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THE EFFECTS OF PRODUCT MARKET COMPETITION ON COLLECTIVE BARGAINING AGREEMENTS: THE CASE OF FOREIGN COMPETITION IN CANADA

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ABSTRACT

In this paper we study the connections between product market conditions, negotiated wage settlements, and union employment in the presence of foreign competition shocks. We exploit the fact that in a small open economy such as Canada the price of imports and exports should represent pure demand shocks. We specify wage and employment determination equations for a sample of collective bargaining agreements from 1965 to 1983. Our estimation strategy consists of specifying the wage as a function of firm-specific value added per worker instrumented with the price of imports and the price of exports in the industry. The OLS specification is rejected in favor of the instrumental variables specification using standard specification tests. The instrumental variables estimates imply that a 1% change in value-added per worker increases the negotiated wage settlements by 0.25%. Similarly, we specify union employment as a function of firm-specific sales instrumented by the price of imports and exports in the industry. The instrumental variables estimates are imprecise and the specification test fails to reject the OLS specification. The OLS estimates imply that a 1% change in firm-specific sales increases employment by 0.19%. We use our estimates to trace the effects of foreign competition on the industry and firm-level sales and value-added measures.

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I. INTRODUCTION

How do product markets conditions influence collective bargaining agreements? Are negotiated wages more sensitive to the firm profitability conditions or to the wages of similar workers in other firms? Although these questions have been at the center of many controversies in the literature on wage determination, they have become particularly important during the last two decades as foreign competitors penetrated the North American product markets.[1] Many recent papers have linked the decline in manufacturing employment, and in particular unionized manufacturing employment, to foreign competition; however, no conclusive evidence supports the view that foreign competition has systematically depressed negotiated wage settlements in unionized manufacturing firms.[2] This is hardly surprising since, in theory, foreign competition has an ambiguous effect on negotiated wage settlements.[3]

The recent internationalization of product markets in Canada and in the United States nevertheless suggests a research strategy for measuring the connections between product market conditions and collective bargaining agreements: in a small open economy like Canada, movements in import and export prices should represent pure demand shocks. It is then possible to use these shocks to identify how changes in the value of quasi-rents affect wage settlements. This point is important since constructed measures of

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[1] See for example Dunlop (1950) and Ross (1956) among others.

[2] Freeman and Katz (1990), Abowd and Lemieux (1990), Revenga (1990).

[3] See the discussion in Abowd and Lemieux (1990). The point is simply that there is no reason to expect the quasi-rent per worker to go down when product prices go down. In fact, the quasi-rent should stay constant for a Cobb-Douglas or a CES production function. See also Grossman (1984) and Staiger (1988) for related arguments.

firm specific quasi-rents are typically plagued with substantial measurement error which attenuates the estimated coefficient of quasi-rents on wages. Furthermore, quasi-rents are endogenous in a wage determination equation when the bargaining power of unions (or firms) is systematically related to the size of the quasi-rents. One central idea of this paper is thus to instrument the quasi-rents using price-based measures of international competition in a wage determination equation. A similar strategy will also be used to estimate conditional demands for unionized labor.

Section 2 of the paper presents a conceptual framework for analyzing how foreign competition affects collective bargaining agreements. The framework used builds on two ideas: first, collective bargaining agreements are characterized by the strong efficiency property of Brown and Ashenfelter (1986). As a result, wage and employment determination can be modeled separately without worrying about endogeneity issues. Second, international competition is analyzed in the context of a three goods models: one import good, one export good, and one good that can only be produced and consumed domestically. This simple model is useful for interpreting the connection between import and export prices and the state of domestic product markets.

In section 3, we discuss the empirical implementation of the concepts introduced in section 2. In particular, we discuss the problems associated with combining data from different sources such as collective bargaining agreements, firm financial reports, output and factor demands at the industry level, and import and export prices for a variety of commodities.

The empirical analysis is then performed in two stages. First, the effect of price-based measures of foreign competition on output, product prices, employment, and value added per worker at the industry level is analyzed in section 4. The estimation is performed using data from twenty

Canadian manufacturing industries at the two-digit level from 1965 to 1983. The micro employment determination and wage determination equations are then estimated in section 5. The data consist of a panel of collective bargaining agreements (negotiated wage and covered employment) in the Canadian manufacturing sector from 1967 to 1984. These data are merged with a series of firm-specific variables such as sales, firm-wide employment, and a measure of value added (or quasi-rents) per worker obtained from COMPUSTAT and related data sources.

We conclude in section 6.

II. THE MODEL

In this section, we analyze how negotiated wages and employment levels are affected by product market competition when contracts are strongly efficient. Like Brown and Ashenfelter (1986), we use the term "strongly efficient" to refer to the total quasi-rent maximization model of union wage determination put forth by Dunlop (1944). The key implication of strongly efficient contracts is that employment is set at a level such that the value of the marginal product of labor is equal to the alternative wage, irrespective of the actual negotiated wage. The level of employment is, thus, Pareto efficient.

Assume that there are only two production factors, labor and material inputs. Consider a log-linear specification for the conditional demand for labor. Under efficient contracts, the conditional demand for labor is given by:

$$\ln(L_i) = \delta_0 + \delta_1 \ln(X_i) + \delta_2 \ln(R_i) + \delta_3 \ln(Q_i) + \epsilon_{Li} \qquad (1)$$

where X_i is the alternative wage, Q_i the firm specific output level, and R_i the price of material inputs. The error term ϵ_{Li} represents either measurement error or an unobserved productivity shock correlated with Q_i.

The quasi-rent is equal to the value of the sales S_i minus the value of material inputs and labor evaluated at their opportunity cost. Quasi-rents per worker are thus given by:

$$QR_i = (S_i - m_i S_i - X_i EMP_i)/EMP_i \qquad (2)$$

where m_i is the share of material costs in the value of output, EMP_i represents total employment in the firm, not just in the bargaining pair. Bargaining over the wage consists of splitting the quasi-rent between the two parties. The negotiated wage is thus equal to:

$$W_i = X_i + \gamma_i' QR_i \qquad (3)$$

where γ_i' is the quasi-rent splitting parameter that reflects the relative bargaining power of the union (Abowd 1989).

In the data, the value added per worker V_i is always positive while the quasi-rent per worker QR_i is not, where V_i is defined as:

$$V_i = (S_i - m_i S_i)/EMP_i \qquad (4)$$

The log of the value-added per worker $\ln V_i$ thus always exists while the log of the value-added per worker $\ln QR_i$ does not. Furthermore, price deflators are easily constructed for value added.[4] It is preferable to use the value added per worker in the empirical analysis because of these considerations. Using the identity $V_i = QR_i + X_i$, the wage determination equation (3) becomes:

$$W_i = (1-\gamma_i')X_i + \gamma_i' V_i \qquad (5)$$

The natural logarithm version of the wage determination equation (4) is obtained using a first-order Taylor approximation:

$$\ln(W_i) = \gamma_0 + (1-\gamma_i)\ln(X_i) + \gamma_i \ln(V_i) \qquad (6)$$

where $\gamma_i = (\gamma_i' E[V_i])/(\gamma_i' E[V_i] + (1-\gamma_i')E[X_i])$ and $\gamma_i < \gamma_i'$. We introduce a

[4] In fact, price deflators for value added are constructed primarily for the purpose of calculating the real GNP (sum of value added for all economic activities).

stochastic structure to the wage determination equation by assuming that the quasi-rent splitting parameter, γ_i, follows a distribution with mean γ. The wage determination equation (6) is thus a random coefficient model that can be rewritten as:

$$\ln(W_i) = \gamma_0 + (1-\gamma)\ln(X_i) + \gamma\ln(V_i) + \epsilon_{iw} \tag{7}$$

where $\epsilon_{iw}=(\gamma_i-\gamma)(\ln(V_i)-\ln(X_i))$.

