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Unionization and Profitability in the Canadian Manufacturing Sector

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Article abstract

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PASQUALE LAPORTA
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This study looks at the effects of unions on profitability in the Canadian manufacturing sector, taking into account structural factors such as concentration and entry barriers. The authors find that, although there is a moderately positive relationship between unionization and profitability at low levels of concentration, at higher levels of concentration unions are able to extract an increasing proportion of incremental profits that the firm (industry) may earn, until any incremental profit (rent) associated with further increases in industry concentration is completely captured by the union. This may reflect a greater ability on the part of unions to organize and exercise bargaining power in concentrated industries and redistribute income from capital to labour, but it also leads to underproduction and resource misallocation.

Numerous studies in industrial economics have developed and empirically tested various hypotheses within the Structure Conduct Performance (SCP) paradigm, particularly within the context of profitability studies. The focus of these profitability studies has been the identification of the technological, demand and structural factors involved in the determination of profitability, using data at either the firm or industry level. There has been only partial consensus concerning the variables thought to be important and the specifications used in econometric analysis to find a "best" or most appropriate fit of the data, in part due to limited knowledge concerning both the firm (e.g., its decision-making process) and the market (e.g., seller interdependencies). This study seeks to assess the effects of unions on profitability in the Canadian manufacturing sector using Standard Industrial Classification (SIC) data at the three-digit level.

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Theory and intuition suggest that unions lower profitability by increasing production costs, particularly in the form of higher labour costs. This has been demonstrated in many previous studies (Hirsch 1991; Brunello 1992; Machin 1991). However, other studies show that, in some instances, unions can raise profitability through greater productivity (e.g., Allen 1987). These widely divergent results can be reconciled by noting that many studies have failed to recognize, and statistically respond to, the reality that there is an accompanying market structure whereby these unions can facilitate the extraction of rents, particularly in highly concentrated industries.

LITERATURE REVIEW

One model that explores the interdependence of firms in a market setting is that of Waterson (1984). It considers a simple market with N sellers of a standardized product with a single selling price, no possibility of entry, inputs purchased at given prices, and outputs sold to price takers (Appendix available upon request from the authors). In this model, Waterson demonstrates that the average price-cost margin is a function of the Herfindahl index, a conjectural variation term, and the price elasticity of demand.

Unions and Profits

One further variable which could be included in the Waterson model is unionization. One explanation of how unions extract profits or "rents" from companies was proposed by Thomas Karier (1985). Karier states that a profit-maximizing monopolist will hire labour up to the point where its marginal revenue product (MRP) equals market wage. Assuming all other factors are variable, labour's marginal revenue product curve would represent the monopolist's long-run demand for labour.

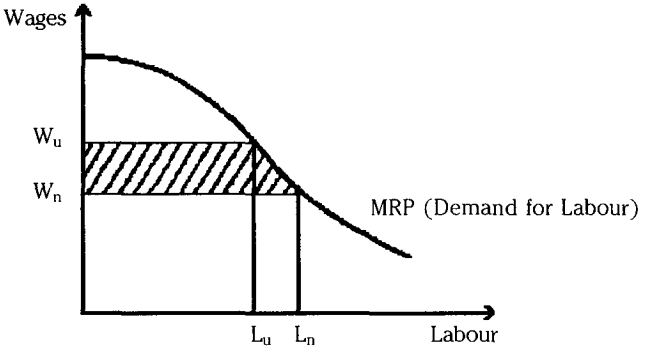
Without unions, equilibrium employment would be determined at the point where the marginal revenue product curve and the nonunion wage W_n intersect (see diagram 1). If unions exist and raise wages to W_u, then employment will decrease from L_n to L_u, the exact amount depending on the elasticity of demand for labour. Karier proposes that the profit effect (reduction) of this union wage increase is the striped area in diagram 1, which he calls the change in employer surplus.

If the average wage increases from the nonunion wage to the union wage, the change in profits is

$$\Delta\Pi = \int_{Wn}^{Wu} L \, dW \qquad (1)$$

So the greater the wage increase due to unions and the smaller the elasticity of the labour demand (in absolute terms), the greater the loss in

DIAGRAM 1

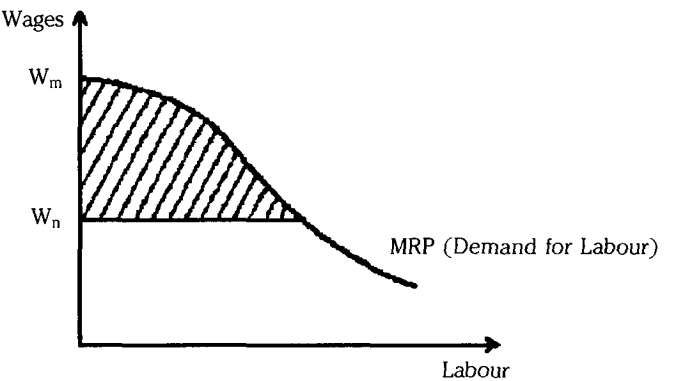


profit to the monopolist. Since the change in employer's surplus is equivalent to the change in profits, the total employer's surplus in diagram 2 is equal to total profits. This occurs if there is a maximum price for labour (W_m) at which point the demand for labour is zero. So the total value of employer's surplus or profits from W_n to W_m is

$$\int_{Wn}^{Wm} d\,\Pi = \Pi_m - \Pi_n = -\int_{Wn}^{Wm} L\,dW \qquad (2)$$

where Π_m is equal to profits at the maximum value, W_m. Since the long-run case is assumed, firms are able to liquidate all assets and profits fall to zero.

