins in most manufacturing industries, but many of them appear suspiciously high with values greater than 2. This is particularly true for industries that are highly exposed to competition (in export markets and from imports in domestic markets), where we might expect that high margins would tend to be reduced by severe competition<sup>18</sup>. Roeger estimates are substantially lower than Hall estimates but still remain larger than our results. Markups range from 1.15 (in Apparel) to 2.75 (in Tobacco and Chemicals) but most of them are between 1.30 and 1.60. Roeger analysis does not incorporate materials inputs, in contrast to our study or the study of Martins and alii. This can explain his higher estimates for the markups to a large extent<sup>19</sup>.

Table 3 presents results obtained from the same three models but now extended to account for workers' bargaining power. A new variable enters the models, which permits the

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16 Note that the effective mark-up is bigger than the mark-up from the demand elasticity, whereas this latter is the one which would prevail in monopolistic competition and which should represent an upper bound. One way of explanation of this result could be found in the existence of capacity constraints.

17 Martins and alii use Roeger's procedure, a method alternative to that of Hall, for estimating markups in 36 manufacturing industries for 14 OECD countries, including France, over the 1970-1992 period. Applying reasoning similar to that of the standard Solow residual, Roeger shows that the dual Solow residual, the difference between the change in output price and an average of changes in factor prices weighted by their respective output shares, can be decomposed into a technological term and a markup factor under imperfect competition in the output market and constant returns to scale. This allows him to derive an expression for the difference of both residuals, which can be used to estimate markups. Roeger argues that his model is advantageous, as it does not rely on the use of instruments.

18 The instrumental variables used by Hall have been heavily criticised and may explain the large magnitude of his results.

19 Using value added instead of production data leads to an overestimate of the markup. See for example Norrbin (1993) or Hyde and Perloff (1995).

identification of the bargaining power coefficient. The first column reports results from model (13), while the last two columns provide results from model (14). Model (13) is a direct transposition of Hall extended macro specification on micro variables, while model (14) is a modified version in which the specificity of this type of data is explicitly taken into account.

The three models perform better in terms of the specification tests. This is particularly striking in columns 1 and 3 of table 3, where the modelling assumptions are largely accepted whereas they were just accepted in these same columns of table 2. This result shows that it is important to consider the new variable both as an additional regressor and an additional instrumental variable. Moreover, this variable is strongly significant when entering the models<sup>20</sup>. We can see that model (14) implies a significant union bargaining power of 0.26 on a scale going from 0 to 1. This result suggests that union power does affect the labor share, which is consistent with the idea that wages are set off the labor demand curve. It can also be interpreted as empirical evidence in favor of the efficient bargaining model and against the alternative right-to-manage model. With comparison to other studies with efficient bargaining, the value of the union power appears lower than the value obtained by Abowd and Allain (1996) for France (0.4) but much closer to the result found by Abowd and Lemieux (1993) for Canada (0.2). It is also in line with the study by Cahuc, Gianella, Goux and Zylberberg (1998) in which the union bargaining power is around 0.2 for France. Note however that these authors consider the case where workers bargain only over wages according to a right-to-manage model. In the present study we clearly reject the fact that the union has no influence over employment. The union has the same influence over both wages and employment, the amount of influence being of an order of 0.25.

An interesting finding is that the mark-up parameter estimate is much higher than the estimate obtained from model (11). The last column in tables 2 and 3 shows indeed that the effective mark-up increases from 1.30 to 1.60 when the model accounts for the possibility that wages are bargained off the labor demand curve. Similarly, it goes up from 1.14 to 1.55 in the restricted case of constant returns to scale. This result may appear first very surprising in so far as one could expect the price cost margin to be reduced by the union wage pressure. To understand this, we have to recall that the margin in the model (14) is not evaluated at the negotiated wages as in model (11) but at the competitive wages. It is thus natural to find a bigger price cost margin, as it embodies the part of product rents captured by unions.

Note finally that we obtain similar findings as those discussed in table 2 : the effective mark-up and the mark-up from the demand elasticity are statistically different but can not be precisely estimated unless constant returns to scale are imposed.