The parameter δ_3 in equation (1) is the elasticity of employment with respect to firm specific output Q_i while the parameter γ in equation (7) is the elasticity of negotiated employment with respect to firm specific value added per workers V_i. These two parameters thus measure the extent to which foreign competition shocks get transmitted to wage and employment through the firm specific product market variables Q_i and V_i. Since price-based and quantity-based measures of foreign competition are only available at the industry level, we analyze the effects of foreign competition on product market variables at that level. Industry-wide and firm-specific product market variables are related by the following decomposition:

$$\ln(V_i) = \ln(V) + v_i \tag{8a}$$

$$\ln(Q_i) = \ln(Q) + q_i \tag{8b}$$

where V is the industry-wide value-added per worker, Q is the industry-wide output level; v_i and q_i are firm-specific departures from the industry-wide conditions. By definition, v_i is orthogonal to ln(V) and q_i is orthogonal to ln(Q). We analyze the effects of foreign competition on V and Q using the three goods model presented below. It will then be possible to relate foreign competition shocks at the industry level to negotiated wages and employment at the firm level, using equations (6), (7), (8a) and (8b).

A Three Goods Model of Foreign Competition.

In a small open economy, the natural measure of foreign competition for an industry producing a homogeneous good is the world price of that good. For given domestic demand and supply conditions, a lower world price increases domestic consumption and decreases domestic production of the good. Under these conditions, the domestic price is equal to the world price and the effects of foreign competition can be summarized in terms of standard price elasticities.

There are two reasons why the small open economy model is an incomplete description of the product market conditions we seek to model. First, because of product differentiation on the world market there are many similar goods which a single country might produce for domestic consumption and for exports while simultaneously importing such goods. An example is automobile brands in the transportation equipment industry. Second, because of the aggregation of related products into industry groups in the creation of national product market data, within a single standard industrial classification there can be domestic production, imports, and exports of related but dissimilar goods. An example is automobile bodies, engines and finished cars in the transportation equipment industry.

To illustrate these points, consider an industry that produces three goods: an import good, produced domestically and imported; a non-traded good, produced and consumed domestically; and an export good, produced domestically and exported. Assume that the three goods are separable in production and that they form a composite commodity separable in consumption from all other commodities. Consider the effects of foreign competition in a partial equilibrium setting. Foreign competition, thus, affects neither factor prices nor the alternative wage. However, foreign competition does affect the negotiated wage in unionized industries.

Assume the supply equations for each good are log-linear in product and factor prices:

$$\ln(Q_h) = a_{10} + a_{11}\ln(P_h) + a_{14}\ln(R) + a_{15}\ln(X) + \upsilon_1 \quad (9a)$$

$$\ln(Q_m) = a_{20} + a_{22}\ln(P_m) + a_{24}\ln(R) + a_{25}\ln(X) + \upsilon_2 \quad (9b)$$

$$\ln(Q_x) = a_{30} + a_{33}\ln(P_x) + a_{34}\ln(R) + a_{25}\ln(X) + \upsilon_3 \quad (9c)$$

where the subscripts h, m, and x refer to the non-traded, import, and export goods, respectively; Q_j is product output, P_j is product price, for $j=h$, m, and x; R is the price of the purchased factor and X is the alternative wage.

Assume the demand equations for the three goods are also log-linear in prices and income:

$$\ln(Q_h) = b_{10} + b_{11}\ln(P_h) + b_{12}\ln(P_m) + b_{13}\ln(P_x) + b_{14}\ln(Y) + \mu_1 \quad (10a)$$

$$\ln(Q_m) = b_{20} + b_{21}\ln(P_h) + b_{22}\ln(P_m) + b_{23}\ln(P_x) + b_{24}\ln(Y) + \mu_2 \quad (10b)$$

$$\ln(Q_x) = b_{30} + b_{31}\ln(P_h) + b_{32}\ln(P_m) + b_{33}\ln(P_x) + b_{34}\ln(Y) + \mu_3 \quad (10c)$$

where Y is the income allocated to the composite commodity formed by the three goods.

Equations (9a) and (10) are not proper reduced forms since the price of the non-traded good (P_h) is determined endogenously. The solution for P_h is obtained by equating demand and supply in equations (9a) and (10a) to yield:

$$\ln(P_h) = c_0 + c_2\ln(P_m) + c_3\ln(P_x) + c_4\ln(R) + c_5\ln(X) + c_6\ln(Y) + u_h \quad (11)$$

where: $c_0 = \dfrac{b_{10}-a_{10}}{a_{11}-b_{11}}$, $c_2 = \dfrac{b_{12}}{a_{11}-b_{11}}$, $c_3 = \dfrac{b_{13}}{a_{11}-b_{11}}$

$c_4 = \dfrac{-a_{14}}{a_{11}-b_{11}}$, $c_5 = \dfrac{-a_{15}}{a_{11}-b_{11}}$, $c_6 = \dfrac{b_{14}}{a_{11}-b_{11}}$, $u_h = \dfrac{\mu_1-\upsilon_1}{a_{11}-b_{11}}$

Next consider the aggregate quantity, Q, and price level, P. Since industry output is the sum of Q_h, Q_m and Q_x, its natural logarithm is approximately equal to a weighted sum of the logs of Q_h, Q_m and Q_x:

$$\ln(Q) = \theta_0 + \theta_h\ln(Q_h) + \theta_m\ln(Q_m) + \theta_x\ln(Q_x) \quad (12)$$

where θ_h, θ_m, and θ_x are the average shares of each of the three goods in production. The aggregate price level P is defined as the index associated with the geometric average of P_h, P_m, and P_x, using the same weights:

$$\ln(P) = \theta_h \ln(P_h) + \theta_m \ln(P_m) + \theta_x \ln(P_x) \tag{13}$$

The equilibrium value of P is found by substituting (11) into (13) to produce:

$$\ln(P) = \alpha_0 + \alpha_2 \ln(P_m) + \alpha_3 \ln(P_x) + \alpha_4 \ln(R) + \alpha_5 \ln(X) + \alpha_6 \ln(Y) + u \tag{14}$$

where: $\alpha_0 = \theta_h c_0$, $\alpha_2 = \theta_h c_2 + \theta_m$, $\alpha_3 = \theta_h c_3 + \theta_x$, $\alpha_4 = \theta_h c_4$, $\alpha_5 = \theta_h c_5$, $\alpha_6 = \theta_h c_6$, and $u = \theta_h u_h$.

