



**TESTING OLIGOPOLISTIC BEHAVIOR WITHIN
AN EFFICIENT WAGE BARGAINING MODEL**

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Discussion Paper n° 9104

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D/1991/3082/04

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MAY 1991

This paper is devoted to the set up of a conjectural elasticity model with efficient bargaining wages between oligopolistic firms and rent-maximizing unions. Based on a production function approach with first-order conditions for factor employment, the model is able to distinguish between output market power and unions market bargaining strength in extracting firms' actual surplus. The analysis is conducted at the firm level for four Belgian manufacturing sectors. Conclusions appear to confirm that - *if any* - firm market power tends to be eroded by wages rents, but always with asymmetric power in favor of the firm. Market power is also such that it is mainly distributed to the highest market share firms within the industry.

* This paper is part of the IRES Research Programme on price and wage formation. Financial support by the Fonds de Développement Scientifique (FDS) is acknowledged. My regards go especially to F.Fecher for providing me the data used in the empirical analysis. I also benefited from several and challenging discussions with D. de la Croix, H. Entorf, Ch. Huveneers, H. Sneessens, X.Wauthy, D.Weiserbs and H.Yamawaki. Any caveat remains however my sole responsibility. Computer assistance was also provided at FUNDP.

1. INTRODUCTION

Recent work in industrial organisation has popularized the conjectural approach as to test for price-taking behavior (see e.g. APPELBAUM [1979; 1982], or ROBERTS [1984]).

While many studies have developed empirical models based on this idea, applications have considered price-taking behavior only in the output market. In contrast, only one -to our knowledge- (SCHROETER [1988]¹) has considered the possibility of imperfections in both the output *and* factor markets. This seems however a natural extension due to the possibility that input prices (and particularly labor) are not priced competitively.

This paper is purposively devoted to the estimation of a conjectural-elasticity model which does not rely on the standard practice in the industrial organization approach that *wages are predetermined*.

Specifically, we adopt here the idea, confirmed by empirical labor market studies (see SVEJNAR [1986]², or MACURDY and PENCARVEL [1986]), that wages originate from a (bilateral) *efficient bargaining* between firms and unions³.

Within such a setting that requires parties to stick to an efficient contract, firm reaction *on* the labor demand curve is no longer valid so that the bargained wage may diverge from the marginal revenue product of labor. Estimation of output market power may well be biased, thus, when one implicitly imposes that the input decisions are unilaterally set up by firms.

The proposed framework uses a production function approach which allows to *measure* the degree of market power in both the output and labor markets. The main assumption for market power identification is that unions are rent-maximizing.

Specifically - and assuming positive marginal products- *output market power becomes apparent* in the first-order conditions associated with factor employment

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1. SCHROETER [1988] considers the possibility of oligopolistically purchased intermediary goods.
 2. We quote namely SVEJNAR (p. 1075): "The econometric results also indicate that, within the expected utility framework, (...) one cannot accept the traditional proposition that the bargaining solution lies on the marginal revenue product curve of labor".
 3. Bilateral monopoly relations between suppliers and buyers are especially common in the labor market and may result from investments in specific human capital, hiring costs, legal barriers, (see WOLINSKI and HORN [1988] on that point).

when marginal product of each input is larger than the ratio of the shadow price of each input to the observed market price.

On the other hand, *labor market power by the union becomes present when marginal revenue product of labor is lower than its observed price* (that is, unions have some power to extract a part of the non-competitive profit which would arise should employment lie *on* the firm's labor demand curve).

Among other notable characteristics of our approach, we quote again :

- 1° As in recent tests for price-taking behavior in the output market, the equilibrium concept used allows for conjectural variation *asymetries* following in essence the 'STACKELBERG-like' idea ⁴ that the greatest-size firms are more able to appropriate the extra profits, while the smallest being mostly close to price-takers.
- 2° To insure that parametric tests of market power are not greatly cautioned by the restrictive form of the technology adopted in the empirical analysis, the model uses the transcendental logarithmic ⁵ production, which is well known for its high generality and flexibility ⁶.
- 3° The study uses pooled time series and cross-section data *at the firm level, and not at the industry level*. This *not only* prevents one to make additional assumptions for save aggregation such that the conjectural elasticities ⁷ are the same for each firm in the industry (see APPELBAUM [1979]). This *also* leaves one with the important problem of the *legitimacy* of aggregating firm production function, even at the industry level.⁸

The paper reads as follows :

Section 2 presents the theoretical framework, Section 3 presents the empirical model and the results based on an application on four Belgian manufacturing sectors. Conclusions stated in Section 4 confirm alternative evidence based on accounting price-cost margins (DOWRICK[1990]) that *observed LERNER* indices tend *indeed* to be eroded by wage rents.

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4. In fact, the STACKELBERG leader-follower model amounts to arguing that small firms act as if they express *Nash* conjectures, not conjectures which would lead them to being *pure price-takers*.
 5. HENCEFORTH, translog.
 6. Refer however to WEISERBS and KUSONDISA [1983] who emphasize that the translog remains only a particular case of the generalized quadratic function of β order early introduced by DENNY [1974].
 7. That is, conjectural variation of the firm multiplied by its market share.
 8. See e.g. CARDELLICHO [1990] for a useful survey of this existence controversy.

2. WAGE PRESSURE ON OUTPUT MARKET POWER

2.1. General premises

The recent literature on employment contracts between unions and management has emphasized that it is in the parties' interests to produce arrangements that lead to efficient contracts (HALL and LILIEN [1979]; McDONALD and SOLOW [1981]; SVEJNAR [1982], [1986]).

In essence, the literature has shown that points on the labor demand are likely to be inefficient since it is always possible to define a Pareto-improving bargain as long as the unions set some value on jobs.

But if bargaining moves off the labor demand curve, it is also expected that the price-cost margin should be lowered by wage rents because any efficient bargain constrains the firm to setting a price compatible with contracted employment.

