

O Poder dos Sindicatos e a Lucratividade das Firms no Reino Unido

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Unions and Profitability over the 1980s: Some Evidence on Union-Firm Bargaining in the U.K. *

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Abstract

In this paper an attempt is made to assess the behaviour of the rate of return on sales of unionised firms as compared to the non-unionised ones in the late 1980s in the U.K. The main aim is to examine what has happened to the relationship between unionisation and profitability after the changes in the union legislation, competition environment and cyclical variations that took place over this period. The impact of different forms of union-firm bargaining on the union-profitability effect is also examined. The data reveal that the negative union effect on profitability exists, even after controlling for firm specific fixed effects, that it is larger where unions negotiate jointly with the firm as part of industry level bargaining, but that it has been sharply reduced over the 1980s.

JEL Classification: J51

Keywords: Trade Unions, Profitability, Bargaining

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The impact of trade unions on profitability has been the subject of numerous theoretical and empirical studies. It is generally accepted as an empirical fact that the presence of unions tends to be associated with lower firms' and plants' rate of return. Few studies, however, have attempted to analyse the behaviour of this relationship over time, by making use of panel data to investigate the action of cyclicity and the possibility of change in structural factors underpinning the union impact.¹

More recently, an interesting part of the economic literature has concentrated on the direct and indirect effects of the anti-union legislation in Britain during the 1980s on various industrial relations and economic indicators.² Overall it seems that unionised firms or establishments experienced relatively high productivity and low wage growth in the late 1980s, but not at the beginning of the decade.³ Despite the importance of these institutional changes for the bargaining scenario there has been no study so far exploring possible changes in the relative profitability of unionised firms as compared to non-unionised ones over this period.⁴

Since gaining power in 1979, the Conservative government has also stimulated an already existent move towards more fragmented bargaining, as part of a general policy of trying to generate a more flexible labour market (see Brown and Walsh, 1991). However, some studies (e.g. Layard, Nickell and Jackman, 1991) questioned the effectiveness of a policy of this sort, by demonstrating connections between the decentralization of the bargaining system and increasing rates of unemployment and wage inflation. One question examined here is: from the microeconomic point of view, has the fragmentation of bargaining had any impact on the bargaining power of firms and unions as measured by the union profitability differential?

Another related feature that has received some attention is the interaction between

¹See Mishel and Voos (1992) for a survey on the relationship between unionisation and profitability and Hirsch (1991) for a study that uses U.S. panel data.

²During the period covered by our exercise (1984-1990) two changes in the law directly related to unions took place: the 1984 Trade Union Act and the 1988 Employment Act (see Metcalf (1990) for a discussion).

³See Stewart (1991), Gregg and Machin (1992), Stewart (1995) and Gregg *et al* (1993), *inter alia*.

⁴Note though that Machin and Stewart (1990) and Machin and Stewart (1996) have detected an improvement in union plants' relative financial performance.

economic performance and the structure of multi-unionism. Marginson and Sisson (1988) underlined the importance that different forms of bargaining procedures may have in shaping various industrial relations outcomes. Machin *et al* (1993) were the first to take this into account in an empirical microeconomic framework, their finding being that plants where unions bargain separately with the firm tend to pay relatively higher wages. This paper tries to extend their work by using the firm as the unit of analysis.

In spite of the comprehensive literature on the effects of unionisation on profit margins, there are no published studies capturing the impact of changes in union status on changes in profitability, that is, controlling for firm specific fixed effects. In the following analysis a variable is utilised that indicates whether or not firms have partially or totally derecognized unions for bargaining purposes during the sample period to assess the importance of the union effect in a first-differences specification.

I. THEORETICAL ISSUES

Firms' and unions' bargaining procedure may be modelled (following Binmore, Rubinstein and Wolinsky, 1986) as a time-preference game with alternating offers in which the asymmetry between parties may arise from different discount factors, that is, different losses incurred with the extension of the negotiation period.⁵ The presence of recognized trade unions may signal to the firm that industrial action is likely to take place if delays in the process of reaching an agreement occur. In this case, an average unionised firm will end up with a lower profit margin than its otherwise identical non-union counterpart, for a higher part of its sales revenue will be appropriated by its workers, as a reflection of its impatience to settle without a strike. One of the effects of the anti-union legislation might be to increase the unions' uncertainty with relation to the occurrence and degree of participation in an industrial action. This in turn would tend to provoke an increase in unions' relative impatience to reach an agreement. A model will be developed below in which this increase in unionised firms'

⁵As shown in Binmore (1982), under certain conditions the solution to this non-cooperative game is equivalent to the solution of the standard Generalized Nash product in which the resulting share of profits depends on the utility functions, discount factors and disagreement pay-offs of the parties, with outside options acting as a constraint.

relative 'bargaining power' will be reflected in an increase in their relative rate of return.

Some recent models have appeared in the literature aiming at offering different predictions concerning the wages associated with different bargaining structures (see Horn and Wolinsky, 1988; Dowrick, 1989,1993; Davidson, 1988 and Dobson, 1994). In this section a simple two-stage bargaining model will be developed. In the second stage, two symmetric firms compete in the product market, while in the first stage they bargain with their unions over wages only. The aim is to investigate the effects of different bargaining scenarios on the firms' profit/sales ratio using a general model along the lines of Dowrick (1993).

Second Stage

In the second stage, firms i and j decide on their output levels, taking wages (determined in the prior stage) as given. Assume labour is the only input in the production process. Under these circumstances, it is possible to derive equilibrium profit (π^i), labour demand (L^i) and union utility (U^i) functions, which depend only on the (exogenous) wages (w^i, w^j). It is assumed throughout the analysis that $\frac{\partial \pi^i}{\partial w^i} < 0$, $\frac{\partial \pi^i}{\partial w^j} > 0$, $\text{sign}(\frac{\partial \pi^i}{\partial w^i} + \frac{\partial \pi^i}{\partial w^j}) < 0$, $\frac{\partial L^i}{\partial w^i} < 0$, $\frac{\partial L^i}{\partial w^j} > 0$, $\frac{\partial U^i}{\partial w^i} > 0$ and $\frac{\partial U^i}{\partial w^j} > 0$.⁶ Define :

$$E^{wi}[\pi^i] = -\frac{w^i}{\pi^i} \frac{\partial \pi^i}{\partial w^i}, E^{wi}[L^i] = -\frac{w^i}{L^i} \frac{\partial L^i}{\partial w^i} \quad (1)$$

$$C^{wj}[\pi^i] = -\frac{w^i}{\pi^i} \frac{\partial \pi^i}{\partial w^j}, C^{wj}[L^i] = -\frac{w^i}{L^i} \frac{\partial L^i}{\partial w^j} \quad (2)$$

Proposition 1a: *an increase in own wage (holding rival's wage constant) will decrease firm i 's profitability if $E^{wi}[\pi^i] > E^{wi}[L^i] - 1$.⁷*

Proof: The proofs of all propositions are collected in the Theoretical Appendix.