The reduced form for industry output is:

$$\ln(Q) = \psi_0 + \psi_2 \ln(P_m) + \psi_3 \ln(P_x) + \psi_4 \ln(R) + \psi_5 \ln(X) + \psi_6 \ln(Y) + e \tag{15}$$

where: $\psi_0 = \theta_0 + \theta_h(a_{10} + a_{11} c_0) + \theta_m a_{20} + \theta_x a_{30}$

$\psi_2 = \theta_h a_{11} c_2 + \theta_m a_{22}$

$\psi_3 = \theta_h a_{11} c_3 + \theta_x a_{33}$

$\psi_4 = \theta_h (a_{14} + a_{11} c_4) + \theta_m a_{24} + \theta_x a_{34}$

$\psi_5 = \theta_h (a_{15} + a_{11} c_5) + \theta_m a_{25} + \theta_x a_{35}$

$\psi_6 = \theta_h a_{11} c_6$

$e = \theta_h (\upsilon_1 + a_{11} u_h) + \theta_m \upsilon_2 + \theta_x \upsilon_3$.

The elasticity of industry output with respect to the price of imports, ψ_2, is the sum of two terms. The direct effect, which is negative, consists of the domestic production of the import good weighted by the import good share domestic production, $\theta_m a_{22}$. The indirect effect consists of the effect of import prices on the production of the non-traded good, which occurs through the substitution in consumption from the import good to the non-traded good, $\theta_h a_{11} b_{12}/(a_{11} - b_{11})$. If the two goods are gross substitutes in consumption ($b_{12} > 0$), then the elasticity ψ_2 is always negative. The sign of the elasticity ψ_2 is ambiguous when the two goods are gross complements in consumption. Consequently, foreign competition might still have a substantial effect on home production of the import good (a_{22} large in absolute value) even though the reduced form effect is small or negative ($\psi_2 = 0$ or $\psi_2 < 0$).

Industry labor demand is the sum of labor demand for each good. The reduced form is:

$$\ln(L)=\omega_0+\omega_2\ln(P_m)+\omega_3\ln(P_x)+\omega_4\ln(R)+\omega_5\ln(X)+\omega_6\ln(Y)+e_L \quad (16)$$

A similar demand equation can be derived for material inputs M. In equation (16) the elasticities ω_j depend upon the same elasticities as the ψ_j in equation (15). In particular, ω_2 and ω_3 have ambiguous sign because of the conflicting direct and indirect effects. The elasticity ω_5 should be negative.

Consider finally the equation for value added per worker, V. We use a first order approximation of the relation:

$$V = \frac{PQ - RM}{L}$$

to yield:

$$\ln(V) = \{[1/(1-m)]\ln(PQ)\}-\{[m/(1-m)]\ln(RM)\}-\ln(L)$$

where m is the share of materials in industry output. Using the solutions for P, Q, R and M, V is a log-linear function of P_m, P_x, R, W, and Y:

$$\ln V=\pi_0+\pi_2\ln(P_m)+\pi_3\ln(P_x)+\pi_4\ln(R)+\pi_5\ln(X)+\pi_6\ln(Y)+e_V \quad (17)$$

In general, the parameters π_2, π_3, and π_6 cannot be signed by the theory. Typically, $\pi_4<0$ and $\pi_5>0$ for production functions in common use.[5]

The reduced form equations (14) to (17) imply that the effects of import prices and export prices on industry outcomes are approximately proportional to the share of import and export goods (θ_x and θ_m) in

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[5] For example, with a Cobb-Douglas production function, the share of labor is fixed and it can be shown that $\pi_2=\pi_3=\pi_6=0$. The latter result also holds in the case where the production function is a CES. This can be shown using the results in Lau (1978).

industrial production. The effects of foreign competition are not necessarily small, rather they may be limited to a small fraction of industrial production. Thus the domestic firms that produce only the imported good may still be seriously affected by the competition of foreign firms.

The model presented above does not impose any cross-equation restriction on the parameters of the reduced form equations (14) to (17). Consider a more restrictive version of the model in which the supply function for the three goods are assumed to be identical so that $a_{11} = a_{22} = a_{33}$, $a_{14} = a_{24} = a_{34}$, and $a_{15} = a_{25} = a_{35}$. In that special case, the industry supply equation (15) becomes:

$$\ln Q = \psi_0 + a_{11}\alpha_2 \ln P_m + a_{11}\alpha_3 \ln P_x + (a_{11}\alpha_4 + a_{14})\ln R + (a_{11}\alpha_5 + a_{15})\ln X + a_{11}\alpha_6 \ln Y + e$$

Combining this industry supply equation with the price determination equation (14) yields a structural industry supply equation:

$$\ln(Q) = \tilde{\psi}_0 + a_{11}\ln(P) + a_{14}\ln(R) + a_{15}\ln(X) + \tilde{e} \quad (15')$$

Similar modifications of the industry labor demand and value added per worker equations (eqs. 16 and 17) yield:

$$\ln(L) = \tilde{\omega}_0 + \tilde{\omega}_1\ln(P) + \tilde{\omega}_4\ln(R) + \tilde{\omega}_5\ln(X) + \tilde{e}_L \quad (16')$$

$$\ln(V) = \tilde{\pi}_0 + \tilde{\pi}_1\ln(P) + \tilde{\pi}_4\ln(R) + \tilde{\pi}_5\ln(X) + \tilde{e}_V \quad (17')$$

Equations (15') to (17') are interpretable as structural equations at the industry level and can be estimated using standard methods. Furthermore, the price of imports, P_m, and the price of exports, P_x, affect the industry price in equation (14) but do not enter directly in equations (15'), (16'), and (17'). P_m and P_x are thus valid instrumental variables for the industry price. P_m and P_x are also valid instrumental variables for V_i and Q_i in the wage (eq. 7) and employment (eq. 1) equations.

III: EMPIRICAL IMPLEMENTATION

The OLS estimates of the elasticity of the negotiated wage with respect to the value added per worker, γ, may be inconsistent for a series of reasons. First, even when contracts are strongly efficient, OLS estimates of γ are biased downward in the presence of measurement error in the valued added per worker, V_i. The bias may be quite severe given the nature of the empirical measure used for V_i (see the discussion below). In addition, the true variation in V_i might be small for theoretical reasons, further reducing the signal-to-noise ratio.[6]

A second problem is that the error term in the wage equation, e_{iw}, is correlated with the value added per worker, V_i, when the relative bargaining power $(\gamma_i - \gamma)$ of the union is correlated with V_i. This could happen if union organizing and negotiating activity is more successful in industries with high profits as compared to those with low profits.