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20 This is not the case in the restricted model (14) where the new variable is not statistically significant (see column 2). It is probably linked to the fact that in this model we do not use the past values of the  $\Delta x$  ( $=s^L(\Delta-\Delta k)+s^M(\Delta m-\Delta k)$ ) regressor as instruments. There is however no serious reason to exclude  $\Delta x$  from the list of instruments so long as  $\Delta/k$  is included. They are both variable inputs and so may react similarly to changes in productivity and demand. But one can think that the restricted model (14) would be rejected if past values of  $\Delta x$  were included in the instruments, as it is indicated by the strong significance of the  $\Delta x$  coefficient in column 3 of table 3.



## Conclusion

Hall's major contribution was first presented as a test of perfect competition in the product market. This paper extends his work and proposes a test to price-setting behavior in both the output market and the labor market. Results strongly reject perfect competition in both markets and reveal that markups are around 1.6 and that the bargaining power is about 0.25.

We also show that ignoring imperfect competition in the labor market leads to an important underestimation in the price cost margin. In that case, the mark-up estimate is only of 1.3. This is due to the fact that the part of the product rents captured by workers is not taken into account.

This work is a first attempt to measure both markups and the bargaining power. It makes use of a large sample but not large enough to examine the important issue of heterogeneity in these two parameters. In particular, it would be interesting to study the heterogeneity among industries and also to test whether higher bargaining power parameters are associated with higher markups. Further work has to be done to address these questions.

Our framework leads us to estimate both the effective mark-up and the mark-up derived from demand elasticity. This latter is the monopoly mark-up and thus should be an upper bound. Surprisingly, we find this parameter to be significantly lower than the effective mark-up. This result calls for further work. One way of explaining it lays in the existence of capacity constraints. In that case, firms can rise their price above the monopoly price. Addressing this issue requires, however, specific data on firms capacity utilization as those, for example, collected in the French business surveys.



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## Appendix A : Explicit consideration of labor market imperfection

In this appendix a simple model illustrates the relationship derived in equation (12). This model is what Brown and Ashenfelter (1986) called the strongly efficient bargaining model. But, the basic models can be found in MacDonald and Solow (1981).

In this model, there is a rent-maximizing union with the objective function  $Lw + (\bar{L} - L)\bar{w}$ , in which  $\bar{L}$  is the membership of the union,  $L$  is employment,  $w$  is the negotiated wage, and  $\bar{w}$  is the alternative market wage. The union bargains with a profit maximizing firm. Its profits are equal to  $\Pi = R - wL - rK - vM$ , where  $R=PQ$  stands for total revenue,  $P$  is the output price,  $Q$  the output,  $K$  the capital stock,  $M$  the materials,  $r$  the capital rental costs and  $v$  the price of materials. To simplify we consider the case in which labor is the only variable input for the firm. But we can show that this assumption on the fixed nature of inputs other than labor does not affect the bargaining solution, provided that union preferences are not dependent on those inputs (see Bughin, 1992 and 1996). The firm and the union bargain over both wages and employment. Their threat points are, respectively, the value of fixed costs and the value of the time of the union workers evaluated at the alternative wage  $\bar{L}\bar{w}$ . The Nash solution to this bargaining problem is obtained by solving the following program:

$$\max_{w,L} [Lw + (\bar{L} - L)\bar{w} - \bar{L}\bar{w}]^q [R - wL]^{1-q}$$

where  $\theta$  represents the union's bargaining power ( $q \in [0,1]$ ). Solving for employment gives an equation of the form:

$$w = R_L + \frac{q}{1-q} \frac{R - wL}{L} \Leftrightarrow w = R_L + q \frac{R - R_L L}{L}$$

where  $R_L$  is the marginal revenue of labor. This equation shows the extent to which *the bargaining solution is off the labor demand curve*. Note that it depends on the bargaining power of the union. Defining the  $\mu$  parameter as the inverse of the elasticity of revenue with respect to output that is  $\mu = (R_Q Q / R)^{-1}$  with  $R_Q$  the marginal revenue, we have  $R_L = PQ_L / \mu$  with  $Q_L$  the marginal product of labor which leads to the following efficient bargaining labor share :

$$s^L = q + (1-q) \frac{\epsilon^{QL}}{\mu}$$

where  $s^L$  is the equilibrium labor share and  $\epsilon^{QL}$  the labor elasticity of output.

In this framework, we can show that the  $\mu$  parameter can be interpreted as a price cost margin evaluated at the alternative wage  $\bar{w}$ .