Consequently, one may conjecture that testing for output market power *with the implicit assumption that wages have no direct influence on a firm's price-cost margin* should be misleading if wages are contractually set up by unions together with employment, *and* employment enters positively in union's preference.

2.2. The bargaining model

2.2.1. The goods market

To illustrate, let us consider a firm which produces a non-differentiated good in an oligopolistic industry. There is a uniform price and the firm chooses output taking into account the effects of its production on prices, and the quantities chosen by the other firms.

The firm has a production function given by :

$$[1]: \quad q = f(L, S)$$

where q stands for its own production; L , for employment and S , for a vector of other inputs associated with production.

The firm maximises its profit, Π :

$$[2]: \quad \Pi = P(Q) q - W L - H$$

where Q is *industry* output and H are the total costs incurred by employing the quantities S of other inputs.

We also note the following identity :

$$[3]: \quad R = P q = P f(L, S)$$

where R is firm's revenue.

The firm reaction function is :

$$[4]: \quad \delta \Pi / \delta q = 0$$

that is, assuming Cournotian conjectural variations for all firms (see g. Makowski [1987]⁹):

$$[5]: \quad P + [\delta P / \delta Q] q = MC$$

with MC standing for marginal (variable) costs.

[5] shows us that the firm price-cost margin, m , is given by:

$$[6]: \quad (P - MC) / P = -[\delta P / \delta Q] [q / P] = -EPq [q / Q] = m$$

where EPq is the (absolute of) the elasticity of industry price with respect to firm output, and is equal to (the absolute of) the price-elasticity of industry output, EPQ , because of Cournotian conjectures.

Accordingly, the proposition arises in this simple model that divergence in price-cost margin across firms belonging to the same industry are *only* to be related to differences in market shares, q/Q .

9. Cournot conjectures are often criticized as being not rational. Recent works argue however they are at least as rational as other conjectural variations. We quote MAKOWSKI [1987; p. 47] : "*The admitted irrational Cournot conjectures, seem at least as rational as [rational] conjectures, at least as reasonable as [reasonable] conjectures, and a lot simpler than either of these fancy conjectures*". In the following, we do not intend to enter this debate as in the empirical analysis, conjectural parameters cannot be identified with the data at hand.

This proposition could be relaxed by assuming divergence among firms concerning their respective conjectural variations about their rivals output responses. In what follows, we will take an alternative way by investigating another cause of divergence in price-cost margin, that is, *the effect of union bargain over employment*.

2.2.2. Efficient bargaining with employment as sole variable input

For clear insight, we concentrate first on a short-run situation with the vector S considered as exogenous. Within such a framework, H in equation [2], represents fixed costs for the firm, while employment is the sole variable input.

In the labor market, trade unions and management are both involved in an efficient contract bargaining situation, which concerns the simultaneous setting of employment and wages. The crucial idea here is that *even though employment is not explicitly specified in contracts, it is implicitly argued that the firm makes an agreement on a contract curve* instead of choosing unilaterally a point on labor demand¹⁰.

The utility functions

Let both parties maximize their respective utility function during the bargaining process. On one hand, union utility $U(W, L)$ depends on both wages and employment, and is specified as¹¹:

$$[7]: \quad U = L \cdot \frac{([W]^\varepsilon - [W^*]^\varepsilon)}{\varepsilon}$$

10. Refer to CLARK [1984], especially when he argues that there is a variety of instruments (such as work practices and compensation rules) that effectively constrain production adjustment by the firm without involving an explicit agreement on the number of workers or on the total hours worked.

11. The utility function could be generalized to more complicated cases, such as the form:

$$U = L \cdot \frac{([W]^\mu - [\alpha \cdot W^*]^\mu)}{\mu} \quad (\mu, \varepsilon, \alpha, \rho = >0)$$

given in BEAN and TURNBULL [1988]. The utility form we have chosen is taken as simple as possible as our main objective remains to provide a clear understanding of the impact of bargain over employment on the observed firm LERNER index. More complicated utility forms simply make the analytics less tractable, while utility form like

where the symbol W^* represents the threat point and ϵ is a risk aversion parameter [with $\epsilon \leq 1$ if one rejects the possibility of risk-loving behavior by the union].

On the other hand, the firm's utility (which is denoted by $V(W, L)$) is assumed to equate its profit function [so that firm is postulated risk-neutral] :

$$[8]: \quad V = R(L) - W L - H$$

with $R''(L) < 0$.

The equilibrium solution

As a bargaining solution, we will use the traditional asymmetric Nash bargaining solution.

The Nash solution is not only justified axiomatically. Also, it can be supported as the equilibrium result from a dynamic strategic approach to bargaining provided that both parties involved in the negotiation react quickly to each other's proposal during the game (see BINMORE et alii [1986]).

Let the vector λ be defined by $(\omega, 1-\omega)$, where ω ($0 < \omega < 1$) is the bargaining strength of the trade union and $1-\omega$ is the power of the management.

The outcome of the bargaining, which is denoted by $\max g$, is then given by ¹² :

$$[9]: \quad \max g : [U - U']^{\omega} \cdot [V - V']^{1-\omega}$$

where U, V are defined respectively by [7] and [8], and U' and V' are the respective *fall-back utility* levels (or '*statu-quo*' points) for the union and the firm.

Let us assume no distinction between the union threat-point and its fall-back utility level, which mainly means that no income fund exists during a strike; we may then proxy $U - U'$ by U (for L large). Should one consider that the fall-back utility of the firm is $-H$, that is, breakdown in negotiation entails the firm to get no revenue yet it has to pay for its fixed inputs, equation [9] reads :

[7] are clearly representative of the unions and bargaining literatures (see e.g. ROSEN [1969], CLARK [1984], VEUGELERS [1989] or HOEL [1990]).