The interpretation of the OLS estimates of γ becomes more problematic when contracts are <u>not</u> strongly efficient. In the absence of strongly efficient contracts, the level of employment and value added per worker both depend on the negotiated wage W_i. This generates a standard endogeneity bias in the estimated value of γ. To illustrate this point, consider a union that chooses a wage rate at random while the firm sets employment according to its labor demand function. When labor is the only production factor and the production function is Cobb-Douglas ($Q=AL^{\alpha}$), it is easily shown that:

$$\ln(W_i) = \ln(V_i) + \ln(\alpha)$$

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[6] See the discussion of equation (17) in the text. With strongly efficient contracts, V_i is fixed for a Cobb-Douglas production function and all the observed variation in V_i is pure noise.

In terms of the rent-sharing equation (7), this simple example implies a quasi-rent splitting parameter, γ, of one. The value of γ estimated by OLS converges to one for mechanical reasons. It is inappropriate to interpret γ as a rent sharing parameter.

The OLS estimates of the elasticity of employment with respect to firm's output, δ_3, may also be inconsistent because of measurement error. In addition, the error term e_{Li} in the employment equation (eq. 1) may be correlated with firm's output, Q_i, in the presence of productivity shocks. The parameters γ and δ_3 can both be consistently estimated by instrumental variables methods. It is clear from the model in section 2 that the price of imports and the price of exports are valid instrument for the product market variables V_i and Q_i; they directly affect V_i and Q_i (equations (8), (15') and (17')) but do not enter directly in the wage (eq. 7) or employment equation (eq. 1).

According to the model of section 2, the price of imports and exports are also valid instruments in the industry level equations (15'), (16') and (17'). The adequacy of the instruments can be verified by comparing OLS and TSLS estimates of these equations, in addition to performing standard specification tests on equations (1) and (7). For example, the TSLS estimates of the supply elasticity a_{11} in equation (15') should be positive, while the sign of OLS estimates of equation (15') is indeterminate in the presence of both supply and demand shocks.

It is also interesting to measure directly the effects of the price of imports and exports on industry variables (eqs. (14) to (17)), subject to the caveats mentioned in section 2. These estimated "reduced form" effects of foreign competition on the industry variables might also be biased down by measurement error in the price of imports and exports. Measurement error in the price of imports and exports does not, however, affect the validity of these variables as instruments for V_i and Q_i. The remainder of this section discusses the measurement of certain variables used in the empirical analysis.

Industry Level Analysis and Price Deflator for Value Added.

One problem with estimating equations (15′), (16′), and (17′) is that the price of material inputs and the industry price P are quite collinear by construction.[7] To avoid this problem, we conduct the empirical analysis using only one price index for the price of material inputs and the price of output. This price index is in fact a deflator for value added (P_v) that we define as:

$$\ln(P_v) = (1/(1-m))\ln(P) - (m/(1-m))\ln(R)$$

where m is the average share of material input costs in total revenue. To illustrate the implicit restrictions associated with using a single price index P_v instead of P and R, consider a structural equation for value added per worker:

$$\ln(V) = \beta_0 + \beta_1\ln(W) + \beta_2\ln(R) + \beta_3\ln(P) + \epsilon_v$$

that can be reduced to:

$$\ln(V) = \beta_0 + \beta_1\ln(W) + \beta_2^{'}\ln(P_v) + \epsilon_v$$

where $\beta_2^{'} = (1-m)\beta_3$ and the restriction $\beta_2 = -m\beta_3$ holds.

Measurement of Firm Specific Product Market Variables

We construct empirical measures of the value added per worker, V_i, and of real output, Q_i, using financial data at the corporation level supplemented by some industry level variables not observed at the

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[7] Prices of inputs and outputs at the industry level are different weighted sums of the same product prices obtained from the production price survey. The weighting scheme used comes from the input-output tables. The two series are thus often correlated for "mechanical" reasons.

corporation level. In particular, V_i is calculated using equation (3), where S_i and EMP_i represent firm-specific sales and employment, while the material share, m, is an average over all the firms in the corresponding two-digit industry. Similarly, the firm's output Q_i is simply the firm's sales, S_i, deflated by the industry price P at the two-digit SIC level. In the data appendix, we discuss the data sources used to construct V_i and Q_i, and in particular COMPUSTAT and the net product accounts by industry.

In addition to these problems, the measures of S_i and EMP_i are obtained at the level of the corporation, which does not necessarily correspond to the definition of the bargaining pair. This is particularly true for establishment level bargaining pairs in large multi-plants corporations. For all these reasons, the constructed measures of V_i and Q_i are only imperfect proxies for their true values, which strengthens the case for using instrumental variables methods.

US versus Rest of the World Trade Measures

The final measurement issue concerns the treatment of bilateral trade between Canada and the United States. The geographical proximity and the high degree of economic integration between the two countries suggests that foreign competition coming from the US differs substantially from the competition from the rest of the world: economic factors, such as productivity, that influence production prices in the U.S. also tend to influence production prices in Canada irrespective of how much trade there is between the two countries.

In other words, demand or supply shocks in Canada and in the US are strongly correlated, which invalidates the exogeneity assumption of the price of imports originating from the US in a Canadian output or employment equation. For example, supply shocks in the automobile industry are correlated since the production processes are fully integrated between the two countries. To avoid these endogeneity problems, we exclude the bilateral trade with the US from our measures of P_m and P_x. These trade prices with countries other than the US are discussed in more details in the data appendix.

IV. EMPIRICAL ANALYSIS OF INDUSTRY-LEVEL VARIABLES.

The specifications presented in this section are all estimated on the first differences of the log of the variables to handle potential fixed effects at the industry level. All the variables are also deflated by the CPI. The average rate of growth of the main industry-wide variables at the two-digit SIC level are reported in Table 1.

The OLS estimates of the reduced form equations (14) to (17) are presented in Table 2. The equations are estimated for all industries pooled together. The effect of price-based measures of foreign competition is never statistically significant in the employment equation (Table 2, columns 1 and 2). On the other hand, the alternative wage has a negative and significant effect on industry employment while the price of material inputs has a positive and significant effect, suggesting substitutability in production between labor and material inputs.

The estimated effect of foreign competition, as measured by the price of imports and exports, is positive but not always statistically significant for output and for the industry price. A positive effect means that lower prices of imports and exports (more competition) lowers industry output and price. The inclusion of year effects increases the magnitude of the estimated coefficients, except for the coefficient of the import price on output. Furthermore, the estimated coefficients of the alternative wage and of the price of material inputs are negative in the output equation and positive in the price equation, as expected. The specifications for the value added per worker are presented in column 7 and 8. Both trade prices have positive and significant effects on the value added per worker, except in the case of the import price when year effects are included.