Proposition 1b: *an increase in both own and rival wages (in the same proportion) will decrease the firms' profitability if $E^{wi}[\pi^i] - E^{wi}[L^i] > C^{wj}[\pi^i] - C^{wj}[L^i] - 1$. This*

⁶Some of these conditions may not hold when the products are strategic complements (see Dowrick and Spencer, 1994).

⁷This condition does not seem restrictive at all. If the labour demand is inelastic the condition is automatically satisfied: Arellano and Bond (1991) used UK firm level data to find a long-run elasticity of around -0.24. Also, a simple linear homogeneous Cournot duopoly model with $L^i = q^i$ and $P = m - n(q^i + q^j)$ has $E^{wi}[\pi^i] = \frac{4w^i}{3nq^i}$ and $E^{wi}[L^i] = \frac{2w^i}{3nq^i}$.

condition will be called C1.⁸

First Stage

In the first stage each firm is bargaining with its union(s) over wages only. Dowrick (1993) (who draws on Davidson, 1988 and Binmore *et al*, 1986) shows that this can be analysed through a model of simultaneous games with alternating offers, which has as equilibrium:

$$w^i(w^j, \beta^i) = \arg \max_{w^i} Z^i(w^i, w^j, \beta^i) = (\beta^i) Ln[\pi^i - \underline{\pi}^i] + (1 - \beta^i) Ln[U^i - \underline{U}^i] \quad (3)$$

where $\underline{\pi}^i$ and \underline{U}^i represent the parties' disagreement pay-offs and $(0 \leq \beta^i \leq 1)$ is firm i 's bargaining power. The FOC for this maximization problem is:

$$\frac{\partial Z^i}{\partial w^i} = Z^i(w^i, w^j, \beta^i) = \beta^i \frac{\pi^i}{\pi^i - \underline{\pi}^i} + (1 - \beta^i) \frac{U^i}{U^i - \underline{U}^i} = 0 \quad (4)$$

and the SOC :

$$Z_{ii}^i = \frac{\partial^2 Z^i}{\partial w^i \partial w^i} < 0 \quad (5)$$

Expression (4) will define the two wage reaction functions: $w^i(w^j)$ and $w^j(w^i)$ whose intersection will define the equilibrium wages w^{i*} and w^{j*} .

Proposition 2 (Dowrick (1993)): *A change in the structure of industrial relations from $Z^{Ii}(w^i, w^j)$ in (3) to $Z^{IIi}(w^i, w^j)$ will raise the equilibrium wage ($w^{IIi*} > w^{Ii*}$) if $Z_{ii}^{IIi}(w^{Ii*}, w^{jI*}) > 0$.*⁹

This means that, for this condition to be satisfied, Z_{ii}^{IIi} evaluated at the equilibrium wages defined by Z_{ii}^{Ii} must be strictly positive. In this sub-section, Dowrick (1993)'s framework will be used to analyse different industrial relations scenarios in order to derive predictions that can be tested using the data set described in the empirical analysis. The analysis will concentrate on the outcomes of the bargaining between firm i and its symmetric unions A and B that represent groups of workers a and b respectively, though as symmetry between the firms is also assumed, they also apply to firm j and its unions (C and D).

⁸This condition does not seem restrictive either. In the Cournot model referred to in the footnote above: $E^{wi}[\pi^i] - E^{wi}[L^i] = \frac{2w^i}{3nq^i}$ and $C^{wj}[\pi^i] - C^{wj}[L^i] = \frac{w^i}{3nq^i}$

⁹The superscripts I, II, etc. are being used here to identify different bargaining regimes.

Case 1 - Competitive Labour Markets : In this situation both firms operate in competitive labour markets with no collective wage bargaining of any type. In this case, the wage is simply the competitive wage for both firms.

Case 2 - Collective Bargaining : In this new structure (II) both firms recognize unions for the purpose of collective bargaining. Firm i bargains with union A , while firm j bargains with union C . With the unions' and firms' disagreement pay-offs normalized to zero, the First-Order Condition (FOC) that implicitly defines the wage that the workers in plant A will get (w^a) is defined by:

$$Z_a^{II} = \frac{\partial Z^{II}}{\partial w^a} = \beta^i \frac{\pi_a^i}{\pi^i} + (1 - \beta^i) \frac{U_a^A}{U^A} = 0 \quad (6)$$

Proposition 3: *A move to a collective bargaining situation where unions have some degree of bargaining power will decrease the firms' profit/sales ratio if condition C1 applies.*¹⁰

Multi-Union Bargaining

Case 3 - Separate Firm-Level Bargaining : In this new scenario each firm has 2 plants (A and B for firm i ; C and D for firm j) the workers of each plant are represented by a different union (indexed in the same way as the plants) and each firm bargains simultaneously but separately with each union. In this situation, firm i would be able to operate plant B should the union in plant A strike and vice-versa, so that there is an increase in firm i 's potential disagreement pay-offs.¹¹ The FOC is:

$$Z_a^{III} = \beta^i \frac{\pi_a^i}{\pi^i - \underline{\pi}^i} + (1 - \beta^i) \frac{U_a^A}{U^A} = 0 \quad (7)$$

Proposition 4: *In the case of separate firm-level bargaining, the firms' profit/sales ratio increases if C1 applies.*

Case 4 - Joint Firm-Level Bargaining : Now the 2 unions (A and B) bargain jointly with the firm but remain independent of each other. In this case, the linking of the negotiations has curtailed the firm's advantage and we are back to case 2.

¹⁰The Cournot model with utility functions of the type $U^i = w^i L^i$, has $(\pi/s)^i = \frac{2(\beta^i+1)}{5-\beta^i}$ so that $\frac{\partial(\pi/s)^i}{\partial \beta^i} > 0$ and $\frac{\partial(\pi/s)^i}{\partial \beta^j} = 0$.