12. The formulation implicitly assumes that labor is in sufficient supply. There is some reasons to believe that, in most of the cases, the union will be strong enough to imply an equilibrium wage such that labor demand is not greater than labor supply, since excess-labor demand makes the firm lose market opportunities.

$$[10]: \max_{W,L} g = [L \cdot \left(\frac{[W^\epsilon] - [W^*]^\epsilon}{\epsilon} \right)]^\omega \cdot [R(L) - W \cdot L]^{1-\omega}$$

under the constraint of the firm's threat point, that is :

$$[11]: V = > 0$$

that we assume fulfilled by now (if not otherwise explicitly stated).

Differencing [10] with respect to L and W and setting the derivatives equal to zero a solution (L°, W°) will occur, which will depend on each party's bargaining strength, the firm's price-cost margin, and the risk-aversion parameter, ϵ .

Specifically, the *contract curve* which results from the tangency between iso-profit curves with union indifference curves is given by the expression (with $R'(L)$ denoting partial derivative of revenue with respect to labor) :

$$[12]: \frac{([W^\epsilon] - [W^*]^\epsilon)}{\epsilon} = [W - R'(L^\circ) \cdot W^{(\epsilon-1)}]$$

and efficient bargained wage is such that

$$[13]: ([W^\epsilon] - [W^*]^\epsilon) = [\omega \cdot \epsilon / (1-\omega)] \cdot [W^{(\epsilon-1)}] \cdot [R - W L] / L$$

which depends indeed of ϵ , λ and 'short-run' profit $R - W L$.

The case of risk-neutral workers

Moreover, by inspecting [12] and [13] more closely, one will check that the problem of finding the bargained solution for L and W is greatly simplified by assuming risk-neutrality of unions in [7].

Setting $\epsilon = 1$ implies that we are on a vertical contract curve in the plan (W,L) so that L° is given, and marginal revenue product of labor matches exactly the threat-point utility W^* . In such a case, the bargain is said '*strongly efficient*' (BROWN and ASHENFELTER [1986]).

In this particular case, thus, which amounts to defining the union objective as a rent-maximization behavior, the contract wage W° results from the first-order :

$$[14]: \quad \delta Lng / \delta \ln W = 0$$

that is :

$$[15]: \quad \delta [\omega \ln(L \cdot [W - W^*]) + (1 - \omega) \ln [R - W \cdot L]] / \delta \ln W = 0$$

or:

$$[16]: \quad W^\circ = R'(L^\circ) + \omega \cdot [V^\circ / L^\circ]$$

with the emphasized particularity that W^* *equals the marginal revenue product of labor* (see Svejnar [1986])¹³, L is set to L° and V° is the short-run profit level *evaluated at W^** .

[16] is a central result since it states that both neutral unions and firm's workers receive a rent from bargaining, which stands for a premium over the marginal revenue and depends on union power, ω .

This premium is defined as a portion of the price-cost margin *which would be set by a profit-maximising firm facing an exogenously determined wage equal to $R'(L^\circ)$* . This is shown easily by rewriting [8] as :

$$[17]: \quad W^\circ = W^* + \omega \cdot [R'(L^\circ) - R'(L^\circ) \cdot L^\circ / R(L^\circ)] \cdot [R(L^\circ) / L^\circ]$$

that is :

$$[18]: \quad W^\circ = W^* + \omega \cdot m \cdot [R(L^\circ) / L^\circ]$$

13. The fact that W^* equals the marginal revenue product of labor is naturally explained by checking that a value $\omega=0$ implies that the firm can impose its own interest and will choose a point on its labor demand curve.

where m has been defined earlier by equation [6] and stands for the price-cost margin that arises if *wages are pre-determined at the level of efficient employment*.

Note that the present formulation [18] is interesting for various reasons as it states two straightforward propositions:

Proposition 1: - *before negotiations unions can expect increase their members' wage above marginal product of labor in the case they have some bargaining power and there is a rent, m , to extract from the firm. Without such a rent, even powerful unions are indeed not able to increase wages above marginal product.*

Proposition 2: - *observed profitability of firms (m^*) underestimates the actual extent of oligopoly profits (m) in industries where unions care about employment and wages are contracted within the set-up of an efficient bargaining framework. Simple manipulations of [10] yield indeed that the *observed* price-cost margin, m^* , is linked to m by ¹⁴:*

$$[19]: \quad m^* = (1-\omega) \cdot m$$

Propositions 1 and 2 are important as they compactly state that imperfections in *both* the output and input markets are important for assessing the nature of competition in each particular market¹⁵: *wage rents depends on the price competition existing in the output market (reflected by m), while price-cost margin can be eroded by wage rents (reflected by ω).*

14. Define the price-cost margin m^* which results from the efficient bargain (W°, L°):

$$m^* = R(L^\circ) - W^\circ \cdot L^\circ / R(L^\circ, C) \quad [a]$$

It is straightforward to see that $m^* \leq m$ given that (see DOWRICK [1990]):

$$m^* = m - [L^\circ / R(L^\circ)] \cdot [W^\circ - R'(L^\circ)] \quad [b]$$

or, inserting [16] from the main text in (b),

$$m^* = m - [L^\circ / R(L^\circ)] \cdot \omega \cdot m \cdot [R(L^\circ) / L^\circ] \quad [c]$$

that is :

$$m^* = m \cdot (1-\omega) \quad [d]$$

to compare with [19] above, in the main text.

15. Formula [19] also reveals to us that with risk-neutral workers, bargaining power leads to efficient contracts which only erode price-cost margins, *without changing employment, output and price decisions*. That is, *efficient contracting with risk-neutral parties implies that bargaining simply divides the wealth*.

With respect to proposition 2, again, one is in face with sound theoretical grounds to understand *how price-cost margins can be directly affected by unions* (see ARNSPERGER and DE LA CROIX [1990a]). *Even under identical union utility form*, thus, divergence in observed price-cost margin across firms may still result from divergence in union bargaining strength, ω .