Table 3 reports estimates of the structural equations (15′), (16′), and (17′) at the two-digit SIC level. In addition, estimates of a standard conditional demand for labor like equation (1) are reported in columns 1 and 2. The estimated elasticity of employment with respect to output is positive (.47) and significant while the elasticity with respect to the alternative wage is negative (-.30) and significant. Two-stage least squares (TSLS) estimates of the conditional demand for labor in which output is instrumented with the prices of imports and exports are reported in column 2. The estimated output elasticity decreases to .36 but the difference between the OLS and the TSLS estimates is not statistically significant (specification test statistic of .86).[8]

Estimates of the unconditional demand for labor (eq. (16′)) are reported in columns 3 and 4 of Table 3. As discussed in section 3, the price of material inputs and the industry price are combined into a single price deflator for value added. The OLS estimates of equation (16′) are reported in column 3: the estimated effect of the alternative wage on employment is negative while the estimated effect of the price deflator for value added is small and positive (.04). The TSLS estimates of the employment equation in which the price deflator for value added is instrumented with P_m and P_x are reported in column 4. The estimated

[8] All the specification test statistics presented in this paper are distributed chi-square with one degree of freedom (see Hausman 1978).

elasticity of employment with respect to the price deflator for value added is positive and larger (.31) than the OLS estimate. Furthermore, the specification test statistic (6.06) suggests the price deflator for value added is endogenous.

The estimates of the output equation (eq. 15′) are reported in columns 5 and 6. The OLS estimate of the elasticity of output with respect to the value added deflator is negative (-.03) but not statistically significant while its TSLS version is positive (.35) and significant. This result suggests that the OLS estimates of the elasticity are negatively biased by supply shocks. Furthermore, the OLS specification is rejected in favor of the TSLS specification (test statistic of 5.99). This evidence suggests that price-based measures of international trade are valid instrumental variables that reflect pure demand shocks.[9] Finally, the OLS and TSLS estimates of the equation for the value added per worker (eq. (17′)) are reported in column 7 and 8. The estimated effect of the price deflator for value added is positive and significant in both specifications. Once again, the estimated effect of the price deflator for value added increases when P_m and P_x are used as instrumental variables (.36 versus .10). The specification test statistic (3.25) also suggest that the price deflator for value added is endogenous, as in the employment and output equations.

In summary, price-based measures of foreign competition have relatively small effects on the reduced form specifications for employment, output, and value added per worker. They constitute nonetheless useful instrumental

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[9] In the same equation where the output price and the price of non-labor inputs are entered separately, their respective estimated coefficients are .10 (.18) and -.06 (.17) respectively. The estimated coefficients become very unstable because of multicollinearity when the output price is instrumented (estimated coefficients of 5.48 and -4.78 respectively).

variables that reflect pure demand shocks. In the next section, we exploit these findings for estimating how product market conditions in general, and foreign competition in particular, affect collective bargaining agreements.

V. EMPIRICAL ANALYSIS OF COLLECTIVE BARGAINING AGREEMENTS

The employment and wage settlement data from Labour Canada's Wage Tape has been analyzed in several other papers, while the firm-specific product market variables V_i and Q_i are an innovation of this paper.[10] We thus start the empirical analysis by looking at these product market variables.

Table 4 presents empirical specifications for firm-specific output, Q_i, and value added per worker, V_i. The OLS estimates of a reduced form equation for output similar to equation (15) are reported in column 1. As expected, the effect of the price of material inputs is negative and significant (-.32) while the effect of the price of imports is positive and significant (.12). The elasticity of output with respect to the price of exports is also positive (.03) but not statistically significant. The effect of the same three variables on value added per worker are reported in column 2: the estimated coefficients (-.36, .10, and .22 respectively) are qualitatively similar to the estimated coefficients in the output equation and are all statistically significant.

The rest of Table 4 reports estimates of the structural equations for output (eq. 15') and value added per worker (eq. 17') estimated at the firm level. The results are similar to the results that were obtained at the industry level (see Table 3). Column 3 presents the OLS estimates of a model in which firm output is expressed as a function of the alternative

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[10] See for example Riddell (1979) for an analysis using the wage data and Card (1990) for an analysis using the employment data.

wage and of the price deflator for value added. The effect of the value added price deflator is negative and significant (-.08), which is inconsistent with the price deflator for value added being driven by demand shocks. The result is robust to the inclusion of year dummies in column 5. On the other hand, when the price deflator for value added is instrumented with the price of imports and exports, its effect on output become positive (.26). This contrast between OLS and TSLS estimates is similar to our results at the industry level. It is not possible, however, to reject the null hypothesis that the OLS specification is correct (test statistic of 3.24, critical value of 3.84).

Column 4 presents estimates from a model in which value added per worker at the firm level is expressed as a function of the alternative wage and of the price deflator for value added. The effect of the price deflator for value added is positive (.13) and significant. This result holds when year effects are included in column 6. Furthermore, the estimated elasticity increases and remains statistically significant when the price deflator for value added is instrumented with the price of imports and the price of exports (.65 in column 8). In fact, the null hypothesis that the TSLS estimate (column 8) of the effect of the price deflator for value added is equal to one is not rejected at a 95% confidence level. Finally, the specification test statistic (6.68) now suggests the price deflator for value added is endogenous.

We next analyze the effect of output on covered employment and the effect of value added per worker on wage settlements using the contract data. We have 1,036 observations for which matched contract and financial data are available. Only 861 observations remain after discarding some contracts with unreliable employment information (see the data appendix for details).

The estimates of several specifications for the conditional demand for labor (eq. (1)) are presented in Table 5. The alternative wage, the price of material inputs and a time trend are included in all the specifications. Table 5 presents specifications using both firm-specific and industry-wide output for the sake of completeness. Both OLS and TSLS estimates of the various specifications are presented.

Column 1 presents the OLS estimates from a model in which employment depends on the industry-wide output and on factor prices. The effect of industry-wide output on employment is positive and significant (.29). The results are qualitatively similar when firm-specific output is used instead (coefficient of .19 in column 2). The discrepancy between the two estimates suggests that firm-specific output is measured with more noise than industry-wide output. The effect of industry-wide and firm specific output remains positive and significant when the two variables are combined in the same equation, with or without year effects (column 3 and 4). In column 5, industry output is instrumented with the price-based measures of foreign competition: the effect of output on employment becomes negative but not statistically significant (-.23). On the other hand, the specification test (4.14) marginally rejects the OLS specification in favor of the TSLS specification. The TSLS estimate of the effect of firm-specific output is negative (-.40 in column 6) and not statistically significant but the specification test (1.79) fails to reject the OLS specification. The evidence in favor of the OLS estimates of the conditional demand for labor is mixed compared to the evidence presented in Table 3. Still, in the more interesting case of firm-specific output, the OLS specification is preferred.

The results reported in Tables 4 and 5 are based on a different data set than the results reported in Table 3, which were based on industry-level variables. In spite of these differences, the two sets of results are quite similar. In both cases, the OLS estimates of the conditional demand for labor seem to be appropriate. On the other hand, the price deflator for value added must be instrumented with the price of imports and the price of exports in both the output and the value added per worker equations. An interesting finding is that the standard error of the regression is typically three times larger for the specifications based on firm-specific data (Table 4) than for the specifications based on industry data (Table 3). This suggests substantial noise in the data at the firm level that is reduced when aggregate data (at the industry level) are used. This finding highlights the importance of using instrumental variables, where appropriate.