¹¹What is important here is the *threat* of strike and the streams of income that *would* accrue to both parties in the event of a strike, since in these games the equilibrium is reached through the acceptance of the first offer, that is, without strikes.

Proposition 5: *In the case of joint firm-level bargaining, the firms' profit/sales ratio falls if compared to case 3 and if C1 applies.*

Proof: Symmetric to the proof of proposition 4.

Case 5 - Separate Industry-Level Bargaining : In this scenario, firms i and j form an employers' association that bargain separately but simultaneously with unions $A - C$ and $B - D$.¹² It is important to notice that in order to continue with the multi-union case and maintain comparability, it is assumed that unions A and C remain as independent entities, although they are bargaining jointly with the employers' association.¹³ In this case, there is an increase in firm i 's disagreement pay-offs if compared to case 2, since the employers' association would be able to operate plants B and D should unions A and C strike and vice-versa. However, the internalization of the gain firm j would have, should the wage of workers a increase, means that the result is not as favourable to firm i . The FOC, after allowing for symmetry $((\pi^i - \underline{\pi}^i) = (\pi^j - \underline{\pi}^j))$ reduces to:

$$Z_a^V = \beta^i \frac{\pi_a^i + \pi_a^j}{2(\pi^i - \underline{\pi}^i)} + (1 - \beta^i) \frac{U_a^A}{U^A} = 0 \quad (8)$$

Proposition 6: *In the case of separate industry-level bargaining, the result in terms of the firms' profit/sales ratio is ambiguous if compared to the joint firm-level case, but profitability unambiguously falls if compared to the separate firm-level case and if C1 applies.*

Case 6 - Joint Industry-Level Bargaining : In this case, the employers' association bargains jointly with all the unions, which nevertheless remain independent of each other. Now the within-firm disagreement pay-offs disappear and the internalization effect remains. The FOC in this case is defined by:

$$Z_a^{VI} = \beta^i \frac{\pi_a^i + \pi_a^j}{2\pi^i} + (1 - \beta^i) \frac{U_a^A}{U^A} = 0 \quad (9)$$

Proposition 7: *In the case of joint industry-level bargaining, the firms' profit/sales*

¹²This would be the case, for example, if plants A and C were located in the same industry.

¹³This means that even though an increase in the wage received by workers a may affect the utility of workers c , union A does not care. On the other hand, as the two firms form an association, firm j 's profits will also have to be included in the maximand.

ratio unambiguously falls if compared both to the joint firm-level case and to the separate industry-level case if C1 applies.

Single-Union Bargaining

The single-union case has been much analysed in the literature.¹⁴ The result is known to depend very much on the specific structure and timing of the negotiations. In this sub-section a general case will be examined in order to highlight the factors involved in the analysis. The single-union single-firm case is equivalent to Case 2 above.

Case 7 - Employers' Association and Industry-Level Bargaining : Now the negotiations are assumed to be centralized. An industry-wide union represents the workers of all plants in the negotiation with the employers' association. The equivalent FOC is:

$$Z_a^{VII} = (\beta^i) \frac{4(\pi_a^i + \pi_a^j)}{2\pi^i} + (1 - \beta^i) \frac{4(U_a^A + U_a^B + U_a^C + U_a^D)}{4U^A} = 0 \quad (10)$$

Proposition 8: *In the case of single-union industry-level bargaining, the result is ambiguous in terms of the firms' profit/sales ratio if compared to the single-firm single-union case.*

II. DATA AND ECONOMETRIC METHODOLOGY

The main data source to be used here is the result of a 1990 survey carried out amongst managers of UK firms operating in various sectors and related to a broad range of union arrangements over the 1980s. The questionnaire was sent to about 2400 firms and the rate of usable responses was around 32% (558).¹⁵ These data were complemented by access to the Exstat database of company accounts.¹⁶ After deleting observations with missing values in any of the key variables, we were left with

¹⁴See Davidson (1988) or Dobson (1994), for example. Note though that their analysis concentrate on the case of an industry-wide union bargaining with independent firms. Proposition 8 below was briefly discussed in Davidson (1988) pp. 420-421.

¹⁵For a thorough analysis of the survey, see Gregg and Yates (1991).

¹⁶A Data Appendix is available on request. It contains a reproduction of the survey, descriptions of the variables used in the analysis, the balance of the panel and the distribution of firms across main industries. It is worth pointing out that the survey was retrospective and that the market share variable was constructed using information on the distribution of firms' sales across 6 different industries.

494 firms that operated for at least 4 continuous years during 1984-90 (responsible for a total employment of around 2.7 million workers in 1987). Among them, 56 % recognized unions in 1984, 14 % of which have partially or totally derecognized unions over the sample period (the vast majority of the derecognitions were partial).

Cowling and Waterson (1976) derive the following expression for the profit/sales ratio of a firm under constant returns to scale:

$$\frac{\pi_i}{s_i} = \frac{MS_i(1 + \lambda_i)}{\eta_j} \quad (11)$$

where (MS_i) is the market share, (η_j) is the industry elasticity of demand and (λ_i) a conjectural variations term. Assuming that λ_i is a function of the number of direct competitors (C_{it}) that the firm faces in the main industry it operates,¹⁷ specifications will be estimated of the form:

$$(\pi/s)_{it} = \alpha_0 + \alpha_j + \alpha_t + \alpha_1 Union_{it} + \alpha_2 MS_{it} + \alpha_3 C_{it} MS_{it} + \alpha_4 C_{it} + \alpha_5 KS_{it} + \varepsilon_{it} \quad (12)$$

where α_j and α_t are industry and time dummies respectively, *Union* represents different bargaining structures (from the model developed above), *KS* is the capital/sales ratio (to control for the fact that entry may be driven by the rate of return on capital), and ε is an idiosyncratic error.¹⁸ Table 1 presents the behaviour of the dependent variable - accounting rate of return on sales (ROS)¹⁹ - over the estimation period and the comparison between firms with different bargaining conditions.²⁰ It is clear that although the non-unionised firms and those that derecognized unions had higher profit margins overall, the difference between the unionised and non-unionised firms had completely disappeared by the end of the period, while the firms that derecognized unions were continually improving their relative position. In what follows this result will be submitted to a more rigorous econometric analysis.

¹⁷In the survey managers were asked whether they faced less than 5 direct competitors in their main product market or not.

¹⁸It is being assumed here that the demand elasticities are being captured by the industry dummies.