To see this, consider the following relation :

$$R_L = \bar{w}$$

which is obtained by combining the first order conditions related to employment and wages from the bargaining problem. This equation implies that employment depends on the alternative wage  $\bar{w}$ , but not on the negotiated wage  $w$ . Accordingly, the optimal labor and the optimal output correspond to their competitive levels respectively denoted as  $\bar{L}$  and  $\bar{Q} = F(\bar{L})$  with  $F(\cdot)$  the firm production function. Making use of the fact that  $R_L = R_Q F_L$  and that  $\mu = (R_Q Q / R)^{-1}$ , we can rewrite the previous equation as :

$$\frac{P}{\mu} = \frac{\bar{w}}{F_L(\bar{L})}$$

Consider now the cost function of the firm :  $C(Q, w) = wL = wF^{-1}(Q)$ . It follows immediately that the marginal cost equals to :  $C_Q(Q, w) = \frac{w}{F_L(L)}$ . Evaluating this function at the competitive levels of output and wages, we have  $C_Q(\bar{Q}, \bar{w}) = \frac{\bar{w}}{F_L(\bar{L})}$  which leads to :

$$\mu = \frac{P}{C_Q(\bar{Q}, \bar{w})}$$

This relation means that the  $\mu$  parameter can be defined as the ratio between price and marginal cost but with marginal cost evaluated at the competitive wage  $\bar{w}$ .

To obtain this result, we consider the case in which labor is the only input in production. Nevertheless, it is possible to generalize it to the case of several factor inputs. Marginal costs are then evaluated at the competitive factor prices. We also assume risk neutrality of the union. In the case of a risk adverse union, we can show that the  $\mu$  parameter can be interpreted as a price cost margin evaluated at the wages on the labor demand curve at the level of efficient labor. These wages are however lower than the competitive wages, as the efficient labor is higher than its competitive level.

## Appendix B: Method of estimation

### *Estimation and tests : the $\mathbf{P}$ matrix and the correlation between perturbations and regressors*

Our models can be written under the more general form :

$$y_{it} = \sum_k x_{it}^k b_k + w_{it} \quad \forall i = 1, \dots, N, \quad \forall t = 1, \dots, T$$

where  $y$  denotes the Solow residual and  $x$  a vector including the regressors in equations (10), (11), (13) or (14)<sup>21</sup>.

Since all the regressors in our models are likely to be correlated with errors, traditional methods like OLS may lead to biased estimators. To take into account the endogeneity of the right-hand variables, we use the Chamberlain  $\Pi$  matrix framework (Chamberlain 1982 and 1984, see also Crépon and Mairesse 1995 for a synthesis). It amounts to parameterize the covariance between the regressors and the disturbances with nuisance parameters, accordingly with the assumptions that have been made, and to express the  $\Pi$  matrix (the total set of coefficients of the regressions of the dependent variable performed for each year on the set of past, present and future values of the explanatory variables) in terms of these additional parameters and the parameters of interest. If we define  $\underline{y}_i' = (y_{i1}, \dots, y_{iT})$ ,  $\underline{x}_i' = (x_{i1}^{(1)}, \dots, x_{iT}^{(1)}, \dots, x_{i1}^{(K)}, \dots, x_{iT}^{(K)})$ ,  $\underline{w}_i' = (w_{i1}, \dots, w_{iT})$ , we can also write :

$$\underline{y}_i = \mathbf{M}(\underline{b})\underline{x}_i + \underline{w}_i \quad \forall i = 1, \dots, N$$

$$\text{where } \mathbf{M}(\underline{b}) = \underline{b}' \otimes \mathbf{I}_T \text{ and } \underline{b}' = (b_1, \dots, b_K).$$

which can be rewritten as :

$$\Pi = \mathbf{M}(\underline{b}) + \Phi \mathbf{E}(\underline{x}_i \underline{x}_i')^{-1}$$

where  $\Pi$  is the chamberlain matrix :  $\Pi = \mathbf{E}(\underline{y}_i \underline{x}_i') \mathbf{E}(\underline{x}_i \underline{x}_i')^{-1}$ , and  $\Phi$  is the covariance matrix of the perturbations and the variables  $\Phi = \mathbf{E}(\underline{w}_i \underline{x}_i')$ .