The estimates of the wage settlement equation (7) are presented in Table 6. For simplicity, we only analyze the real wage in the first month of each contract. The alternative wage and a time trend are included in all the specifications reported in Table 6. Columns 1 and 2 report the OLS estimates of specifications in which the value added per worker at the firm level and at the industry-level are included separately. Both variables have a positive and significant effect on wage settlements (.02 and .03, respectively). When the two measures are combined in column 3, the value added per worker at the firm level is positive and significant (.02) while the industry-level variable is still positive (.02), it is no longer significant. This last result is accentuated when year effects are included in the wage equation (column 4).

The effect of the value added per worker on wage settlements is precisely estimated in columns 1 to 4, but it is small relative to the estimated effect of the alternative wage. In fact, the sum of the two coefficients is significantly smaller than one contrary to what equation (7) predicts.

The last four columns of Table 6 present estimates of the wage settlement equation (7) in which the value added per worker is instrumented with various price indices. In columns 5 and 6, the instrumental variable used is simply the price deflator for value added. The TSLS estimates of the effect of firm specific value added per worker on wages is equal to .33 while it is equal to .12 when the value added per worker at the industry level is used. These result should be interpreted with caution since the price deflator for value added was found to be endogenous in the previous tables.[11]

The TSLS estimates that use the price-based measures of foreign competition as instruments are reported in columns 7 and 8. The results are similar when either the firm-specific or the industry-wide measure of the value added per worker is used (estimated coefficients of .25 and .24 respectively). Furthermore, the OLS specifications of column 1 and 2 are clearly rejected on the basis of the specification tests (7.86 and 21.3, respectively). The sum of the estimated coefficients for the alternative wage and the value added per worker is also closer to one than it was with the OLS specification. In fact, the null hypothesis that the sum of the

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[11] The price deflator of value added is an appropriate instrumental variable when measurement error is the only source of bias. It is not appropriate when contracts are not strongly efficient, especially when the firm or the union have some market power domestically.

Table 6: Wage Settlement Equations Based on Contract Data[a]

Est. Method:	OLS	OLS	OLS	OLS	TSLS	TSLS	TSLS	TSLS
Equation:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Alternative Wage[b]	0.560 (0.053)	0.548 (0.054)	0.552 (0.054)	0.458 (0.077)	0.575 (0.095)	0.516 (0.055)	0.571 (0.078)	0.476 (0.062)
Firm Specif. V.A. per Wkr	0.025 (0.007)	---	0.023 (0.007)	0.018 (0.006)	0.334 (0.110)	---	0.252 (0.078)	---
Industry V.A. per Wkr	---	0.033 (0.013)	0.024 (0.013)	0.016 (0.013)	---	0.124 (0.024)	---	0.238 (0.048)
Trend	-0.001 (0.000)	-0.001 (0.000)	-0.001 (0.000)	---	-0.001 (0.000)	-0.001 (0.000)	-0.001 (0.000)	-0.001 (0.000)
Year Effects	No	No	No	Yes	No	No	No	No
Mean of the Dep. Var.	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022
Standard Err. of the Eqn.	0.024	0.024	0.024	0.022	0.043	0.025	0.035	0.027
R-squared	0.302	0.297	0.304	0.408	0.124	0.298	0.170	0.265
Instrumental Variables	---	---	---	---	V.A. Price	V.A. Price	Imp.Pr. Exp.Pr.	Imp. Exp.Pr
Hausman Test Statistic	---	---	---	---	7.86	21.30	8.54	19.68

Sources:

1. Contract data: *Wage Tape* and *Collective Bargaining Review*.
2. Firm real sales: *Compustat Canadian File*, Financial Post *Survey of Industrials*, Moody's *International and Industrial Manuals*, Consumption and Corporations Canada *Bulletin of Corporations*, Dunn's *Principal International Business*.
3. Price of materials and industry output: *Real Domestic Product per Sector 61-71*, *Gross Domestic Output per Industry*, 1978 and 1984.
4. Alternative wage: *CANSIM University Base*, 1984, supplemented with *Bank of Canada Review*.

Notes:

[a] Sample Size is 1036. All the variables are expressed in first differences of their natural logarithms and are deflated by the CPI.

[b] National average of weekly earnings in the industrial composite.

the other hand, the effects on the negotiated wage are now positive in the sense that lower import and export prices (or more foreign competition) tend to reduce wages. Furthermore, these effects go in the same direction as the effects of foreign competition on value added (or quasi-rents) available to the workers. A final caveat is that the calculations presented in Table 7 underestimate the effects of foreign competition on a firm competing in a market 100% exposed to foreign competition for the reasons discussed in section 2.

CONCLUSION

In this paper, we have investigated the relation between union wages and employment and the state of the product market as measured by the firm's sales and value added per worker. We focused our analysis on changes in product market conditions due to foreign competition. We found that both industry-wide and firm-specific measures of product market conditions had a statistically significant effect on union wages and employment.

We also found that an increase in foreign competition was typically associated with a reduction in firm specific output and value added per worker as well as a reduction in bargaining pair employment and negotiated wages. Furthermore, price-based measures of foreign competition were found to be useful instrumental variables for the the firm's product market variables, and in particular for the value-added per worker: the TSLS estimate of the rent sharing parameter γ is equal to 25% while the OLS estimate is equal to only 2.5% only. Price-based measures of foreign competition are valid instrumental variables because they are correlated with product market conditions but uncorrelated with supply shocks in a small open economy. Our results also suggest that price-based measures of foreign competition could be used for looking at other economic questions in which inference is complicated by the simultaneous presence of supply and demand shocks.

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Table 1: Mean Growth Rates by Two Digit (SIC) Manufacturing Industry from 1963 to 1983[a]