Keep in mind that both formulas [18] and [19] are subject to the constraint of the firm's threat point (see [11]). Intuitively, one feels that, *ceteris paribus*, the higher the fixed costs, the more probable the shadow value associated with the constraint [11] is becoming positive. Hence, with exogenous fixed costs, ω is likely to depend on the proportion of fixed costs in firm total expenses, because the leverage effect likely makes the firm more aggressive in wage negotiations.

Of course, one may argue that [11] is always verified if the firm has the possibility of choosing its level of other inputs, *after* the negotiation has been made over wages and employment. In that case, the fall back utility is not longer lower than the outside option, but unions in the negotiation have now to integrate a new 'threat' given by the possibility the firm has to substitute among inputs.

The generalization to more than one variable inputs is now deeper discussed.

2.2.3. *Efficient bargaining with flexible inputs*

A priori, when one allows for other flexible inputs, the two main changes in the discussion above, are *first* that the margin definition is to be reinterpreted accordingly, that is, the margin is no more defined on the sole labor variable, but is defined on *all* these variable inputs. The second change results in the possible impact of inputs substitution on the wage bill extraction by unions.

This impact is explicitly derived in ARNSPERGER and DE LA CROIX [1990a] in a model of monopolistic competition, with efficient wage bargaining and capital-labor substitution. We ask the interested reader to refer extensively to that paper for the analytical results, since we will here simply explain unformally the actual consequence of input substitutions on the efficient bargaining outcome.

To keep the things simple, assume that substitution is possible between capital and labor¹⁶. Bargaining occurs between firms and unions over both wages and employment, taking into account the firm reaction function related to its optimal stock of capital.

Compared to the precedent case, the contract curve given by [12] becomes such that $R'(L)$ has to be replaced by $R'(L,K)$, that is, *the marginal revenue product of labor, $R'(L,K)$ now incorporates the movements of the capital stock*.

16. Generalization to more than two inputs does not modify the basic insights.

In particular, one has :

$$[20]: \quad R'(L,K)=R'(L)+R'(K).K'(L)$$

where $K'(L)$ represents the labor derivative of capital.

To get the marginal productivity of labor *at a fixed capital stock* , $q'(L)$, one will note that :

$$[21]: \quad R'(L,K)= P.[1-m].[q'(K) K'(P) P'(q) q'(L)+ q'(L)] \quad 17$$

(with $A'(B)$ represents the partial derivative of A with respect to B)

or:

$$[22]: \quad R'(L,K)= P.(1-m).X.q'(L)$$

with $X = q'(K). K'(P).P'(q)+1$.

In general, $X \leq 1$, reflecting the fact that capital and labor *are substituable* ¹⁸ so that bargained employment in case of (substituable) flexible inputs is lower than bargained employment under fixed inputs.

Incorporating [22] in [18], one reads :

$$[23]: \quad W^o = \frac{(1-m). P}{(1+z)} \cdot \delta \cdot \frac{q}{\delta L} + \omega m. \frac{(P q)}{L}$$

or :

17. To understand why P appears in the r.h.s. of [21], recall the identity : $R = P.q$. On its hand, the term $P.[1-m]$ represents the shadow price (so that when $m=0$, marginal revenue equals price as in pure competition).

18. The case of a LEONTIEFF technology is particularly interesting because optimal L and K move proportionately, with no substitution among the inputs . In this case, one will check that $X = 1$ (see ARNSPERGER and DE LA CROIX [1990b]), so that the equation [19] holds true.

$$[24]: \quad W^o = \frac{(1-m)}{(1+z)} \cdot \frac{(P.q)}{L} \cdot \frac{\partial nq}{\partial nL} + \omega \cdot m \cdot \frac{(P.q)}{L}$$

with $z > 0$ if inputs are substitutes, implying 'ceteris paribus' a reduction in the wage share ^{19,20}.

In the empirical work [24] will be used as to test for the effects of union's bargaining on price-cost margin.

Keep in mind that [24] is based on the *a priori* restrictive assumption that unions workers are risk-neutral ($\epsilon=1$). However, and as explained in the footnote 35 hereafter, risk-neutrality does seem a proper assumption in our sample. Furthermore, the condition of risk-neutrality is consistent with some empirical findings (ABOWD [1989], or DOWRICK [1990]) ²¹, and has been used in other empirical analyses (VEUGELERS [1989]).

19. Rearranging [24], one gets :

$$\frac{W.L}{P.q} = \frac{(1-m)}{(1+z)} \cdot \frac{\partial nq}{\partial nL} + \omega \cdot m$$

so that any increase in Z entails '*ceteris paribus*', a fall in the share, $W L / P q$.

20. The expression of [24] with $[1/(1+z)] = X$ aims to facilitating the analogy with the case of monopolistically purchased labor one obtains when $\omega = 0$.

21. Empirical studies that do not find support for 'strong efficiency' are e.g. NICKELL and WADHWANI [1988].

3. THE EMPIRICAL MODEL

Having outlined the theoretical framework, this section provides an application to various manufacturing sectors of the Belgian economy. Those respective sectors ²² are :

- (1) : Chemical industry (sample : 66 firms)
- (2) : Textile industry (97 firms)
- (3) : Footwear and clothing industry (44 firms)
- (4) : Printing and publishing (98 firms) ²³

The estimation is conducted at the firm level with pooling of annual data from 1977 to 1983 ²⁴.

3.1. The production function approach

Equation [24] requires to specify a production function to estimate the elasticity of output with respect to employment, Eq1.

3.1.1. The technology form

Of course, the functional form to be considered must be such that it does not impose too high restrictions on the technology characteristics of the industry. In consequence, the application will consider the suitable translog function.