The modelling assumptions about the correlations of the errors with the explanatory variables impose some restrictions on the  $\Phi$  matrix :  $\Phi = \Phi(\underline{\beta})$ , where  $\underline{\beta}$  is a set of nuisance parameters, and imply the following set of relations between the moments of the variables  $\Pi$  and  $\mathbf{E}(\underline{x}_i \underline{x}_i')^{-1}$  and the unknown parameters  $\underline{b}$  (parameters of interest) and  $\underline{\beta}$  (nuisance parameters) :

$$\Pi = \mathbf{M}(\underline{b}) + \Phi(\underline{\beta}) \mathbf{E}(\underline{x}_i \underline{x}_i')^{-1}$$

Various specifications for the disturbances are possible. Each of them correspond to a particular parameterization of the  $\Phi$  matrix. For example, we can assume that errors and regressors are totally uncorrelated that is  $\Phi = 0$ . We can also consider that current shocks are uncorrelated with only past values of the regressors. In this latter case, it is easy to see that  $\Phi$  is a repeated upper triangular matrix which can be parametrized by  $KT(T+1)/2$  parameters. In fact, any kind of correlation between errors and regressors can be considered provided there is room for identification.

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<sup>21</sup> All variables are measured as deviations from their total averages.

The Chamberlain method uses the restrictions on the moments of the variables to estimate the parameters of the model ( $\underline{b}$  and  $\underline{\beta}$ ), using Minimum Distance or Asymptotic Least Squares (ALS) estimators. These restrictions can be rewritten in a vectorial form as:

$$\underline{\pi} = \mathbf{H}(\underline{m})\underline{\delta} \text{ where } \underline{\pi} = \text{vec}(\Pi'), \underline{m} = \text{vec}(E(\underline{x}_i \underline{x}_i')), \text{ and } \underline{\delta}' = (\underline{b}', \underline{\beta}')$$

$$\Leftrightarrow \mathbf{g}(\underline{\delta}, \underline{\gamma}) = \underline{\pi} - \mathbf{H}(\underline{m})\underline{\delta} = 0 \text{ where } \underline{\gamma}' = (\underline{\pi}', \underline{m}')$$

The principle of estimation is to minimize a weighted quadratic sum of the g's with respect to  $\underline{\delta}$  :

$$\hat{\underline{\delta}} = \arg \min_{\underline{\delta}} \{ \text{Obj}(\underline{\delta}, \mathbf{W}) = \mathbf{g}(\underline{\delta}, \hat{\underline{\gamma}})' \mathbf{W}^{-1} \mathbf{g}(\underline{\delta}, \hat{\underline{\gamma}}) \}$$

where  $\hat{\underline{\gamma}}$  is a consistent and asymptotically normal estimator of the auxiliary parameters  $\underline{\gamma}$

and  $\mathbf{W} = \mathbf{V}_{\text{as}}(\mathbf{g}(\hat{\underline{\delta}}, \hat{\underline{\gamma}})) = \frac{\partial \mathbf{g}(\hat{\underline{\delta}}, \hat{\underline{\gamma}})}{\partial \underline{\gamma}'} \mathbf{V}_{\text{as}}(\hat{\underline{\gamma}}) \frac{\partial \mathbf{g}(\hat{\underline{\delta}}, \hat{\underline{\gamma}})'}{\partial \underline{\gamma}}$ . Since the optimal weight matrix  $\mathbf{W}$

is unknown because it is a function of the parameters  $\underline{\delta}$ , the optimal ALS estimator  $\hat{\underline{\delta}}$  must be implemented in two steps. We first compute, in a first step, a consistent estimator  $\hat{\mathbf{W}}$  based on a ALS estimator with an arbitrary weight matrix which is then used to derive, in a second step, the optimal estimator  $\hat{\underline{\delta}}$  :

$$\hat{\underline{\delta}} = \left[ \mathbf{H}(\hat{\underline{m}})' \hat{\mathbf{W}}^{-1} \mathbf{H}(\hat{\underline{m}}) \right]^{-1} \mathbf{H}(\hat{\underline{m}})' \hat{\mathbf{W}}^{-1} \hat{\underline{\pi}} \text{ and } \hat{\mathbf{V}}_{\text{as}}(\hat{\underline{\delta}}) = \mathbf{H}(\hat{\underline{m}})' \hat{\mathbf{W}}^{-1} \mathbf{H}(\hat{\underline{m}})$$

A specification test of the model can be implemented, by using the objective function of the optimal ALS as a test statistic. More precisely, under the null hypothesis that  $\mathbf{g}(\underline{\delta}, \underline{\gamma}) = 0$ , it can be shown that  $\text{NObj}(\hat{\underline{\delta}}, \hat{\mathbf{W}}) \rightarrow \chi^2(n_g - n_{\underline{\delta}})$  where  $n_g$  is the number of estimating equations  $\mathbf{g}$  and  $n_{\underline{\delta}}$  is the dimension of the parameters of interest.