¹⁹There is an extensive literature on the choice of the dependent variable in profitability studies (see, *inter alia*, Scherer and Ross, 1990). Pre-tax profits/sales will be used here because it is the best proxy for the companies' profitability that is available in the company accounts.

²⁰Only three firms completely derecognized unions in the sample period and they are assigned to column (3) although, strictly speaking, they are not unionised any more by 1990. Three firms that newly reconized unions are being treated as non-unionised until the year when their union density departs from 0.

Table 0.1: The Rate of Return on Sales (ROS) over Time

	(1)	(2)	(3)	(4)	(5)	(6)
Mean ROS	All Firms	Union Recognition (No Changes)	Union Recognition (Derecognition)	No Union Recognition	(2 - 4)	(3 - 4)
1984-90	0.081	0.070	0.092	0.091	-0.021	+0.001
1984	0.074	0.058	-	0.098	-0.040	-
1985	0.074	0.059	0.078	0.092	-0.033	-0.014
1986	0.081	0.070	0.085	0.091	-0.021	-0.006
1987	0.092	0.077	0.100	0.105	-0.028	-0.005
1988	0.093	0.079	0.113	0.104	-0.025	+0.009
1989	0.080	0.075	0.105	0.081	-0.006	+0.024
1990	0.069	0.069	0.099	0.063	+0.006	+0.033

III. RESULTS

Pooled Sample

The results of the first set of estimated equations (using the pooled data) are set out in Table 2. Column (1) investigates the correlation between 'ROS' and union recognition after allowing for a constant term and time dummies. A union derecognition variable is also included to identify firms that changed their union status in the period.²¹ It shows that on average unionised firms indeed tend to have significantly lower margins than non-unionised ones. Columns (2) and (3) indicate that this result is maintained if we include market share, a few competitors variable, the capital/sales ratio and (one digit main product) industry dummies.²² In column (4) we include an interaction of market share and competition as indicated in the econometric methodology, which enters strongly and significantly. The 'few competitors' variable is now negative and significant and the results as a whole are in line with the findings of

²¹This variable is a dummy equal to one for each year between 1985 and 1990 for those firms whose managers reported a reduction in the number of plants recognizing unions at some point over that period not related to the closure of these plants.

²²Using only the main industry sales to construct the market-share variable resulted in a very similar coefficient (standard error) to the one reported in column (2): 0.159 (0.060).

Mueller (1986) and Stevens (1990) using U.S. data. According to these results, to exert market power the firm must have a high share in a concentrated market.²³

Table 0.2: Pooled Sample (1984-1990)

ROS	(1)	(2)	(3)	(4)
Union Recognition	-0.019 (0.008)	-0.023 (0.008)	-0.023 (0.008)	-0.022 (0.008)
Union Derecognition	0.017 (0.010)	0.009 (0.010)	0.019 (0.010)	0.021 (0.010)
Market Share	-	0.163 (0.061)	0.077 (0.079)	-0.042 (0.108)
Less than 5 competitors	-	-0.009 (0.012)	-0.019 (0.012)	-0.022 (0.012)
Market Share * Less than 5 competitors	-	-	-	0.216 (0.110)
Capital /Sales	-	0.048 (0.010)	0.034 (0.011)	0.033 (0.011)
Constant	0.084 (0.009)	0.073 (0.009)	0.182 (0.058)	0.185 (0.058)
SE	0.01244	0.01152	0.01076	0.01074
Wald 1 (p-value)	6.57 (0.037)	38.53 (0.000)	23.97 (0.000)	43.20 (0.000)
Wald 2 (p-value)	24.45 (0.000)	28.66 (0.000)	26.86 (0.000)	26.72 (0.000)
Wald 3 (p-value)	-	-	44.12 (0.000)	44.76 (0.000)
SC1	5.220 (0.000)	4.875 (0.000)	5.116 (0.000)	5.119 (0.000)
SC2	4.479 (0.000)	4.098 (0.000)	4.312 (0.000)	4.313 (0.000)
Number of Firms	494	494	494	494
Sample size	3132	3132	3132	3132

Notes to Table

(1) Dependent variable is Rate of Return on Sales (ROS); (2) All standard errors (in brackets) are robust to both serial-correlation and heteroscedasticity; (3) SE is the standard error of the regression; (4) Wald 1 is a test of joint significance of reported coefficients, asymptotically distributed as Chi-Squared; (5) Wald 2 is a test of joint significance of the time dummies; (6) Wald 3 is a test of joint significance of the industry dummies (7) SC1 and SC2 are first and second order serial correlation tests, asymptotically distributed as $N(0,1)$

²³The results of column (4) suggest that the rate of return on sales of firms that recognize trade unions are lower by an average of 23% as compared to the average non-unionised firm. Hirsch (1991) has found a number of 14% using a similar specification applied to U.S. firms in the 1968-80 period and Machin (1991) of around 21% for British firms in 1984-85. Experiments with interactions between union recognition and the 'market power' variables (to check for evidence of some redistribution of monopoly rents) were performed without any significant result.

The serial correlation tests present evidence of persistent serial correlation, as expected in this kind of exercise, since the firms with higher than average unexplained profitability tend to be the same across periods. If this firm specific effect is uncorrelated with the included variables, then the OLS results are consistent but not efficient. It should be emphasized that all the reported standard errors are robust to any form of serial correlation that may arise from the fact that we are pooling series of observations of the same firm over time. The method used (provided automatically by Arellano and Bond (1991)'s DPD software) is similar to Newey and West (1987) and allows for lags equal to the number of observations for each firm to be used in the procedure. However, if the individual specific effect is correlated with any of the right-hand side variables, then its coefficient will also be biased. One way of examining this is to look at first-differences specifications, a task to be performed below. The exogeneity of union recognition was tested for with the use of human capital variables (proportion of female and proportion of part-timers in 1990) as instruments. The resulting recognition coefficient (s.e.) was -0.063 (0.030) but a Hausman test did not reject the null of exogeneity ($\chi^2(21) = 1.04$). A regression using the average value of the variables in the whole period (to minimize measurement error problems) resulted in a recognition coefficient of -0.024 (0.009).