The firm's output supply function is thus given by :

$$[25]: \ln q_{jk} = \beta_0 + \sum_{l=1}^M \beta_{1l} \ln X_{l1} + \frac{1}{2} \sum_{l=1}^M \sum_{r=1}^M \beta_{lr} \ln X_l \ln X_r$$

where q_{jk} is j th firm production in the industry k , X_l 's are the M inputs, and the marginal product for the l th input is defined by :

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- 22. The sample has been kindly provided by F. FECHER, from Ulg. For details, refer e.g. to FECHER and PERELMAN [1989]. Sectors considered in our study match closely those in VEUGELERS [1989], yet there is no guarantee that firms in the sample are the same.
 - 23. Sample size is *after outlier deletion*. An outlier is e.g. defined as a firm whose accounting mark-up ratio (value added over wage bill) is lower than unity.
 - 24. Pooling the data is of course of high interest for better efficiency in the estimates, while it will allow us to consider fixed-effects in the production function.

$$[26]: \quad fX1 = [\beta_1 + \sum_{r=1}^M \beta_{1r} X_r] (q_{jk}/X_1)$$

In the application, production will be measured by total sales ²⁵. Considered inputs are respectively labor ($X_1=L$), which is priced within an efficient bargain, and two other *competitively* priced inputs, respectively known as intermediate goods ($X_2=MP$) and capital ($X_3=K$).

3.1.2. The empirical production-approach model

Our production-approach model is thus defined by the production function [25] together with the three following first-order conditions associated with factor employment ²⁶:

$$[27]: \quad [W/P] = \frac{(1-m).fL + \omega.m.(q_{jk}(L^\omega) / L^\omega)}{(1+z)}$$

$$[28]: \quad [N/P] = (1-m).fMP$$

$$[29]: \quad [R/P] = (1-m).fK$$

with N is intermediate goods price and R is cost of capital.

Inserting marginal production conditions expressed by [26], in [27]-[29], one reads:

25. A gross production function seems better than a function for value added because conditions for a value added production function are often rejected by empirical tests. This is a priori the case here (see FECHER and PERELMAN [1989]).

26. Factor employment sums up to $[1 - ((1-\omega).m)]$. In order to prevent *singularity* of the estimated variance-covariance matrix of cross-equation disturbances in the econometric model, one 'factor-employment' equation should be omitted before estimation. In the results below, omission concerns either [28] or [29], and results are *average* estimates, depending on the equation which is omitted.

$$[30]: \quad LS = \frac{(1-m)}{(1+z)} [\beta_1 + \sum_{r=1} \beta_{1r} L_r X_r] + \omega \cdot m$$

$$[31]: \quad IGS = (1-m) [\beta_2 + \sum_{r=1} \beta_{2r} L_n X_r]$$

$$[32]: \quad KS = (1-m) [\beta_3 + \sum_{r=1} \beta_{3r} L_n X_r]$$

where LS, IGS and KS stand respectively for labor, intermediate goods and capital share in nominal production ²⁷.

3.1.3. The market power tests

Given the cross-equation restrictions imposed in the β_i 's, one is able to test whether :

- ω is significantly positive so that unions are able to force firms to give up a part of their original rents;

- m is significantly higher than zero so that firms have original output market power.

This implies that we consider ω and m as *parametric accross firms*, although there is no guarantee that m and ω could not be firm-specific.

As a well-grounded theory of what actually determines the firm's bargaining strength ω , is actually lacking in the literature [*see however the interesting papers by Dewatripont [1988 a, b]*], we shall simply assume in the following that ω is an exogenous parameter at the firm level ²⁸.

In contrast, models of the determinants of the own firm output market power, are now quite well-established on a theoretical ground ²⁹, and we should rely on such

27. Insofar factor shares are measured by proxies given by accounting variables, our approach may still be limited by measurement difficulties (see HARRIS [1988] or VERMA [1990] on this point).

28. An evident caveat of the 'uniform ω assumption' is that it requires that the parties' threat point are never binding (see SCARAMOZZINO [1991]). However, information as to determine the *status* of the constraints given by the parties' threat points are not directly available so that we prefer dropping that possibility in the analysis. Refer however to footnote, 45, *infra*, in an attempt to make ω *industry-specific*, in a rather -we concede- ad hoc way.

29. See e.g. HARRIS [1988] for , an appealing summary, although in a different context.

models, if one is willing to refine the testing of output market power :

3.1.4. Defining firm market power

Recall that the equation [6] has been derived from a simple oligopoly model with homogenous goods, within the framework of a closed (to open-trade) industry.

However, despite its simplicity, equation [6] provides the basic insight for emphasizing the causal variables of the firm market power.

Indeed, rewriting the equation [6] with more general conjectural variations, the j th firm price cost-margin in industry k becomes :

$$[33]: \quad mk_j = [(q_k/Q_k) \cdot \eta_k] [1 + \alpha_{kj}]$$

with η_k is the market demand elasticity and $\alpha_{kj} = \sum_{i \neq j} \delta q_{ki} / \delta q_{kj}$

$$i \neq j$$

is the conjectural variation of the j th firm concerning the output response of the other firms in industry k to an output change of firm j in industry k ³⁰.

The equation [33] reveals us that the causal variables of interest are the industry trade-offers elasticities, the firm market share and its conjectural variation. *More precisely, the greater the demand elasticity, the lower the market share, and the closer the conjectural variation is to minus one* ³¹, *the lower is the j th firm market power.*

Generalizations are of course possible such as the opening to trade with differentiation between foreign and domestic goods . In this case one conjectures that the firm price-cost margin becomes an average of the LERNER indices on both the domestic and the exports market. Furthermore, the domestic LERNER index becomes influenced by the competition from imports, while the price-cost margin on exports sales becomes influenced by foreigners' supply.

Models of this type are e.g. presented in HUVENEERS [1981], or in NEUMANN et alii [1985]. However, the basic idea remains in the sense that *this is still the*

30. We assume for simplicity that the conjectural variation across industry is nil. This is of course a simplification , compared e.g. to the model presented by GELFANT and SPILLER [1987].