Industry	Output	Employment	Real Wages	Real Output Price	Imports	Exports	Real Import Price	Real Export Price
Food Products	2.77 (1.71)	0.15 (2.00)	2.69 (2.45)	-0.78 (4.64)	4.93 (9.99)	4.94 (10.24)	-2.95 (13.10)	-0.56 (7.90)
Tobacco Products	1.38 (5.14)	-0.14 (5.15)	2.26 (2.04)	-0.41 (3.26)	4.20 (20.44)	5.08 (12.78)	-0.13 (7.96)	-0.69 (8.71)
Rubber & Plastic	4.65 (7.54)	0.41 (4.29)	2.19 (2.61)	-0.94 (3.22)	3.39 (12.99)	1.53 (25.07)	-0.43 (4.06)	0.82 (15.60)
Leather Products	0.39 (5.62)	-2.04 (5.78)	1.61 (2.78)	0.02 (3.90)	7.41 (12.38)	3.39 (13.39)	-1.39 (13.04)	0.61 (11.05)
Textile	3.96 (8.72)	-1.06 (5.68)	2.28 (2.38)	-2.40 (3.44)	3.65 (14.24)	1.04 (17.53)	-1.76 (6.64)	-0.67 (9.97)
Knitting	2.27 (4.83)	-1.27 (4.76)	1.75 (2.85)	-1.48 (1.91)	6.37 (13.17)	4.59 (16.64)	1.18 (6.54)	-0.46 (2.66)
Clothing	2.27 (4.83)	-1.27 (4.76)	1.75 (2.85)	-1.48 (1.91)	6.37 (13.17)	4.59 (16.64)	1.18 (6.54)	-0.46 (2.66)
Wood Products	3.16 (8.88)	-0.28 (7.55)	3.08 (2.73)	0.02 (7.62)	0.15 (35.06)	3.17 (21.44)	-0.18 (17.53)	0.27 (11.88)
Furniture and Fixtures	3.49 (5.78)	-0.19 (8.07)	1.86 (2.59)	-0.39 (1.86)	7.46 (9.84)	4.59 (16.64)	-0.43 (5.15)	-0.46 (2.66)
Pulp & Paper	2.88 (7.55)	0.59 (4.94)	2.46 (2.72)	-0.33 (6.60)	7.41 (12.38)	4.21 (11.12)	-1.39 (13.04)	-0.40 (11.40)
Publishing and Printing	3.49 (5.78)	1.28 (2.38)	1.58 (2.04)	-0.39 (1.86)	7.46 (9.84)	4.59 (16.64)	-0.43 (5.15)	-0.46 (2.66)
Primary Metals	2.06 (7.28)	0.14 (4.51)	2.10 (2.07)	0.04 (4.14)	1.54 (21.75)	1.27 (22.58)	0.66 (10.95)	-0.41 (10.56)
Fabricated Metal Products	1.76 (7.48)	-0.26 (5.72)	2.14 (2.23)	0.12 (2.96)	3.74 (7.53)	7.21 (12.15)	-0.66 (3.90)	1.40 (6.80)
Machinery	4.99 (8.67)	0.67 (6.94)	1.84 (2.09)	-1.62 (2.76)	2.58 (13.12)	5.36 (11.73)	0.34 (3.41)	0.37 (2.72)
Transportation Equipments	7.62 (12.50)	0.91 (6.20)	1.87 (2.47)	-1.13 (2.03)	10.24 (16.29)	19.93 (28.73)	-0.25 (3.75)	-1.72 (1.83)
Electrical Products	3.03 (7.24)	0.02 (5.75)	1.71 (2.05)	-1.30 (2.37)	9.14 (10.79)	8.89 (9.68)	-2.05 (3.52)	-1.95 (1.29)
Non-Metallic Minerals Prod.	1.58 (8.28)	-0.75 (5.18)	2.49 (2.37)	0.34 (2.06)	4.14 (10.87)	7.22 (12.15)	-0.74 (4.88)	1.40 (6.80)
Petroleum Products	2.82 (7.10)	1.87 (3.51)	2.28 (2.39)	5.11 (12.03)	-3.93 (22.51)	8.77 (20.80)	7.45 (23.48)	8.08 (21.12)
Chemical Products	4.65 (5.16)	1.12 (2.78)	1.86 (1.94)	-0.48 (4.86)	5.50 (11.65)	7.22 (12.33)	-0.21 (7.07)	0.43 (8.25)
Miscellaneous Manufacturing	3.49 (5.78)	1.08 (4.89)	2.26 (2.04)	-0.39 (1.86)	5.38 (10.15)	7.09 (10.97)	0.25 (2.70)	-0.41 (2.38)

Notes:
[a] Standard deviations in parenthesis

Table 2: Reduced Forms for Employment, Output, Output Price, and Value Added per Worker at the Two Digit (SIC) Industry Level[a]

Dependent Variable:	Empl.	Empl.	Output	Output	Price	Price	VAPW[b]	VAPW[b]
Equation:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Alternative Wage[c]	-0.638 (0.131)	---	-0.583 (0.173)	---	0.185 (0.062)	---	0.795 (0.239)	
Price of Materials	0.227 (0.053)	0.182 (0.056)	-0.198 (0.070)	-0.236 (0.074)	0.836 (0.025)	0.853 (0.027)	-0.160 (0.097)	-0.113 (0.103)
Import Price	0.012 (0.026)	0.020 (0.027)	0.056 (0.034)	0.022 (0.036)	0.025 (0.012)	0.035 (0.013)	0.115 (0.047)	0.093 (0.050)
Export Price	-0.017 (0.026)	-0.019 (0.027)	0.054 (0.035)	0.061 (0.036)	0.010 (0.012)	0.017 (0.013)	0.151 (0.048)	0.174 (0.050)
GNP	1.131 (0.097)	---	1.854 (0.129)	---	0.029 (0.046)	---	1.033 (0.178)	---
Trend	-0.001 (0.001)	---	-0.000 (0.001)	---	0.011 (0.000)	---	0.005 (0.178)	---
Year Effects	No	Yes	No	Yes	No	Yes	No	Yes
Mean of the Dep. Var.	-0.000	-0.000	0.031	0.031	-0.004	-0.004	0.024	0.024
Standard Err. of the Eqn.	0.039	0.038	0.052	0.051	0.019	0.018	0.072	0.071
R-squared	0.440	0.489	0.475	0.522	0.840	0.850	0.177	0.235

Sources:

1. Price of materials, output, output price, VAPW: *Real Domestic Product per Sector 61-71, Gross Domestic Output per Industry*, 1978 and 1984.
2. Other variables: *CANSIM University Base* 1984, *CANSIM Main Base* 1984, supplemented with *Bank of Canada Review*.

Notes:

[a] 378 annual observations on 20 two digit (SIC) manufacturing industries from 1965 to 1983. All the variables are expressed in first differences of their natural logarithms. The price and value added variables are deflated by the CPI. All the specifications are estimated by ordinary least squares.

[b] Value added per worker.

[c] National average of weekly earnings in industrial composite.

Table 3: Structural Equations for Employment, Output, and Value Added per Worker at the two digit (SIC) Industry Level[a]

Dependent Variable:	Empl.	Empl.	Empl.	Empl.	Output	Output	VAPW[b]	VAPW[b]
Method:	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS
Equation:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Alternative Wage[c]	-0.301 (0.112)	-0.350 (0.126)	-0.689 (0.152)	-0.736 (0.215)	-0.448 (0.210)	-0.512 (0.297)	0.613 (0.242)	0.567 (0.284)
Price of Value Added	---	---	0.037 (0.014)	0.308 (0.111)	-0.027 (0.019)	0.347 (0.154)	0.095 (0.022)	0.357 (0.147)
Price of Materials	0.274 (0.037)	0.277 (0.038)	---	---	---	---	---	---
Output Price	---	---	---	---	---	---	---	---
Industry Output	0.469 (0.027)	0.358 (0.123)	---	---	---	---	---	---
Trend	-0.002 (0.000)	-0.002 (0.001)	-0.005 (0.001)	-0.005 (0.001)	-0.006 (0.001)	-0.006 (0.001)	0.001 (0.001)	0.001 (0.001)
Mean of the Dep. Var.	-0.000	-0.000	-0.000	-0.000	0.031	0.031	0.024	0.024
Standard Err. of the Eqn.	0.034	0.035	0.048	0.068	0.066	0.093	0.076	0.089
R-squared	0.574	0.342	0.169	0.102	0.143	0.087	0.062	0.029
Specif. Test	---	0.86	---	6.06	---	5.99	---	3.25

Sources:

1. Price of value added, price of materials, VAPW, output, output price: *Real Domestic Product per Sector 61-71*, *Gross Domestic Output per Industry*, 1978 and 1984.