#### **Getting back to the structural parameters**

We use the *Slutsky Theorem* to work back to the structural parameters and their standard errors. We have :

$$\sqrt{N}(\mathbf{g}(\hat{\underline{b}}) - \mathbf{g}(\underline{b})) \rightarrow \mathbf{N} \left[ 0, \frac{\partial \mathbf{g}}{\partial \underline{b}'}(\underline{b}) \mathbf{V}_{\text{as}}(\hat{\underline{b}}) \frac{\partial \mathbf{g}'}{\partial \underline{b}}(\underline{b}) \right]$$

where  $\hat{\underline{b}}$  is the two-step Asymptotic Least Square estimator and :

$$\mathbf{g}(\underline{b}) = (\mu \quad \lambda \quad \theta \quad \mu_{\eta})' = \left[ (1 + b_1)/(1 - b_4) \quad (1 + b_2)/(1 - b_4) \quad b_3/(1 + b_1 + b_3) \quad 1/(1 - b_4) \right]'$$

in the case of the model (14). All the parameters are replaced by their ALS estimates.

**Table 1 : Simple statistics on the main variables, 1986-92, 1026 firms**

Variable	Name	Mean	Standard-deviations	Min	Max
Production <sup>a</sup>	$y$	0.028	0.203	-4.027	4.049
Solow residual <sup>a</sup>	SR	0.002	0.082	-1.337	1.467
Labor <sup>a</sup>	$\Delta l$	-0.002	0.151	-3.526	3.466
Capital <sup>a</sup>	$\Delta k$	0.039	0.208	-5.632	5.511
Intermediate factors <sup>a</sup>	$\Delta m$	0.037	0.248	-4.641	4.645
Labor share <sup>b</sup>	$s^L$	0.267	0.131	0.009	0.974
Materials' share <sup>b</sup>	$s^M$	0.613	0.147	0.013	0.988

<sup>a</sup> Annual growth rates

<sup>b</sup> Factor shares in the value of the production

**Table 2 : Markups and scale elasticity estimates**

Model	Basic model		Augmented models			
	(10)		(11) with $\mu=\mu_\eta$		(11)	
Reduced form parameters						
Index of labor and materials	0.08		-		0.08	
$\Delta x$	(0.02)				(0.02)	
Capital	-0.05		-0.09		-0.05	
$\Delta k$	(0.02)		(0.01)		(0.02)	
Industry output	-		0.32		0.17	
$\Delta q_t$			(0.22)		(0.11)	
Specification tests						
Statistic	41.2		10.5		38.7	
Degrees of freedom	28		13		27	
P-value	0.05		0.66		0.07	
Structural parameters : $\mu, \mu_\eta$ et $\lambda$						
	(U)	(R)	(U)	(R)	(U)	(R)
Effective mark-up	1.08	1.14	1.47	1.09	1.30	1.14
$\mu$	(0.02)	(0.02)	(0.47)	(0.02)	(0.17)	(0.02)
Markup from demand elasticity $\mu_\eta$	-	-	1.47	1.09	1.20	1.06
			(0.47)	(0.02)	(0.15)	(0.02)
Scale elasticity	0.95	1	1.34	1	1.14	1
$\lambda$	(0.02)		(0.43)		(0.15)	

**Notes :**

The reported results are Chamberlain coefficients. Numbers in parentheses are standard errors. The « instruments » include past values of  $\Delta x$  and  $\Delta k$  in models (10) and (11) and only past values of  $\Delta k$  in model (11) when  $\mu=\mu_\eta$ .

We denote (U) the unrestricted case in which returns to scale are estimated and (C) the restricted case where constant returns to scale are imposed.

We define  $\Delta x_{it} = s_{it}^L (\Delta l_{it} - \Delta k_{it}) + s_{it}^M (\Delta m_{it} - \Delta k_{it})$ .