31. A conjectural variation of minus one for each firm j amounts to asserting that *BERTRAND competition* is at work in industry k , since for each firm j , the observed market price equates firm j marginal cost. This is easily understood when one keeps in mind that a value close to minus one for the firm j implies that the j th firm acts as if it expects its industry rivals to response to its change in output by an off-setting change in their output supply so that market prices remain unchanged (see ROBERTS [1984]).

combination of market share, supply and demand elasticities, and conjectural variation about competitors which represent the key variables for understanding the firm market power.

Due to the lack of microdata and the further complexity in estimating industry supply- and demand- elasticities in our model ³², we are constrained to adopt a clear short-cut in assuming that each firm price-cost margin, m_{jk} , is simply a linear function of its market share ³³:

$$[34]: \quad m_{jk} = \mu_0 + \mu_1 \cdot (q_{jk}/Q_k) \quad (\mu_1 > 0)$$

Broadly speaking, the coefficient μ_1 may be considered as a kind of '*combined index of collusive power and efficiency*' (in managing *persistent* market share).

Moreover, asymetries in conjectural variation seem the empirical rule (GOLLOP and ROBERTS [1979]), or GEROSKI [1981]) with the notable characteristic that the market structure is likely to be composed of 'price-making' dominant firms with a competitive fringe.

We wish to account for such hypothetical asymetries, by imposing the γ_k largest firms as a benchmark of each industry k market power.

Accordingly, we also investigate an amended equation [34] of the form :

$$[35]: \quad m_{kj} = \alpha_0 + \alpha_1 \cdot (q_{jk}/Q_k) \quad \text{for } j \text{ belonging to } \gamma_k \\ = 0 \quad \text{otherwise,}$$

32. Due to the cross-equation restrictions in the system, the model becomes very cumbersome to estimate, when one adds further equations in the model.

Furthermore, we face a serious lack of degrees of freedom because of the short time-series dimension of our data (6 years). In this respect, a preliminary version of this paper specified an industry demand function as a (truncated) COBB-DOUGLAS function of the form (APPELBAUM [1982]):

$$\ln QK = a_{1k} - a_{2k} \cdot \ln (P_k/P')$$

with $a_{2k} = \eta_k$ is the demand elasticity (assumed constant in the plane $[P, Q]$), P' is the implicit GNP deflator; Q_k , sectoral production and P_k , sectoral added value deflator index at factor cost. Results based on this specification were indeed very poor, the coefficient a_{2k} being mostly insignificant.

33 Recall however that our main objective is to infer the *existence* of market power, m , not to analyse its causes. Thus our objective in this subsection is to make the inference of m more flexible, depending *inter alia* on the firm market share, since the positive link between price-cost margins and higher mark-ups is robust across all possible rival responses conjectures, and therefore " provides an analytical foundation for the traditional industrial organization association between high market shares and greater-firm specific market power over price" (HARRIS [1986], p. 40).

where α_i are 'reduced form' parameters to be estimated and firms have been ranked by market share before the grid search on γ_k .

3.3. Results

3.3.1 Stochastic framework

For estimation, we assume the production function and the input share equations to be stochastic due to optimization errors. Dummies on the constant terms are also introduced in order to account for possible fixed-time differences in the management efficiency ³⁴.

All the disturbance terms are assumed Normal variate, with constant variance, and constant covariance among them.

3.3.2. Data measurement

Output and input variables are from annual financial statements ³⁵. The output variable is provided by the accounting measure of total sales, deflated by the sectoral added value index at factor price. Capital is measured by accounting data on gross fixed assets net of depreciation and less-value, and is deflated by the sectoral investment index. Intermediary goods are measured by the accounting measure of cost of raw materials, merchandises and furnitures, and are deflated by the same index as output ³⁶. Finally, employment is measured by the annual average number of workers hired at the firm.³⁷ Concerning factor price, nominal wage is the accounting measure of wage bill, divided by total employment. On its hand, capital cost is proxied by the interest rate on long-term investment credit, as in VEUGELERS [1989].

3.3.3. Estimation technique

Since all regressors in the model are endogenous, and subject to measurement errors (see GRILICHES and HAUSMAN [1986], or GARBER [1989], I.V. techniques have to be used. The set of instruments for each input is composed of its price ³⁸, and its lagged value. Concerning the versions [34] and [35] of the

34. This exploits the time-dimension of the data-base, while in the meantime accounts for DEMSETZ [1974]'s argument that *differences between firms performance can be related to difference in efficiencies*.

35. This means that firms included in our sample are those for which publication of financial statements are mandatory. Since the mandatory conditions applicable to the Belgian firms are especially fulfilled by large firms, our sample tends to give a picture of an industry which is composed of firms with the greatest market shares.

36. See FECHER and PERELMAN [1989] (footnote 7) for the reason of this choice.

37. The source is here to the O.N.S.S., since financial statements only provide the wage bill.

38. Remember that in the case of the labor input, our theoretical approach has assumed risk-neutral unions. In this case, efficient contract leads to a partial correlation between wages

model, the market share variable has been simply instrumented by its two lags. Estimation with other potential instruments (such as firm's lagged added value) does not modify the results.

Finally, due to cross-equation restrictions, and simultaneity among equations of the system, this has been estimated by Non Linear Iterative Three-Stage-Least-Squares techniques (HENCEFORTH, NL3SLS).

3.3.4. *Estimated parameters*

a. *Translog parameters:*

Table 1 hereafter exhibits the industry estimates for the production function. Those results are those obtained when defining the firm LERNER index by [34]. Imposing a competitive fringe constraint as defined by the rule [35] does not significantly modify the estimates.

Results are close to those obtained by FECHER and PERELMAN [1989]. Goodness-of-fit, as measured by the (adjusted) R-square statistic is particularly important, as is usual with a translog formulation.

Based on those estimates, input elasticities of output, and input substitution elasticities can be computed, as well as specific assumptions concerning the underlying production technology.