DIAGRAM 2

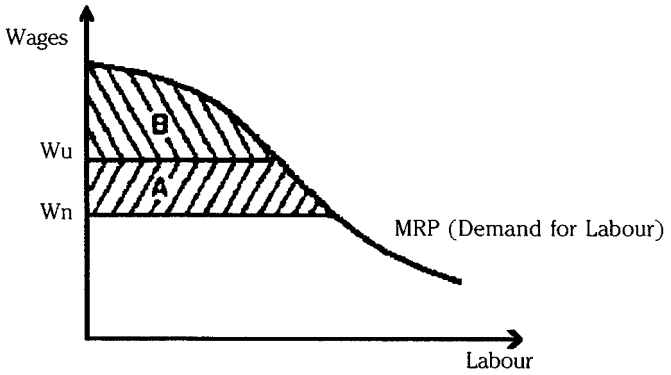


The above equation can be rewritten as

$$\Pi_n = \int_{Wn}^{Wm} L\,dW \qquad (3)$$

This integral above is the total employer's surplus, which is equal to monopoly profits in the nonunion case.

DIAGRAM 3



A monopolized industry can capture the entire surplus, which from diagram 3 above can be seen as area A + B, when the labour used is nonunion. Karier classifies this area as the "potential" profits from market power. Now if unions raise wages to W_u, then industry profits decrease by area A, and the profits "earned" are shown by area B. By way of contrast, in a perfectly competitive market, this cannot occur. Higher union wages will tend to force up product prices higher than those of nonunion firms. This will, in the long run, cause unionized businesses to fail due to their inability to compete. Even in the case where all firms in a competitive industry became unionized, profits will still remain at normal levels due to firm exit. Karier concluded from his regression analysis that industries with moderate and high levels of concentration (4–firm concentration ratios greater than 45 percent) had excess profits and that, since the union variable was negative and significant, unions appropriate a portion of the excess profits earned in concentrated industries. In contrast, the coefficient for the union variable for industries with low levels of concentration was nearly zero and statistically insignificant, which supports the hypothesis that unions have little effect on profits in relatively "competitive" industries.

Another paper that looks at this topic is that of Hirsch (1991). It looks at the effect of unions on profitability in the United States through an analysis of the earnings and market valuation of 705 publicly traded U.S. companies from 1972 to 1980. Profitability equations used the natural logarithm of Tobin's q (ln(q) the ratio of the market value of a firm to the replacement cost of its tangible assets) and the rate of return on capital (Π_k) as dependent variables. Use of the Box-Cox transformation rejected

the linear specification and supported the semi-logarithmic specification. The profit equation estimated was

$$\Pi_{it} = \alpha + \sum \beta_j X_{jit} + \sum \gamma Z_{kit} + \sum \theta_d IND_{di} + \sum \delta_m YEAR_{mt} + \psi UN_i + e_{it} \quad (4)$$

where Π_{it} was the profitability of firm i in year t, measured by either ln(q) and Π_k; α was an intercept; X represented j firm-specific variables affecting revenues and costs; Z represented k industry variables; IND represented d industry dummies; YEAR represented m year dummies; UN_i measured 1977 union coverage in firm i; and e_{it} is the error term. The error term in equation (4) was thought to be serially correlated across years within firms, since firm profit determinants in year t were likely to be positively correlated with those in year t-1. This meant that standard errors were slightly biased downwards. Therefore Hirsch decided to use a two-step model. In the first step, profitability was regressed on all time-varying profit determinants, plus 705 firm dummy variables (no intercept used). In the second step, the coefficients of the firm dummies, measuring firm fixed effects averaged over the 1972–1980 period, were used as the dependant variables in a weighted least squares regression, with all time-invariant variables as regressors. The first step OLS regression was

$$\Pi_{it} = \sum \beta'_j X'_{jit} + \sum \gamma'_\kappa Z'_{kit} + \sum \delta'_m YEAR_{mt} + \sum \phi_i FIRM_i + e'_{it} \quad (5)$$

where $FIRM_i$ represented 705 firm dummies with coefficients ϕ_i, X′ is equivalent to X except for the exclusion of company age (AGE is a linear combination of the firm and year dummies), and Z′ is equivalent to Z except for removing the time-invariant industry union variable I-UN.

A second step, weighted least squares (WLS), regression was then estimated (n=705) with the firm fixed effects ϕ_i as the dependant variable, using the inverse of the standard errors from the firm dummy coefficients in equation (5) as weights, and right-hand variables being the time-invariant variables: firm union coverage, industry union density, industry dummies (IND), company age in 1977, and the firm-specific means of variables in X′ and Z′.