Recall that :

model (10) is :

$$SR_{it} = (\mu - 1)\Delta x_{it} + (\lambda - 1)\Delta k_{it} + \Delta a_{it}$$

model (11) with  $\mu=\mu_\eta$  is :

$$SR_{it} = 0\Delta x_{it} + \left(\frac{\lambda}{\mu^\eta} - 1\right)\Delta k_{it} + \frac{\mu^\eta - 1}{\mu^\eta}\Delta q_{it} + \Delta v_{it}$$

and finally model (11) is :

$$SR_{it} = \left(\frac{\mu}{\mu^\eta} - 1\right)\Delta x_{it} + \left(\frac{\lambda}{\mu^\eta} - 1\right)\Delta k_{it} + \frac{\mu^\eta - 1}{\mu^\eta}\Delta q_{it} + \Delta v_{it}$$

**Table 3 : Markups, scale elasticity and workers' bargaining power estimates**

Model	Basic model		Augmented models			
	(13)		(14) with $\mu=\mu_\eta$		(14)	
	Reduced form parameters					
Index of labor and materials $\Delta x$	0.27 (0.04)		-		0.25 (0.04)	
Capital $\Delta k$	-0.19 (0.02)		-0.15 (0.05)		-0.19 (0.02)	
Labor per capital $\Delta l/k$	0.47 (0.07)		0.10 (0.08)		0.44 (0.07)	
Industry output $\Delta q_t$	-		0.42 (0.16)		0.22 (0.10)	
	Specification tests					
Statistic	48.2		20.0		45.3	
Degrees of freedom	42		27		41	
P-value	0.24		0.83		0.30	
	Structural parameters : $\mu, \mu_\eta, \lambda$ et $\theta$					
	(U)	(R)	(U)	(R)	(U)	(R)
Effective mark-up $\mu$	1.27 (0.04)	1.14 (0.03)	1.72 (0.47)	1.20 (0.09)	1.60 (0.21)	1.55 (0.07)
Markup from demand elasticity $\mu_\eta$	-	-	1.72 (0.47)	1.20 (0.09)	1.28 (0.17)	1.23 (0.03)
Scale elasticity $\lambda$	0.81 (0.02)	1	1.45 (0.40)	1	1.04 (0.15)	1
Workers' bargaining power $\theta$	0.27 (0.03)	0.07 (0.01)	0.09 (0.07)	0.10 (0.07)	0.26 (0.03)	0.26 (0.03)

Notes :

The reported results are Chamberlain coefficients. Numbers in parentheses are standard errors. The « instruments » include past values of  $\Delta x$ ,  $\Delta k$  and  $\Delta l/k$  in models (13) and (14) and only past values of  $\Delta k$  and  $\Delta l/k$  in model (14) when  $\mu=\mu_\eta$ .

We denote (U) the unrestricted case in which returns to scale are estimated and (R) the restricted case where constant returns to scale are imposed.

We have  $\Delta x_{it} = s_{it}^L(\Delta l_{it} - \Delta k_{it}) + s_{it}^M(\Delta m_{it} - \Delta k_{it})$  and  $\Delta l / k_{it} = (s_{it}^L - 1)(\Delta l_{it} - \Delta k_{it})$ .

Recall that model (13) is :

$$SR_{it} = (\mu - 1)\Delta x_{it} + (\lambda - 1)\Delta k_{it} + \mu \frac{\theta}{1 - \theta} \Delta l / k_{it} + \Delta a_{it}$$

model (14) with  $\mu=\mu_\eta$  is :

$$SR_{it} = 0\Delta x_{it} + \left(\frac{\lambda}{\mu^\eta} - 1\right)\Delta k_{it} + \frac{\theta}{1 - \theta} \Delta l / k_{it} + \frac{\mu^\eta - 1}{\mu^\eta} \Delta q_{it} + \Delta v_{it}$$

and finally model (14) is :

$$SR_{it} = \left(\frac{\mu}{\mu^\eta} - 1\right)\Delta x_{it} + \left(\frac{\lambda}{\mu^\eta} - 1\right)\Delta k_{it} + \frac{\mu}{\mu^\eta} \frac{\theta}{1 - \theta} \Delta l / k_{it} + \frac{\mu^\eta - 1}{\mu^\eta} \Delta q_{it} + \Delta v_{it}$$