Union Recognition Effect over Time

Turning now to the main focus of the paper, Table 3 presents the results of estimates including interactions of the basic recognition variable (and of the controls) with year dummies. The results are quite striking. The union recognition effect has fallen dramatically from 1984 to 1990, even after controlling for the other determinants of profitability. It also seems that the fall in the union effect in the manufacturing sector was more concentrated at the beginning of the period. The percentage union profitability differential of -39 % in 1984 was reversed to +15 % in 1990. Fig. 1 illustrates this behaviour by plotting the estimated coefficients of the interactions against the years covered by our sample (the dotted lines represent the 95% confidence interval).²⁴

²⁴We also estimated single cross-sections which produced very similar results (both in terms of coefficients and standard errors) to those reported in Table 3. The pooled results were presented instead because they are more efficient.

Table 0.3: Union Recognition Effect over Time

ROS	1984	1985	1986	1987	1988	1989	1990
Full Sample							
Union Recognition	-0.040 (0.011)	-0.039 (0.011)	-0.026 (0.010)	-0.029 (0.010)	-0.022 (0.012)	-0.002 (0.010)	0.010 (0.011)
Market Share	-0.018 (0.083)	-0.060 (0.101)	-0.009 (0.138)	-0.079 (0.125)	-0.111 (0.126)	-0.039 (0.123)	-0.047 (0.122)
Less than 5 competitors	0.010 (0.013)	-0.018 (0.017)	-0.009 (0.014)	-0.025 (0.017)	-0.039 (0.027)	-0.045 (0.018)	-0.016 (0.014)
Market Share * Less than 5 competitors	-0.114 (0.110)	0.351 (0.153)	0.153 (0.142)	0.228 (0.129)	0.284 (0.130)	0.289 (0.143)	0.213 (0.136)
Capital /Sales	0.088 (0.022)	0.051 (0.014)	0.033 (0.012)	0.033 (0.014)	0.028 (0.006)	0.031 (0.008)	0.020 (0.022)
Manufacturing Only							
Union Recognition	-0.035 (0.011)	-0.037 (0.014)	-0.026 (0.013)	-0.010 (0.014)	-0.009 (0.018)	0.019 (0.015)	0.017 (0.016)

Diagnostics	Full Sample	Manufacturing
Constant	0.084 (0.009)	0.090 (0.015)
SE	0.01061	0.0083
Wald 1	140.29 (0.00)	39.95 (0.00)
Wald 2	22.27 (0.00)	23.23 (0.00)
Wald 3	42.30 (0.00)	1.19 (0.55)
SC1	5.082 (0.000)	3.066 (0.000)
SC2	4.269 (0.000)	4.051 (0.000)
Number of Firms	494	215
Sample size	3132	1383

Notes to Table

- (1) Pooled Regression - time dummies interacting with each variable
See notes to Table 2

The behaviour of the other determinants of profitability throughout the period also deserves some inspection. The coefficient on the capital/sales ratio showed a rather pronounced fall between 1984 and 1986 and remained roughly constant after that. There is some indication that the market power interaction and the negative 'absence of competition' effect appear to behave pro-cyclically, suggesting an interesting field of future research.

Different Bargaining Structures

From the results derived in the theoretical section, some variation in the union-profitability effect is to be expected, depending on the structure of the bargaining between unions and firms. In this sub-section those predictions will be examined. Column (1) of Table 4 shows that the union impact is stronger in firms with only one establishment vis-à-vis multi-establishment firms.²⁵ However, propositions 4 and 5 in the theoretical section showed that the advantage of the multi-establishment firms in terms of disagreement pay-offs tends to be offset in the joint bargaining case. Therefore in column (3) the multi-establishment firms were split into those bargaining jointly and those bargaining separately with their various unions. Interestingly, the union impact for the firms in the joint bargaining case is very close to the one for the single-plant firms, whereas the separate bargaining firms' coefficient is smaller than both of them.²⁶ Additional experiments (not reported) were performed using a variable indicating whether the unions were recognized in all of the firms' establishments or only in some of them. These experiments indicated that the union impact is stronger in the 'all-unionised' firms, that the joint-bargaining effect is also stronger in this sub-sample and that the single-union effect, although not significant in column (2), is strongly negative only if the 'all-unionised' firms are considered.

Column (3) shows that the influence the bargaining level has on profitability is very different in the multi-union firms as compared to the single-union ones, which was expected from the theoretical results. It seems that the union impact in the multi-

²⁵Adding interactions of union recognition with size variables (like employment) to the specifications did not affect the results in this Table. The information on the number of establishments refers to 1990 and no information on changes is available. Also note that the sample size was reduced due to missing values on some bargaining structure variables.

²⁶No difference was found between the joint and separate bargaining cases for the single-plant firms.

Table 0.4: Different Bargaining Structures

ROS	(1)	(2)	(3)	(4)
Union Recognition, Single-Establishment	-0.035 (0.011)	-0.035 (0.011)	-0.034 (0.011)	-0.030 (0.010)
Union Recognition, Multi-Establishment	-0.018 (0.009)	-	-	-
Union Recognition, Multi-Establishment, Multi-Union and Joint Bargaining	-	-0.032 (0.017)	-	-
Union Recognition, Multi-Establishment, Multi-Union and Separate Bargaining	-	-0.016 (0.009)	-	-
Union Recognition, Multi-Establishment, Single-Union	-	-0.012 (0.011)	-	-
Union Recognition, Multi-Establishment, Multi-Union and Industry Bargaining	-	-	-0.046 (0.012)	-
Union Recognition, Multi-Establishment, Multi-Union and Company Bargaining	-	-	-0.011 (0.011)	-
Union Recognition, Multi-Establishment, Single-Union and Industry Bargaining	-	-	0.007 (0.018)	-
Union Recognition, Multi-Establishment Single-Union and Company Bargaining	-	-	-0.023 (0.012)	-
Union Recognition, Multi-Establishment Joint and Industry Bargaining	-	-	-	-0.072 (0.017)
Union Recognition, Multi-Establishment Separate and Industry Bargaining	-	-	-	-0.029 (0.011)
Union Recognition, Multi-Establishment Joint and Company Bargaining	-	-	-	-0.011 (0.020)
Union Recognition, Multi-Establishment Separate and Company Bargaining	-	-	-	-0.004 (0.003)
Constant	0.225 (0.078)	0.226 (0.079)	0.229 (0.078)	0.226 (0.079)
SE	0.011168	0.011153	0.011077	0.011087
Wald 1	44.65 (0.00)	43.65 (0.00)	65.52 (0.00)	66.72 (0.00)
Wald 2	20.80 (0.00)	21.72 (0.00)	20.87 (0.00)	22.24 (0.00)
Wald 3	45.46 (0.00)	45.44 (0.00)	44.90 (0.00)	46.45 (0.00)
SC1	5.014 (0.000)	5.053 (0.000)	4.951 (0.000)	4.942 (0.000)
SC2	4.213 (0.000)	4.217 (0.000)	4.150 (0.000)	4.131 (0.000)
Number of Firms	452	452	452	452
Sample size	2883	2883	2883	2883