In this respect, it can be shown e.g. that the restriction to a COBB-DOUGLAS technology is a clear shortcut for the four industry considered ^{39,40}.

Furthermore, it can be shown (*-upon request to the author-*) that the elasticity of output with respect to intermediary goods is especially high while capital elasticity of output is rather low. Also substitution appears between inputs, with the notable

and employment which is nil so that price should not enter in the instrumental employment equation.

However, experiments with employment equations including the price variable were performed, and revealed with some -good- surprise that the partial correlation between wages and employment is indeed very small (average : - 0,13) and poorly significant for each of our industry sample. Moreover, since the price output deflator and labor likewise can be expected to be measured with errors because of, say for labor, differences in effort or overtime, the least squares correlation could be simply of spurious nature due to errors-in-variables. Experiments following the procedure by KLEPPER and LEAMER [1984] revealed indeed that the interval of estimates for the real wages coefficient overlaps the origin (that is absence of actual correlation) for a squared correlation, ρ , between measurement and true real wage variable as high as 0,92 (!), on average. Only ρ for the textile industry must decrease to 0.78 to get an interval of estimates that overlaps the origin.

39. FISCHER test reveal indeed that the COBB-DOUGLAS is rejected at $\alpha = 1\%$ for each sector.

40. This confirm SVEJNAR's conjecture (p.1073) that the sensibility of estimates he obtains may be due to the fact that the COBB-DOUGLAS technology is misspecified.

exception ⁴¹ that intermediary goods and labor are significantly complementary in the printing and publishing industry.

Interestingly, also a F-ratio on the firms' fixed effects is statistically significant ($p < 0.001$ applied to each sector estimation), which can be seen as *the reflect of heterogeneity in management efficiency across firms*, as challenged by DEMSETZ [1974].

b. Market power indices

- ω and m parametric across firms

There are different ways to measuring market power.

The first strategy amounts to assuming ω and m as parametric across firms. Table 2 presents the estimated indices of market power, based on this assumption.

Table 1: Estimated parameters of the translog system

Industry	[1]	[2]	[3]	[4]
	(chemic.)	(textile)	(footw.)	(print.)
Translog parameters:				
β_0	9,98**	11,13**	11,46**	17,32**
β_1	1,91**	1,41**	0,79**	2,81**
β_2	-0,76*	-0,41*	-0,71**	-1,34**
β_3	0,05	0,14*	0,17	-0,48*
β_{11}	0,09*	0,05**	0,04*	0,21**
β_{22}	0,06*	0,07*	0,08*	0,08**
β_{33}	0,03**	0,02*	0,01	0,02**
β_{12}	-0,12*	-0,17*	-0,14**	-0,32**
β_{13}	0,02	0,04*	0,01	-0,15**
β_{23}	-0,41**	-0,05*	-0,02*	-0,03
R-square	0,96	0,93	0,98	0,98

Notes : *(**): significant at $\alpha = 5\%$ (1%). [fixed-effects not reproduced]

41. This exception also appears in FECHER and PERELMAN [1989].

This table shows already interesting results as both the footwear and the printing industries have on *average* significant output market power.

Moreover, union bargaining power is significant in those two industries, exercising redistribution of original rents to workers. As example, one will view that that *observed* extra profits is about 16% of sales in the footwear industry, *after* distribution of wage rents to industry workers.

Concerning the two other sectors, the market power indices are not quite well estimated. This is particularly true for the textile industry, where the estimates were very difficult to obtain by NL3SLS iteration.

Table 2:Market power estimates
 ω and m parametric across firms

Industry	[1]	[2]	[3]	[4]
	(chemic.)	(textile)	(footw.)	(print.)
output market power:				
m	0,30	0,12	0,18*	0,19*
union bargain. power:				
ω	0,23*	0,14	0,16*	0,12*

Notes : *(**) : significant at $\alpha = 5\%$ (1%). R-squares for equations [30], [31], [32] are respectively : 0.56; 0.52; 0.48 (see also footnote 26).

- m as a function of market share

We also estimated the model by assuming the firm i price-cost margin to be linearly related to its market share (equation [34]).

Results are presented in Table 3.

For the two last sectors of this table, the estimates ω and m are quite comparable to those in Table 2. Efficiency in parameter estimates is gained ⁴², although for each of those sectors, the estimate μ_1 is insignificant.

42. See e.g. the level of significance of $m=\mu_0$ for both industries.

More interestingly, output and labor market power level estimates are higher for both chemicals and the textile industry. For the former, the output market power becomes even significant at the 5-% risk level.

Concerning the union bargaining power ω , results appear now uniform throughout sectors to assert that the *unions are all able to extract a significant part of the profit of the firms.*

Table 3
Market power estimates
m given by [34]

Industry	[1]	[2]	[3]	[4]
	(chemic.)	(textile)	(footw.)	(print.)
output market power: (+)				
m	0,34*	0,16	0,17**	0,17**
union bargain. power				
ω	0,26*	0,15*	0,15*	0,14**

Notes : *(**) : significant at $\alpha = 5\%$ (1%). (+) : The market power variable is estimated at the sample mean for sectors where the estimate μ_1 is significantly greater than zero; otherwise, m is given by the estimate μ_0 . R-squares for factor share equations are respectively : 0.61; 0.57; 0.54.

- competitive fringe

We have finally performed some experiments to analyse asymetries in conjectural variation among sectors. Based on the rule expressed by [35], we performed a grid search (five by five firms) on the number ($N_k - \gamma_k$) of firms that could be part of a competitive fringe ⁴³.

⁴³ Of course, the experiment is subject to the caveat that it is only based on a *sample* of firms, while a competitive fringe model requires logically *complete* information on each sector. (I thank H. ENTORF for pointing out to this problem). Recall however that the experiment is only set out to analyse how m is affected by more flexible forms, not to infer the actual structure of the sector.