The equation is

$$\phi_i = \alpha' + \psi' UN_i + \tau I\text{-}UN_i + \zeta AGE_i + \sum \theta'_d IND_{di} + \sum \Gamma_j \overline{X'_{ji}} + \sum \Theta_k \overline{Z'_{ki}} + \nu_{it} \quad (6)$$

Coefficients from the first step measure within-firm effects, while between-firm effects are captured by firm dummies. In the second step, between-firm effects are explained by differences in firm and industry unionization, age,

industry, and firm means of variables in X′ and Z′. Interpretation of the second step union coefficient ψ' in (6) is analogous to interpretation of ψ from (4). Firm-level variables used in X′ include firm size, capital intensity, R & D intensity, advertising intensity, and logarithmic sales growth. Industry-level variables in Z′ are industry sales growth, concentration, and import penetration. Included in the second step regression are firm means over time of the variables in X′ and Z′, firm union coverage, industry union density, company age, and industry dummies. Hirsch finds that union profit effect estimates ψ from OLS estimation of (4) are larger (in absolute value) than are estimates from (6), and estimates are substantially larger than expected without controlling for firm specific growth and industry.

Firm dummy coefficients from the first step ln(q) and Π_k regressions are used as the dependent variables. Hirsch finds from these results that unionized companies have significantly lower market valuation of assets and profit rates than nonunion companies. Coefficient estimates for q and Π_k are lower by an average of 12.4% and 9.2%, respectively, in an average unionized firm (UN=0.43) than in a nonunion firm. Also Hirsch finds that union-nonunion differentials in q of -4.5%, -14.7%, and -19.5% for companies with low, medium and high union coverage and for Π_k the differentials are -8.7%, -12.6% and -18.5%. Industry union coverage has no significant independent effect on profitability, after accounting for firm-level coverage. So Hirsch found that unions appropriate a share of the returns from profitable firms and that unionization had an important influence on company earnings, such that unionism cannot be ignored in profitability studies.

Another study is that of Giorgio Brunello (1992), which looks at the effect of unions on firm performance in the Japanese manufacturing industry. Brunello's sample is based on 979 unionized and nonunion Japanese manufacturers drawn from the *Yearbook of Japanese Unlisted Companies*. Using this data was advantageous because it explicitly differentiated between union and nonunion firms, and also included a substantial number of small and medium-sized firms. The firms chosen were from seven industries: electrical engineering, textiles and apparel, steel, industrial machines, glass and cement, foodstuffs, and pharmaceuticals. Of the 979 firms, 596 were unionized and 383 nonunionized.

Labour productivity was 13.5% higher in nonunion firms than in unionized firms and the capital-labour ratio was 1.5% higher in unionized firms. Unionized firms were older and had older employees. They employed fewer women and paid more than nonunion firms, but nonunion firms had higher rates of return on total invested capital (ROI), and a higher profits to sales ratio (PS).

The estimating equation used was

$$\Pi_i = \alpha_0 + \alpha_1 KS_i + \alpha_2 KS_i^2 + \alpha_3 YEAR_i + \alpha_4 YEAR_i^2 + \alpha_5 AGE_i + \alpha_6 AGE_i^2 + \alpha_7 FEM_i + \alpha_8 FEM_i^2 + \alpha_9 MS_i + \alpha_{10} MS_i^2 + \alpha_{11} + UN_i + \text{Industry Dum.} + \text{Interaction} + \varepsilon_i \quad (7)$$

where $\Pi_i = ROI_i$ or PS_i.

Brunello found that capital-labour ratios, capital sales ratios, and employment were correlated with the errors, i.e. simultaneity was present. He dealt with this potential bias by using variables aggregated by industry and partitioned by firm size as instruments and, when possible, used lagged values of firm-specific variables. Also, it was thought that current market share was also correlated with the error term, so the lagged market share was used in the regression. The union status was also thought to be correlated with the disturbance term. Accordingly, Brunello used Heckman's two-step estimator, where the first step was to estimate a probit equation for union status, and the second step was to augment the list of regressors in the profitability equation with the estimated inverse Mills ratio and its interaction with UN.

Brunello started from the above equation and simplified by excluding variables that were not significantly different from zero. He computed the relevant F test at each step until further simplification was rejected by the F test.

In both cases, the effects of unions on profitability were found to be significant and negative, regardless of whether ROI or PS was used. When the dependent variable was ROI, the rate of return on invested capital, the effect was -19.56% with OLS and -23.8% with IVM estimates. For PS, the profit to sales ratio, the effect of unions on profitability was -36.5% with OLS estimates and -37.8% with IVM estimates. It was also found that this effect was smaller in small and medium-sized firms than in large firms, due to greater pressure to cut costs and to subcontract. However, an important limitation of this paper's result is that they cannot be generalized to the entire Japanese manufacturing industry, given the specific sample chosen.

Machin (1991) examined the effect of unions on profitability using British firm-level data. The analysis indicated that unionized firms, on average, earned 1.7% less in profit margin than nonunion firms. Machin used profit margin as his measure of profitability because he felt that it more closely approximated the degree of monopoly power. Capital intensity was higher in unionized firms due to the higher price of labour, which led companies to adopt more capital intensive methods of production. Market share was also found to be higher among unionized firms, reflecting the fact that unions are more likely to be formed in larger firms. Machin included industry-level variables in his profit margin regression, such as the five-firm

concentration ratio, industry cost disadvantage ratio, industry growth variable, import and export intensity and an industry-level union variable.

The main hypothesis explored in Machin's paper was whether unions affected profitability. Machin concluded that capital intensity significantly raised profitability, as did the firm's market share. The age proxy was negatively related to profits, suggesting that newer firms earned higher rates of return and, if there was a cost disadvantage for small plants, then firm profitability was higher. However, high industry growth rates, as well as high import or export intensity, did not seem to have a significant effect on profitability. The coefficient of the union variable was negative and significant, suggesting that unions reduce the profit rate of return by 2.3% on average. The Wald test suggests that there are missing "non-linearities" in the model, which is why he introduced interaction terms.