Notes to Table

(1) All columns include dummy variables for firms that derecognized unions and for those that changed the bargaining structure in the period; (2) All controls of Table 2 column (3) are included
See notes to Table 2

union firms is much stronger when bargaining takes place at the industry level, while the opposite seems to be the case in the single-union firms. From the model developed in the theoretical section, the strongest negative effect on profitability should arise where unions bargain jointly and at the industry level (see proposition 7). Column (4) shows that this is indeed the case.²⁷ Furthermore, it seems the separate industry level case leads to lower profits than the separate firm level one (a result consistent with proposition 6).²⁸ In general, it seems fair to conclude that the predictions from the bargaining model have been confirmed by the empirical exercises.

First-Differences

The derecognition variable will now be used in an attempt to control for firm specific effects that have been omitted so far and might arguably have been responsible for part of the estimated effects obtained to date. In the place of the 'number of competitors' variable used in the levels regressions, two variables will be used (increase and decrease in competition) that reflect changes in the competition environment as perceived by the managers who answered the survey.²⁹

In Table 5 the first-differences results are set out. The simplest specification is reported first and clearly firms that derecognized unions have had faster profitability increases over 1984-90 than the other firms. This effect is robust to the inclusion of the other controls in column (2) which were, in general, imprecisely estimated. However, an interaction between decreased competition and changes in market share entered strongly, providing further evidence that market share is only important in industries with few leading firms. In column (3) we control for potential endogeneity of changes in market share, capital/sales ratio and of the interaction variable using the standard GMM estimation procedure (see Arellano and Bond, 1991). Apart from an improvement in the capital/sales estimated coefficient, no other changes in the

²⁷Note though that only 6 % of the unionised firms in our sample present both characteristics, as opposed to 13 % with joint and establ/comp level, 9 % with separate and ind. level and 25% with separate and establ/comp level bargaining.

²⁸ $\beta_{joint\&ind} = \beta_{sep\&ind} : \chi^2(1) = 7.47$, $\beta_{joint\&ind} = \beta_{joint\&comp}$
 $\chi^2(1) = 6.87$, $\beta_{sep\&ind} = \beta_{sep\&comp} : \chi^2(1) = 6.65$

²⁹The managers were asked separately about changes in the *local* and *foreign* competition. However, these variables were grouped together as they were not significantly different from each other neither for the increase in competition case nor for the decrease one.

Table 0.5: First-Differences (1985-1990)

d (ROS)	(1)	(2)	(3)	(4)
Derecognition	0.006 (0.002)	0.006 (0.002)	0.005 (0.002)	0.027 (0.012)
d(market share) ^a	-	-0.104 (0.093)	-0.106 (0.158)	-0.326 (0.136)
Increase in competition	-	0.002 (0.004)	0.002 (0.003)	0.012 (0.015)
Decrease in Competition	-	0.002 (0.003)	0.004 (0.003)	0.016 (0.015)
d(market share) *	-	0.725 (0.342)	0.808 (0.422)	0.596 (0.321)
Decrease in Competition ^a	-	-0.001 (0.136)	-0.066 (0.200)	0.007 (0.209)
d(capital/sales) ^a	-	-0.006 (0.010)	0.062 (0.042)	0.059 (0.021)
Constant	-0.004 (0.002)	-0.006 (0.005)	-0.006 (0.005)	-0.035 (0.015)
SE	0.02749	0.02751	0.02860	0.01205
Wald 1	9.03 (0.00)	14.64 (0.04)	11.94 (0.10)	24.29 (0.00)
Wald 2	31.03 (0.00)	19.14 (0.00)	21.92 (0.00)	-
SC1	-1.361 (0.174)	-1.309 (0.190)	-1.810 (0.070)	-
SC2	-1.631 (0.103)	-1.633 (0.102)	-1.646 (0.100)	-
Sargan	-	-	59.70 (0.057)	-
Number of Firms	494	494	494	494
Sample size	2336	2336	2336	494

Notes to Table

- (1) Dependent variable is change in the rate of return on sales $d(ROS)$; (2) All standard errors (in brackets) are robust to both serial-correlation and heteroscedasticity; (3) The Sargan Statistic is a Chi-Square test of over-identifying restrictions under the null of instrument validity; (4) ^a: Variables treated as endogenous in column (3). Instruments used are $X_i(t-2)$ and $X_i(t-3)$; (5) Column (4) reports the results of a long-differences specification (see main text).

parameters were visible and, in particular, the derecognition variable is robust to all specifications.³⁰ Finally, column (4) sets out the results of a 'long-differences' specification (last - first year in the sample) to try to deal with measurement error in the derecognition variable.³¹ They suggest a stronger derecognition effect, more in line with the results of the levels specifications.

As additional tests illustrating the robustness of these results, levels of (cash/liabilities) and (debt/equity) ratios lagged two and three periods were used as instruments for derecognition with a resulting coefficient (s.e.) of 0.021 (0.031), but a Hausman test (using the results of column(3)) did not lead to the rejection of the exogeneity assumption ($\chi^2(12) = 1.20$).

In Table 6 the levels results regarding different bargaining structures are shown to be robust to the inclusion of fixed effects. Firms that moved to separate bargaining patterns with different unions had an increase in their profitability over the period.³² A move towards a more fragmented bargaining structure and a decrease in the number of establishments recognizing unions (the last being a type of derecognition) also seem to be associated with higher profitability. It is worth noting that all these effects are conditional on the increasing profitability due to the decreasing union effect over time and also that only a very small number of firms have incurred more than one of these changes in the period. This suggests that the results are not being driven by a broader re-structuring strategy taking place in a small group of firms in the sample.

IV. DISCUSSION

Columns (1) to (5) in Table 7 examine whether any sort of cyclical behaviour of the union-profitability differential is driving the main results, and if so to what extent. Arguments can be found in the literature both supporting and rejecting a more pro-cyclical behaviour of the union wage differential. In line with the first, Stewart (1991)

³⁰One-digit industry dummies were included but were jointly insignificant ($\chi^2(8) = 12.8$). When used as instruments, no significant changes were noticed.