Table 4 presents the final estimates, based on the results that the chi-square statistic of restrictions to no output power is lower than its 5-% critical value.

Very interestingly, asymetries in output market power across firms seem the rule, the only exception being the printing industry.

The leading firm model with competitive fringe is especially relevant for the textile industry, where the first quartile in the sample stands for the benchmark of firms which possess market power. One conjecture for this result is that the dominant firms are price-setters on the widely internationally traded textile market (see HUVENEERS [1981]), while the competitive fringe represent atomistic firms which were unable to preserve their margins in the industry.

Concerning the chemical industry, the benchmark is just below the median of our sample. Yet the sector is mainly *price-taker vis-à-vis the Germany* (HUVENEERS [1981]), the estimated margin is quite high and may represent the existence of significant *international collusive behavior*.

Table 4
Market power estimates
m given by [35]: grid search on γ_k

Industry	[1]	[2]	[3]	[4]
	(chemic.)	(textile)	(footw.)	(print.)
Critical benchmark (+)				
($nK-\gamma_k$) :	30	80	10	-
output market power : (++) (+++) m	0,38*	0,32*	0,22*	0,21**
union bargain power ω	0,31*	0,13*	0,19**	0,14**

Notes : ***(**)** : significant at $\alpha = 5\%$ (1%). **(+)** : The benchmark is defined by $(nK-\gamma_k)$ where nK is the number of firms in our sample [results should be interpreted accordingly]. **(++)** : The market power variable is estimated at the sample mean for sectors where the estimate α_1 is significantly greater than zero; otherwise, the estimate is based on α_0 . **(+++)** : Estimate at the restricted sample (γ_k) mean. R-squares for factor share equations are respectively : 0.78; 0.68; 0.59 (see footnote 26).

Turning now to wage rent power estimates, those are all significant and are in light to these obtained by other studies (see e.g. FREEMAN [1983]) or VEUGELERS [1989] ⁴⁴). The results confirm the conjecture that observed profit - *if any*- tends to be eroded by wage rents obtained by the unions within efficient real wages contracts.

Quite surprisingly, the fact that wage rent power does not increase for firms with market power leads us to assume that the union bargaining strength is not necessarily facilitated by higher firm output market power ^{45, 46}.

Results also tend to prove that *asymetric power prevails* in favor of firms, and confirm the relevance of applying a generalized Nash-Zeuthen-Harsanyi asymmetric bargaining model in the Belgian wage formation process.

44. See especially, VEUGELERS [1989], p. 176 : *on average*, sectoral bargaining power is 0.234 . Sensible disparities to our results appear for each sector considered separately but this is of course to be related to the different methodology used in the studies, particularly the assumption regarding the fall-back point, as union bargaining power ω should of course be sensitive to this latter measure. Turning to FREEMAN [1983] estimates, now, unions decrease firm profit rates by around 20% in concentrated industries.

45. Cross-industry variation of the bargaining power parameter was also examined, so as to determine the factors leading to union asymmetric power. Estimating ω for each year, we have got our disposable (6*4) estimates which could be related to factors assumed to determine unions bargaining strength. The best (still 'ad hoc') specification found is given in [a] with standard errors in parentheses. This specification is log-linear and links ω negatively to the sectoral proportion of firms 'said constrained by their demand' (symbol: PK) [Source : N.B.B.] :

$$\text{Ln}(\omega) = 1.06 - 0.14 \text{Ln}(\text{PK}) \quad \text{R-square : 0.15} \quad [\text{a}]$$

(0.03) (0.05)

As suggested, neither industry price-cost margin nor any concentration measure (HERFINDHAL index) does enter the equation. Also and contrary to other studies (VEUGELERS [1989]), the unemployment rate did not enter significantly in the equation (*but is correlated with PK*).

46. At the first sight, this not replicate the argument that market power generates more 'ability to pay' (see MACHIN and STEWART [1990]). Recall however that no statistical test is set up here to analyse this assumption that ' unions effects are less marked if market share is low' . Furthermore, our model suggests that such an effect is mainly empirically distinguishable when *efficient* contracting is present. This is contrary to the bulk of the unions literature which analyses the impact of unions on wage rewards independently on the nature of the bargain.

4. CONCLUSIONS

This paper has presented a conjectural variation model of output market power which accounts for the possibility that wages are bargained *off* the labor demand curve.

Within a rent maximizing framework for the union objective, the estimates for four Belgian manufacturing sectors have revealed that unions are indeed generally able to accaparate a(n asymmetric) part of output rent, *making observed rent significantly lower than that originating from actual firm output market power.*

Furthermore, there has been some evidence that output market power is asymmetrically distributed within sectors, with the greatest share firms acting dominantly, the others representing a competitive fringe.

We claim those preliminary results interesting as they confirm earlier conjectures by some authors that mistaken inference concerning the structure-conduct-performance paradigm could originate from *unexplicit consideration of input market imperfection*; in this specific case, *confusion between the contract curve and the labor demand curve may lead to the neglect of any direct effect of wages on the firm's price-cost margin.*

Caveats are still possible and one has to perform further work as to investigate how sensible those results presented here are *to the hypotheses maintained all along this work* [recall the VARIAN [1983]'s criticism (brackets added) : '[this] procedure suffers from the defect that one is always testing a joint hypothesis: whatever one wants to test plus the maintatined hypothesis of functional form'].

Among others, it should be important to allow for some rigidities in inputs (such as fixity in the capital stock, and hoarded labor), and other types of input imperfections (such as monopsonistic power in the intermediary goods market).

Furthermore, it should be crucial to analyse the speed of adjustment in the output market, as the implicit output conjectural variation model presented here assumes that equilibrium takes place within the unit interval taken for estimation. Accordingly, the redistribution effect should be analysed more deeply as it could represent simply the lag in prices indexation to wage increase that appeared in Belgium in the years before the currency devaluation in 1982.

In this respect, the time-dimension of the data is an asset that should be employed in further research.

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