The interaction between union recognition for bargaining purposes (RECOG) and market share was negative and significant. Machin suggested that this indicates that a firm with a higher market share is a "pre-requisite" for unions to capture rents, lowering profitability by 2.7% in this case. Since the interaction between RECOG and concentration was positive but insignificant, Machin concluded that firm market share is a more important source of union rents than industry concentration. Since the interaction between RECOG and industry-level unions was negative and significant, Machin proposed that unions are more likely to obtain rents when competitors in the industry are heavily unionized. The statistically significant positive coefficient of the interaction between RECOG and import intensity suggests that those firms or industries with less import pressure were more affected by unions. Machin therefore concluded that unions reduce profitability, not so much in conjunction with industry concentration as with a large market share for the unionized firm.

Allen's (1987) study, in its analysis of the costs of various unionized and nonunion construction projects, appears (at first glance) to find an exception to the negative unionization-profitability relationship. Allen examined a total of 195 projects divided into three categories (office buildings, elementary and secondary schools, and hospitals and nursing homes), which were further subdivided three times by square footage. Allen proposed that the cost disadvantages of union projects, relative to nonunion projects, diminish as the scale of project increases (and become an advantage in the office building case) due to better organization of larger casual labour markets, administered through union hiring halls which provide large supplies of skilled labour in a short period of time. Because unions have a greater ability to screen workers, costs arising from worker turnover, absenteeism, and uncertainty about the quality of labour are reduced.

The sample of 195 projects is broken down into 83 commercial office buildings (64 unionized, 19 nonunion), 68 elementary and secondary school buildings (57 unionized, 11 nonunion), and 44 hospitals and nursing homes (36 union, 8 nonunion). Using the translog cost function, Allen finds that, for office buildings of greater than 75,000 square feet, projects constructed by union contractors had costs only 77% of those of their nonunion rivals. But, for the other eight sub-categories of construction projects, it was found that nonunion contractors were more cost efficient. Allen attributes the greater relative cost efficiency in the construction of large office buildings to the fact that there is a "competitive union" in that market, whereas, for the other projects, a "monopoly union" exists. However, he fails to take into account product market structure in his analysis. He determines market structure ex post, rather than as part of his model. Since fewer, larger than average, contractors compete in the large office building market, with non-union contractors at a cost disadvantage and in a minority, overall wage and building costs tend to be higher, and profitability lower, due to the coincidence of high levels of industrial concentration and unionization. Allen's findings do not, therefore, diverge from those of other studies.

MODEL

Drawing on these four models, but ultimately using different estimation techniques, the basic equation used here to estimate the impact of unions on profitability, using industry data, is:

$$PS = \beta_1 + \beta_2 *KS + \beta_3 *H + \beta_4 *MES + \beta_5 *ADS + \beta_6 *MS + \beta_7 *REGD + \beta_8 *GRS + \beta_9 *UNL + \beta_{10} *CGD + \beta_{11} *RDS + e \quad (8)$$

where:

PS = net profits before direct taxes as a percentage of sales,

β_1 = constant,

KS = total assets as a percentage of sales,

H = minimum Herfindahl index calculated using the four- and eight-firm and concentration ratios, as well as the residual number of firms in the industry, with assumed equality of market shares within each of the three groups (Schmalensee min H),

MES = average market share of firms producing one-half of industry output,

ADS = advertising expenditure as a percentage of sales,

MS = imports as a percentage of sales,

REGD = regional market dummy variable (assigned a value of 1 where the industry has regional markets and a value of 0 where the industry has a national market),

GRS = percentage growth or decline in sales over years 1982-1987,

UNL = number of unionized workers in each industry divided by the total labour force in each industry (= percentage of workers in each industry that are unionized),

CGD = consumer goods dummy variable (assigned a value of 1 for consumer goods industries and a value of 0 for producer goods industries),

RDS = research and development expenditure as a percentage of sales, and

e = error term.

PS, or net profits to sales ratio, is a variation of the rate of return on assets measure, as shown by Collins and Preston (1969):

$$\frac{P - v - (\rho + \delta)(K/Q)}{P} = \frac{PQ - vQ}{PQ} - (\rho + \delta)\frac{K}{PQ}$$

where

P = price, v = variable cost per unit, Q = output, K = dollar value of capital employed, ρ= competitive rate of return and δ = depreciation rate of capital.

The first term on the right is the price-cost margin, as is used in this study. Under competitive conditions, this term should on average equal the second term, which is the required rental on assets per dollar of sales, which is used as a independent variable in this study. One assumption made here is that the competitive rate of return (ρ) and the rate of depreciation (δ) are the same for all industries in the sample.

KS, or capital to sales ratio, which is the second term describe above, would tend to be higher in highly unionized industries as firms switch to more capital intensive procedures, due to the relatively higher cost of labour. KS also acts as an entry barrier, since high capital requirements, or sunk costs, deter entry, as these costs are not recoverable upon exiting the industry. H, or the Herfindahl index, is a measure of concentration which would tend to have a positive effect on profits and on the degree of unionization, as noted above by Machin, who argues that unions are more likely to form and to be better able to extract rents in highly concentrated industries.