³¹The exact year between 1985 and 1990 when some of the unionised firms derecognized their unions is not known.

³²It must be emphasized that only 4% of the unionised firms in our sample experienced such a change, so that this result is only generalizable if viewed in conjunction with the results of the levels specification.

Table 0.6: Changes in Bargaining Structures

d (ROS)	(1)	(2)	(3)
Change from Joint to Separate Bargaining	0.008 (0.004)	-	-
Decentralization of Bargaining	-	0.005 (0.002)	-
Decreasing Number of Establ. Recognizing Unions	-	-	0.009 (0.003)
Union Recognition - 110 Changes over 80s	0.006 (0.002)	0.006 (0.002)	0.007 (0.002)
Constant	-0.007 (0.005)	-0.007 (0.005)	-0.007 (0.005)
SE	0.02901	0.02901	0.02899
Wald 1	18.53 (0.01)	19.23 (0.00)	18.95 (0.01)
Wald 2	16.12 (0.01)	16.23 (0.01)	16.33 (0.01)
Wald 3	-	-	-
SC1	-1.087 (0.277)	-1.085 (0.278)	-1.091 (0.275)
SC2	-1.629 (0.103)	-1.629 (0.103)	-1.632 (0.103)
Number of Firms	452	452	452
Sample size	2130	2130	2130

Notes to Table

- (1) Dependent variable is change in the rate of return on sales d (ROS); (2) All the controls of Table 5 column (2) were included;
See Notes to Table 5

argues that rigidities in union-firm bargaining process imply that union wages tend to be less sensitive to economic fluctuations. On the other hand, the simple bargaining model outlined above would predict a fall in union wages in troughs following a lower probability of workers finding a temporary job and an increase in the availability of outsider workers for the firms (e.g. Shaked and Sutton, 1984). Column (1) supports

Table 0.7: Union Profitability Effect: Cycle or Trend?

ROS	(1)	(2)	(3)	(4)	(5)
Union Recognition	-0.021 (0.008)	0.005 (0.010)	-0.021 (0.008)	-0.051 (0.012)	-0.031 (0.016)
GDP-Growth	0.005 (0.001)	0.009 (0.002)	-	-	0.007 (0.002)
Union Recognition * GDP-Growth	-	-0.008 (0.002)	-	-	-0.004 (0.002)
Trend	-	-	-0.001 (0.001)	-0.005 (0.002)	-0.003 (0.002)
Union Recognition * Trend	-	-	-	0.007 (0.002)	0.006 (0.002)
Constant	0.169 (0.056)	0.156 (0.055)	0.190 (0.158)	0.206 (0.059)	0.173 (0.059)
SE	0.01073	0.01071	0.01077	0.01072	0.01068
Wald 1	72.00 (0.00)	72.73 (0.00)	43.90 (0.00)	73.83 (0.00)	101.39 (0.00)
Wald 2	-	-	-	-	-
Wald 3	41.98 (0.00)	45.00 (0.00)	45.29 (0.00)	45.57 (0.00)	44.88 (0.00)
Number of Firms	494	494	494	494	494
Sample size	3132	3132	3132	3132	3132

Notes to Table

(1) Controls of Table 2, column (3) are included in all specifications

See Notes to Table 2

the view of a generally pro-cyclical behaviour of profit margins,³³ while column (2) suggests that unionised firms' margins are less so. Columns (3) and (4) show that unionised firms have had an upward trend in their profit margins over the 1980s and that this effect was not so clear amongst the non-unionised ones. Finally, the results of the last column wherein cyclical and trends indicators are put together suggest that, even after accounting for cyclical effects, the upward trend in the profitability of

³³See Machin and Van Reenen (1993).

unionised firms during the late 1980s remains clear.³⁴

V. CONCLUSIONS

This paper examined the impact of union recognition on the behaviour of the rate of return on sales of British firms between 1984-90. The main result is that the negative union effect on the profitability declined substantially over that period. This result seems to be consistent with the view that legislation changes have weakened the unions' "bargaining power". It also seems that the unionised firms have a less pro-cyclical profitability behaviour. On the basis of these results it can tentatively be predicted that an even better profitability comparison in favour of the unionised firms has taken place in the 1991/93 period, following the 1990 Employment Act and the deepening of the recession in the UK. As subsidiary results, it was found that the profitability of unionised firms is even lower where the firms have only one establishment and where different unions bargain jointly with the firm at the industry level. Furthermore, it was shown that the union effect persists in a first-differences specification.

VI.

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³⁴We also compared the effects of increasing product market competition in the union sector with its effect in the sample as whole (see Metcalf, 1993 and Brown and Wadhwani, 1991). The coefficient of the interaction of this variable with our basic recognition variable was proved *not* to be significantly different (at 10 % level of significance) from the coefficient of the variable alone in the 1984-90 period as a whole.

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VII. APPENDIX

Proof of Proposition 1a:

Define the profits/sales ratio as :

$$\pi/s^i(w^i, w^j) = \frac{\pi^i(w^i, w^j)}{\pi^i(w^i, w^j) + w^i L^i(w^i, w^j)} \quad (13)$$

Then:

$$\frac{\partial(\pi/s)^i}{\partial w^i} = \frac{\frac{\partial \pi^i}{\partial w^i}(\pi^i + w^i L^i) - \pi^i(\frac{\partial \pi^i}{\partial w^i} + w^i \frac{\partial L^i}{\partial w^i} + L^i)}{(\pi^i + w^i L^i)^2} \quad (14)$$

As the denominator is positive, the expression will be negative if the numerator is negative.