MES will act as an entry barrier, as a higher percentage of the industry producing at MES (Minimum Efficient Scale) will put newer and/or smaller firms in the industry at a cost disadvantage, making them less profitable or

less willing to enter the industry; on the other hand, it would make larger, more efficient firms more profitable, since it is assumed that the largest firms are the ones that are often able to produce at a least-cost position (lower or minimum point on average cost curve) over those smaller or newer firms in the industry. This helps to explain why these firms tend to be larger in size and tend to stay in the industry longer than other firms in the same industry.

ADS, or advertising expenditures as a percentage of sales, may prove to be endogenous, along with H. If tests for simultaneity are positive, an appropriate simultaneous equations estimation procedure is necessary for consistent and efficient estimates. ADS is expected to act as an entry barrier and to enhance market power, with a corresponding positive impact on profitability. MS, or import intensity, would tend to restrict the exercise of seller market power and the power of unions, as imports compete with comparable Canadian goods, thus lowering profitability. GRS, or growth in sales, would be positively related to profitability, as fast growing industries tend to have higher rates of profits (especially in capital intensive industries where supply lags are more likely), which unions can then extract.

Research and development would have a positive effect on profitability if there is sufficient patent protection for the discovery of new technologies or processes. However, it has been shown that research and development expenditures tend to be lower in highly concentrated, unionized industries (see Hirsch and Connolly 1987).

UNL is a measure of concentration of unions in each industry, with those industries that are more unionized, on average, expected to have lower levels of profitability due to the extraction of rents by unions through higher wages and benefits and featherbedding (pecuniary and nonpecuniary) unless unions share any productivity increases with firms. However, it may also be the case that profitability and unionization are endogenous, as unions are more likely to form in industries where there are greater rates of profitability from which unions can extract rents. In that case, UNL may have a positive, rather than a negative relation with PS. HUNL, an interactive term involving the Herfindahl index and UNL, controls for the possibility that unions have the potential to extract relatively larger rents in those industries that are highly concentrated, not only because higher profits exist but also through the greater exercise of bargaining power by unions in a partially unionized, non-competitive/concentrated, industry. It is also readily demonstrated that the profits of a (product) monopolist are diminished within the context of successive (labour and product) single-stage monopolies.

Two dummy variables were developed in order that certain aspects of the market were taken into account in the profitability analysis: the first is a regional market dummy variable (REGD), which is used to distinguish national

from local or regional markets; the second is the consumer goods dummy variable (CGD), which separates the effects of consumer versus producer goods industries.

The REGD variable identifies those industries that tend to be of a local nature, possibly due, for example, to high shipping costs or the length of the life of the product. In those industries, producers are often able to charge a premium above the price that would be charged if the product were sold on a national scale, due to limited competition, or the inability of consumers to find an appropriate substitute for the good, without incurring high transaction or transportation costs. In those industries with regional markets, the tendency would be to have higher profit rates on average than those industries that are national in nature.

The CGD variable (which is 1 for consumer goods industries and 0 for producer goods industries) is expected to have a positive coefficient, since consumer goods industries would on average have higher profit rates than producer goods industries, due to the lack of buying power by consumers, compared to producers, as they are not able to form sufficiently large buying groups, with the ability to reduce the purchase price of goods.

DATA

Financial data, primarily for 1987, for total assets (K), profits (P), sales (S) and growth in sales (GRS) were taken from Statistics Canada's *Corporation Financial Statistics* (a yearly publication last released for 1987). Advertising expenditures (ADS) as a percentage of sales on an industry level were available for 1965 and 1989. The 1989 data is only for small businesses (that is, for companies that have less than 5 million dollars in annual sales), but were at least more timely than the obviously dated 1965 data. The correlation between the 1965 and 1989 data for common industries is 0.71062. The data for the minimum H, or the Herfindahl index, were retrieved from the CANSIM data base using the four- and eight-firm concentration ratios and the number of firms in each relevant three-digit industry. It was constructed using the formula, originally used by Richard Schmalensee (but expressed as a percentage):

$$MIN\ H = [(\frac{CR4}{4})^2 * 4 + (\frac{CR8\text{-}CR4}{4})^2 * 4 + (\frac{1\text{-}CR8}{N\text{-}8})^2 * (N\text{-}8)] * 100$$

Since there has been no actual reported data on the Herfindahl index at the three-digit level since 1980, other than at the two-digit level, MIN H is

used as a proxy for H. As mentioned earlier before, this is a minimum value, as it assumes that the distribution of market share among each of the top 4, 8, and remaining N–8 firms is equal in each group. This, of course, is not the case, which would lead to an understatement of the true H. Nonetheless, min H is a reasonably good proxy for the actual Herfindahl index, and it does incorporate more information about market structure than CR_4 or CR_8 alone. The correlation between the min H in 1980 and the reported H for 1980 was 0.71187. For the Minimum Efficient Scale variable (MES), the measure that has been used in several previous studies as a proxy for the economies of scale variable is the average market share of the largest firms comprising fifty percent of the industry. Although a more direct measure of minimum efficient scale for Canadian manufacturing industries is found in a working paper by Fuss and Gupta (1979), it reflects Canadian manufacturing industries for the years 1965–1968. This would be an inappropriate measure for MES due to the many changes in technology over the last twenty years. Imports (M) were allocated to each of the three-digit industries using the *Imports by Commodity* publication by Statistics Canada. Since imports are classified by commodity, rather than by industry, it was necessary to allocate the commodities to the appropriate manufacturing industries. On average, the commodities classification and the industrial classification were similar. This exercise was made easier by using a detailed list of what is considered to be contained in each of the three-digit SIC industries. Research and development expenditures as a percentage of sales (RDS) was found in the 1987 Statistics Canada publication *Industrial Research and Development Statistics*. This is the only available source for industry expenditure on research and development, but unfortunately it is reported only at a two-digit level SIC. Hence all three-digit industries in the same two-digit grouping were assigned the same value of RDS. The union variable (UN) and the labour variable (L) were necessarily obtained directly from Statistics Canada at modest expense, due to the fact that the only industry data published on unionization is at a two-digit level of aggregation. Although the data obtained was for 1988 rather than 1987, no significant change in unionization over that one year was expected. The regional market (REGD) and consumer goods (CGD) dummy variables were constructed with the help of the analysis of Jones, Laudadio, and Percy (1973), and Jenkins (1993), as well as through choosing the most "appropriate" category for those industries not previously defined elsewhere.

All of the variables used in the regression analysis were formulated in a percentage form (for easier interpretation), except for the regional and consumer goods dummy variables which take on values of one or zero (see Table 1 for variable means and standard deviations).

TABLE 1

Means and Standard Deviations of the Variables Used

Variable	*Mean*	*Standard Deviation*
PS	7.8488	7.1012
KS	82.119	45.789
H	6.7848	5.9817
MES	8.808	7.5836
ADS	0.9046	0.7113
MS	37.419	50.005
REGD	0.33871	0.47713
GRS	42.868	31.958
UNL	21.775	17.118
CGD	0.37097	0.48701
RDS	1.5387	2.8278

Note: Sample size (N) = 62

ESTIMATION

Initially, ordinary least squares (OLS) estimation was used with the original variables only (see Table 2 for regression results). The Breusch Pagan test, as well as other diagnostic tests for heteroskedasticity indicated statistically significant heteroskedasticity. Accordingly the error terms were plotted against the variables used in the initial regression in order to determine which variable(s) were involved in the heteroskedasticity. Since this procedure failed to identify these variable(s), White's error correction (using HETCOV in OLS estimation) was used. This preserves the ability to make statistical inferences, but does not minimize variance as in the case of Generalized Least Squares (GLS). To perform GLS, however, one would have to know the exact form of the heteroskedasticity.

In the final specification, heteroskedasticity was found to be "remedied" by the use of weighted least squares estimation, with the weighting variable the reciprocal of GRS, or 5-year growth in sales. This choice had intuitive plausibility as industries with high rates of growth tend to have a large variation in profitability due to their varying abilities, depending upon technological and structural interactions, to increase production to meet demand. The speed of adjustment from a position of disequilibrium back to one of equilibrium is thought to be especially variable across industries. The WLS regression results reported in Table 2 are expected to be unbiased and consistent.

TABLE 2

OLS Regression Results

Variable	*OLS (initial)*	*OLS (final)*	*OLS(weight=1/GRS)*
CONSTANT	-2.5992	-12.817*	-18.515*
CGD	-2.0035	14.611*	17.574*
KS	0.11818*	0.20983*	0.26702*
KSCGD		-0.2044*	-0.22656*
MES	-0.45786	0.4006**	0.56011*
MESCGD		-0.76819**	-0.80845**
ADS	1.1345	5.1168*	7.2363*
ADSCGD		-4.5534*	-6.3607*
REGD	3.349*	3.8429*	3.8642*
GRS	-0.00084402	0.076123	0.12113*
GRSKS		-0.0012356	-0.0020234*
H	-0.072029	-0.44762***	-0.50716**
HCGD		1.1726*	1.1747*
UNL	0.031649	0.0958**	0.12148*
HUNL		-0.013907*	-0.018388*
ADJUSTED R^2	0.6472	0.8151	0.8948
SSE	907.3	438.19	369.3
σ^2	17.79	9.3232	7.8575

Note: Significance at the 1%, 5%, and 10% levels indicated by *,**,***.

There is no indication of autocorrelation in the model, as would be expected in a cross-section study. However, tests for autocorrelation would also detect other problems such as incorrect functional form. Testing for functional form using the Mcaleer and Bera test, it was found that the logarithmic specification could be rejected. The linear specification, however, failed to be rejected at a five percent level of significance. Hence the linear form is used in the regression analysis.

There may be a problem, as discussed earlier, of endogeneity in the model, in particular involving PS, H, ADS and UNL. Using an Instrumental Variables or Two Stage Least Squares (2SLS) regression analysis, where the instruments used were number of corporations in the relevant three-digit industry (NCO) and the previous year's sales figure in the industry (S86), and performing the Hausman test for endogeneity of PS, H, and ADS and of PS and UNL, the hypothesis of no endogeneity among these variables in our model failed to be rejected at the 1% level of significance. This result is, of course, dependent upon whether the instruments used were appropriate, or "good" instruments; that is, they are highly correlated with the explanatory variables in general, and uncorrelated with the error term.