Proof of Proposition 1b :

Total differentiating the profit/sales function, we have:

$$d(\pi/s)^i = \frac{\partial \pi/s^i}{\partial w^i} dw^i + \frac{\partial \pi/s^i}{\partial w^j} dw^j \quad (15)$$

If $dw^i = dw^j > 0$, then : $d(\pi/s)^i < 0$ if :

$$\frac{\partial \pi^i}{\partial w^i}(\pi^i + w^i L^i) - \pi^i(\frac{\partial \pi^i}{\partial w^i} + w^i \frac{\partial L^i}{\partial w^i} + L^i) < \frac{\partial \pi^i}{\partial w^j}(\pi^i + w^i L^i) - \pi^i(\frac{\partial \pi^i}{\partial w^j} + w^i \frac{\partial L^i}{\partial w^j}) \quad (16)$$

Proof of Proposition 2 :

Represent a marginal change in the industrial relations' structure by ' $d\theta$ ' and make $Z^i(w^i, w^j, \beta^i)$ also a function of θ . Then :

$$\frac{dw^i}{d\theta} = \frac{\partial w^i}{\partial \theta} + \frac{\partial w^i}{\partial w^j} \frac{dw^j}{d\theta} = w_\theta^i + w_j^i \frac{dw^j}{d\theta} \quad (17)$$

Assuming symmetry³⁵ and solving :

$$\frac{dw^i}{d\theta} = \frac{w_\theta^i}{1 - w_j^i} \quad (18)$$

Now, given SOC :

$$\text{sign} \frac{\partial w^i}{\partial \theta} = \text{sign} - \frac{Z_{i\theta}^i}{Z_{ii}^i} = \text{sign} Z_{i\theta}^i \quad (19)$$

Assuming the stability condition for a symmetric Cournot equilibrium holds ($|w_j^i| < 1$) :

$$\text{sign} \frac{dw^i}{d\theta} = \text{sign} \frac{\partial w^i}{\partial \theta} = \text{sign} Z_{i\theta}^i \quad (20)$$

³⁵That is : $w_\theta^i = w_\theta^j$ and $w_j^i = w_i^j$. See Dowrick (1993) for the proof of the general case.

Hence, by integrating over the range $[\theta^I, \theta^{II}]$ and subject to the continuity conditions described in Dowrick (1993), a discrete change in the bargaining structure that increases the value of Z_i^i and Z_j^j will increase $w^i(w^j)$ and $w^j(w^i)$ thereby increasing w^{i*} and w^{j*} .

Proof of Proposition 3 :

In the bargaining framework analysed here, each party will always get a least the equivalent to its outside option, which act as a constraint to the solution. This means that the union workers will get at least the wage in the competitive sector. Now , given SOC:

$$\text{sign} \frac{\partial w^a}{\partial \beta^i} = \text{sign} \left(-\frac{Z_{a\beta^i}^{II}}{Z_{aa}^{II}} \right) = \text{sign} Z_{a\beta^i}^{II} \quad (21)$$

and, given the assumptions stated in the main text:

$$Z_{a\beta^i}^{II} = \frac{\pi_a^i}{\pi^i} - \frac{U_a^A}{U^A} < 0 \quad (22)$$

Proof of Proposition 4:

Evaluate $Z_a^{III}(w^i, w^j)$, that is, compare Z_a^{III} with Z_a^{II} :

$$Z_a^{III} - Z_a^{II} = (\beta^i) \frac{\pi_a^i \pi^i}{\pi^i (\pi^i - \pi^i)} < 0 \quad (23)$$

given the assumptions stated in the main text and the fact that the outcome of the bargaining must be higher than the fall-back position. Then apply Proposition 2 and condition C1.

Proof of Proposition 6:

a)

$$Z_a^V - Z_a^{II} = (\beta^i) \frac{\pi^i \pi_a^j - \pi_a^i (\pi^i - 2\pi^i)}{2\pi^i (\pi^i - \pi^i)}? \quad (24)$$

b)

$$Z_a^V - Z_a^{III} = (\beta^i) \frac{\pi_a^j - \pi_a^i}{2(\pi^i - \pi^j)} > 0 \quad (25)$$

Proof of Proposition 7:

a)

$$Z_a^{VI} - Z_a^{II} = (\beta^i) \frac{\pi_a^j - \pi_a^i}{2\pi^i} > 0 \quad (26)$$

b)

$$Z_a^{VI} - Z_a^V = (\beta^i) \frac{-\pi^i(\pi_a^i + \pi_a^j)}{2\pi^i(\pi^i - \pi^j)} > 0 \quad (27)$$

Proof of Proposition 8 :

$$Z_a^{VII} - Z_a^{II} = (\beta^i) \frac{2\pi_a^j + \pi_a^i}{\pi^i} + (1 - \beta^i) \frac{U_a^B + U_a^C + II_a^D}{U^A} ? \quad (28)$$

In Table 8, the main results including the lagged dependent variable are presented, in the light of the persistence of profitability literature (see Mueller, 1990). The derecognition variable is significant throughout the different specifications. Also note the very high estimated coefficients on the lagged profitability (less so when specific effects are controlled for). The positive union recognition effect in the levels specifications reflects the fact that unionised firms experienced a higher than average profitability growth in the period, since including a lagged dependent variable is an alternative to including changes in profitability as the dependent variable, where the coefficient of the lagged term is allowed to be different from one.

Table 0.8: Dynamics

ROS	Levels (OLS)	Levels (GMM)	First Differences (GMM)
Union Recognition	0.002 (0.002)	0.002 (0.002)	-
Derecognition	0.006 (0.003)	0.006 (0.003)	0.003 (0.001)
Market Share ^a	0.006 (0.030)	-0.005 (0.031)	-0.010 (0.147)
No (Less) Competition	-0.005 0.004	-0.005 (0.004)	0.003 (0.003)
Market Share *	0.048	0.065	0.637
No (less) Competition ^a	(0.032)	(0.040)	0.727
Capital /Sales ^a	0.008 (0.004)	0.008 (0.005)	0.036 (0.022)
More Competition	-	-	0.001 (0.003)
ROS (t-1) ^a	0.761 (0.043)	0.760 (0.043)	0.458 (0.141)
Constant	0.036 (0.013)	0.036 (0.015)	-0.005 (0.005)
SE	0.004672	0.004672	0.003397
Wald 1	728.48 (0.00)	666.97 (0.00)	25.81 (0.00)
Wald 2	25.87 (0.00)	23.36 (0.00)	17.49 (0.00)
Wald 3	9.83 (0.27)	10.06 (0.25)	-
SC1	0.658 (0.511)	0.658 (0.511)	-2.010 (0.040)
SC2	-1.627 (0.104)	-1.627 (0.103)	-1.460 (0.140)
Sargan	-	64.11 (0.37)	63.65 (0.17)
Number of Firms	494	494	494
Sample size	2994	2994	2336

Notes to Table

(1) Dependent Variable is Rate of Return on Sales (ROS) (2) All Standard Errors (in brackets) are Robust to both Serial-Correlation and Heteroscedasticity (3) (a): Variables treated as endogenous. Instruments used are $X_i(t-1)$ to $X_i(t-3)$ in column(2) and $X_i(t-3)$ to $X_i(t-6)$ in column (3)



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