Another possible econometric problem is imprecise estimation due to multicollinearity. For example, the correlation between H and MES was 0.93436. One possible response is dropping one of these variables, but this is inappropriate as they are both potentially important factors in determining profitability. Other econometric methods intended to "remedy" the problem include the use of Principal Component (PC) analysis and Ridge Regression. Both these methods basically "trade off" biasedness in the coefficients for a lower standard error. In the case of principal component analysis, a non-exhaustive set of linear combinations of the explanatory variables is used to explain the variation in the dependent variable. The problem here is that, even if the coefficients for the explanatory variables are now more "significant", it is at the cost of a loss of explanatory power and the biasedness of coefficients. Ridge regression has a similar rationale, whereby one accepts biasedness in the coefficients in return for lower standard errors. Again, some of the same problems arise, as now the estimates are both biased and inefficient. If no remedy for multicollinearity were pursued, then at least unbiasedness in the coefficients would be achieved and maximum explanatory power gained from the model. Therefore, neither principal component analysis nor ridge regression results were shown here or used in the final estimation, especially since the results were neither robust nor always plausible in sign or magnitudes of coefficients.

Finally, additional interaction variables were included that had "economic" justification based on economic theory, e.g., ADS and CGD. Others were found to be insignificant, so they were dropped and not used in the final specification.

REGRESSION RESULTS

Looking at the final WLS regression in Table 2, the value of the coefficient for KS is positive and statistically significant, with an implied rate of return to capital of 26.7% — much higher than the (more normal) 11.8% of the OLS regressions. However, using the average KS of 82.119 and combining with the constant of -18.515, a producer goods industry of minimal concentration and other variables approaching zero would have a mean profit of 3.41%. Similarly, the coefficient of the CGD variable suggests that consumer goods industries earn a 17.574 % higher rate of profit than producer goods industries. However, this result is best interpreted in light of the coefficient of the KSCGD variable, — again using the average of KS of 82.119, the consumer goods industry has almost identical profits to those of a producer goods industry of minimal concentration and similar "zero" characteristics (2.38% vs. 3.41%). These four variables (and possibly even UNL discussed below) should be dealt with together, as their individual

effects cannot be precisely isolated, possibly due to the absence of an elasticity of demand variable in the estimated equation. Omission of elasticity of demand, a variable felt to be important in the regression, can cause biasedness in the estimation of other coefficients, which should be taken into consideration when evaluating the regression results.

The coefficient of the MES variable had a positive and significant value (0.56011), suggesting that economies of scale in production are an important entry barrier leading to an increase in profitability (i.e. a 1% increase in the minimum efficient scale point in production enables a 0.56% increase in profitability).

ADS had a significant and positive coefficient, while ADSCGD had a significant, negative coefficient, implying a large/small positive effect of advertising on profits in producer/consumer goods industries. Perhaps advertising in consumer goods industries is a costly form of non-price rivalry which erodes potential, entry-barrier related, profits within consumer goods industries (e.g., beer, cereal, and detergent).

The coefficient of the REGD variable, which is significant and positive, indicates that industries that have regional markets enjoy a 3.86% higher level in profitability, supporting the hypothesis that industries with regional markets exercise greater market power than those which operate on a national market basis.

The positive coefficient of the GRS variable supports the idea that industries that grow faster will achieve higher levels of profitability, due to the possibility that supply requires time to catch up with increases in demand, with prices rising and those who most value the product actually obtaining the good. The coefficient of the GRSKS interaction is found to be negative and significant; for KS equal to its mean value, the combined GRS and GRSKS coefficient is -0.04503. A possible explanation for the negative sign for the coefficient of GRSKS is that, in times of high industry growth in sales, prices, output and revenues rise, but so do costs. If in the short-run period of growth, firms have to deviate from their long-run cost curves onto to their short-run cost curves, due to this disequilibrium, then it may be the case that for firms in capital-intensive industries wishing to maintain (or perhaps enhance) their current market positions, costs increase sharply and profits may go down, in the short term, in order to maximize long-run profits.

The MS and RDS variables were dropped in the final specification. This was justified by their insignificance and by the fact that previous studies have found mixed results.

The H variable was found to have a statistically significant, negative coefficient, which is contrary to economic theory. This may be due to the

fact that the existence of fewness of firms is a necessary, but not a sufficient condition, for increased profitability. However, combining the coefficients of H and the HCGD interaction variable, an overall statistically significant positive value was obtained, giving some validity to the hypothesis that, at least in consumer goods industries, where no offsetting monopsony power exists, concentration leads to higher profits.

The coefficient of the union variable UNL was positive and significant, which suggests that unions contribute to an increase in profitability. This is possibly due to unions' facilitating an increase in productivity, perhaps by reducing worker turnover rates, achieving higher levels on the "learning curve", or increasing the sense of team play. However, it may also reflect a tendency for profitable industries to attract unionization, even though previous testing of the data showed no sign of endogeneity between profitability and unionization, i.e. high profitability encourages unions to organize in these, as opposed to minimally profitable, industries. Moreover, noting the negative coefficient for HUNL, the coefficient of the combined union variable, $\delta PS/ \delta UNL$, is 0.12148 - 0.018388H, which becomes negative for H>6.6065 (modestly below the mean H of 6.7848). In addition, $\delta PS / \delta H$ is -0.50716 + 1.1747 CGD -0.018388 UNL, suggesting, for example, that for each one percent increase in concentration (H) in a consumer goods industry with average unionization, unions appropriate 0.4004 / 0.66754 = 59.98% of any incremental profit. Once UNL reaches 36.03%, unions are able to capture all of the incremental profits from further concentration. Unions are apparently able to extract some or all of monopoly profits as rents, whether in the form of higher wages or benefits (pecuniary or nonpecuniary). This is quite consistent with the expectation that firm profits within a context of successive single stage (labour and product) monopolies will be lower than the profits of a nonunion monopolist. In any event, it is clear that the effects of unions on industry profitability should be explored in conjunction with the effects of concentration.

CONCLUSIONS

Within the context of a broadly specified industry profitability analysis for the Canadian manufacturing sector in 1987, it was determined that there was a modest positive relation between profitability and unionization in industries of below-average concentration, but an increasingly negative impact of unionization on profitability, as the level of industry concentration rose. For industries with concentration (H) above 6.61% (and the mean H of 6.78%), this effect was explicitly negative, with (for example) unions appropriating 60%/100% of incremental profits from further concentration at a unionization level of 21.78% (mean)/ 36.30% in consumer goods industries.

Second, unions seem to have a stronger rent/profit incentive to form in concentrated industries. Although this might be viewed as leading to more egalitarian income distribution, the juxtaposition of two successive single stage monopolies (labour – product) is generally conducive to higher prices and, unless the union facilitates greatly improved productivity, a higher degree of underproduction/resource misallocation, leading to a possible equity-efficiency trade-off for labour legislators.

To improve the results of this study, a larger and more detailed sample would be needed, although data appears thus far to be unavailable, given the current position of the Canadian government on the funding and collecting of statistics. Also, different industry definitions may improve the results; it is possible that the current groups of firms comprising the "industry" may misrepresent the true "competitive" nature of the relevant market. This would require a restructuring of the current SIC code in Canada. The last such restructuring was in 1984. It is also possible that there are variables that are omitted from the analysis, and thus the estimates are "suboptimal". In addition, a firm-level analysis might prove to be more "useful" than one using industry-level data. Again it does not appear that this is possible due to data limitations. Finally, it would be a worthwhile exercise, if the data were available, to attempt to measure more directly the productivity effects of unions for purposes of weighing their more favourable efficiency consequences.

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RÉSUMÉ

La syndicalisation et la rentabilité dans le secteur manufacturier canadien

En procédant à une plus grande intégration de la théorie et de la méthodologie empirique de l'économique du travail avec celles de l'organisation industrielle, la présente étude veut explorer de façon rigoureuse l'impact des syndicats sur la rentabilité — surtout celle résultant de la concentration industrielle, dans le secteur manufacturier canadien. Nous spécifions et estimons une équation de rentabilité industrielle contrôlant non seulement le degré de syndicalisation, mais également des variables, et leurs interactions, telles les conditions de base de demande et de technologie (intensité de capital, la dichotomie des biens de production, biens de consommation, et le taux de croissance des ventes) et l'interaction entre de hauts niveaux de syndicalisation et la concentration.

Un échantillon de 62 industries manufacturières canadiennes en 1987 et une procédure d'estimation de moindres carrés interactifs pondérés ont été utilisés pour estimer l'équation de rentabilité (le rapport profits avant impôts/ventes). Lorsque prévus théoriquement et statistiquement significatifs, les effets interactifs sur la rentabilité impliquant des paires de variables furent captés dans l'équation de régression : par exemple, l'intensité de capital et le taux de croissance des ventes ; l'intensité de publicité et une variable dichotomique des biens de consommation ; la concentration et une variable dichotomique des biens de consommation ; concentration et syndicalisation.

Les résultats démontrent une relation modestement positive entre la syndicalisation et la rentabilité à des bas niveaux de concentration, reflétant possiblement des augmentations de productivité dus aux syndicats. Cependant, la relation syndicalisation-rentabilité, reflétant les effets combinés de la syndicalisation seulement (positifs) et l'interaction entre la syndicalisation et la concentration (négatifs), devient de plus en plus négative à des niveaux de concentration au-dessus de la moyenne. Ce résultat respecte la théorie du monopole à stade unique successif (main-d'œuvre et produit) selon laquelle l'exercice du pouvoir monopolistique du syndicat est plus efficace dans des marchés du travail hautement syndiqués et a un impact négatif plus grand sur la rentabilité dans des marchés du produit en aval concentrés/monopolisés. De plus, dans les industries de biens de consommation avec

des niveaux typiques de syndicalisation (22 %–36 %), les syndicats sont capables de s'approprier de 60 % à 100 % du profit additionnel associé à une plus grande concentration de l'industrie.

Vu ces résultats, il semble que les syndicats produisent un incitatif financier plus grand et des rendements plus intéressants ainsi qu'une plus grande habileté à organiser, à utiliser leur pouvoir de négociation, dans ces industries concentrées avec un grand employeur oligopolistique. Même si cela peut mener à une distribution plus égalitaire du revenu en redistribuant les profits des capitalistes monopolistiques aux travailleurs syndiqués (sous forme de salaires plus élevés, meilleures conditions de travail et une plus grande sécurité d'emploi), cela peut aussi causer (sauf dans ces rares cas de marchés du travail bilatéralement monopolistiques) la sous-production, le sous-emploi et une mauvaise allocation des ressources associées à un plus grand degré de monopole à stade unique successif.