2. *CANSIM University Base*, 1984, supplemented with *Bank of Canada Review*.

Notes:

[a]378 annual observations on 20 two digit (SIC) manufacturing industries from 1965 to 1983. All the variables are expressed in first differences of their natural logarithm. The price and value added variables are deflated by the CPI.

[b]Value added per worker.

[c]National average of weekly earnings in industrial composite.

Table 4: Real Sales and Value Added per Worker Equations Based on Firm Specific Financial Data[a]

Dependent Variable:	Sales	VAPW[b]	Sales	VAPW[b]	Sales	VAPW[b]	Sales	VAPW[b]
Est. Method:	OLS	OLS	OLS	OLS	OLS	OLS	TSLS	TSLS
Equation:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Alternative Wage[c]	0.225 (0.244)	0.121 (0.256)	0.263 (0.235)	0.088 (0.247)	---	---	0.399 (0.253)	0.301 (0.273)
Price of Value Added	---	---	-0.076 (0.034)	0.131 (0.035)	-0.095 (0.033)	0.108 (0.035)	0.255 (0.187)	0.648 (0.203)
Price of Materials	-0.318 (0.087)	-0.355 (0.092)	---	---	---	---	---	---
Import Price	0.124 (0.046)	0.096 (0.049)	---	---	---	---	---	---
Export Price	0.028 (0.056)	0.217 (0.059)	---	---	---	---	---	---
Trend	-0.004 (0.001)	-0.000 (0.001)	-0.004 (0.001)	-0.001 (0.001)	---	---	-0.004 (0.001)	-0.001 (0.001)
Year Effects	No	No	No	No	Yes	Yes	No	No
Mean of the Dep. Var.	0.035	0.014	0.035	0.014	0.035	0.014	0.035	0.014
Standard Err. of the Eqn.	0.179	0.188	0.180	0.189	0.175	0.185	0.184	0.199
R-squared	0.026	0.015	0.020	0.008	0.075	0.056	0.017	0.006

Sources:

1. Financial data: *Compustat Canadian File*, Financial Post *Survey of Industrials*, Moody's *International and Industrial Manuals*, Consumption and Corporations Canada *Bulletin of Corporations*, Dunn's *Principal International Business*.
2. Price of value added, price of materials: *Real Domestic Product per Sector 61-71*, *Gross Domestic Output per Industry*, 1978 and 1984.
3. Other variables: *CANSIM University Base* 1984, *CANSIM Main Base* 1984, supplemented with *Bank of Canada Review*.

Notes:

[a] Sample size is 1941. All the variables are expressed in first differences of their natural logarithms and are deflated by the CPI.

[b] Value added per worker.

[c] National average of weekly earnings in industrial composite.

Table 5: Employment Determination Equations Based on Contract Data[a]

Estimation Method:	OLS	OLS	OLS	OLS	TSLS	TSLS
Equation:	(1)	(2)	(3)	(4)	(5)	(6)
Alternative Wage[b]	-0.309 (0.229)	-0.366 (0.224)	-0.252 (0.226)	-0.138 (0.205)	-0.629 (0.285)	-0.748 (0.392)
Price of Materials	0.293 (0.084)	0.255 (0.082)	0.296 (0.082)	0.205 (0.106)	0.185 (0.102)	0.184 (0.112)
Industry Output	0.294 (0.066)	---	0.210 (0.067)	0.262 (0.080)	-0.230 (0.266)	---
Firm Real Sales	---	0.191 (0.030)	0.169 (0.031)	0.167 (0.031)	---	-0.405 (0.446)
Trend	0.001 (0.001)	0.000 (0.001)	0.002 (0.001)	---	-0.003 (0.002)	-0.005 (0.004)
Year Effects	No	No	No	Yes	No	No
Mean of the Dep. Var.	-0.010	-0.010	-0.010	-0.010	-0.010	-0.010
Standard Err. of the Eqn.	0.087	0.086	0.086	0.085	0.090	0.104
R-squared	0.044	0.065	0.076	0.100	0.021	0.016
Instrumental Variables	---	---	---	---	Imp.Pr. Exp.Pr.	Imp.Pr. Exp.Pr.
Specif. Test	---	---	---	---	4.14	1.79

Sources:

1. Contract data: *Wage Tape* and *Collective Bargaining Review*
2. Firm real sales: *Compustat Canadian File*, Financial Post *Survey of Insdustrials*, Moody's *International and Industrial Manuals*, Consumption and Corporations Canada *Bulletin of Corporations*, Dunn's *Principal International Business*.
3. Price of materials and industry output: *Real Domestic Product per Sector 61-71*, *Gross Domestic Output per Industry*, 1978 and 1984.
4. Alternative wage: *CANSIM University Base*, 1984, supplemented with *Bank of Canada Review*.

Notes:

[a] Sample size is 861. All the variables are expressed in first differences of their logarithms. The alternative wage and the price of material inputs are deflated by the CPI while the sales are deflated by the industry output price.

[b] National average of weekly earnings in industrial composite.

Table 6: Wage Settlement Equations Based on Contract Data[a]

Est. Method:	OLS	OLS	OLS	OLS	TSLS	TSLS	TSLS	TSLS
Equation:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Alternative Wage[b]	0.560 (0.053)	0.548 (0.054)	0.552 (0.054)	0.458 (0.077)	0.575 (0.095)	0.516 (0.055)	0.571 (0.078)	0.476 (0.062)
Firm Specif. V.A. per Wkr	0.025 (0.007)	---	0.023 (0.007)	0.018 (0.006)	0.334 (0.110)	---	0.252 (0.078)	---
Industry V.A. per Wkr	---	0.033 (0.013)	0.024 (0.013)	0.016 (0.013)	---	0.124 (0.024)	---	0.238 (0.048)
Trend	-0.001 (0.000)	-0.001 (0.000)	-0.001 (0.000)	---	-0.001 (0.000)	-0.001 (0.000)	-0.001 (0.000)	-0.001 (0.000)
Year Effects	No	No	No	Yes	No	No	No	No
Mean of the Dep. Var.	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022
Standard Err. of the Eqn.	0.024	0.024	0.024	0.022	0.043	0.025	0.035	0.027
R-squared	0.302	0.297	0.304	0.408	0.124	0.298	0.170	0.265
Instrumental Variables	---	---	---	---	V.A. Price	V.A. Price	Imp.Pr. Exp.Pr.	Imp. Exp.Pr
Hausman Test Statistic	---	---	---	---	7.86	21.30	8.54	19.68

Sources:

1. Contract data: *Wage Tape* and *Collective Bargaining Review*.
2. Firm real sales: *Compustat Canadian File*, Financial Post *Survey of Industrials*, Moody's *International and Industrial Manuals*, Consumption and Corporations Canada *Bulletin of Corporations*, Dunn's *Principal International Business*.
3. Price of materials and industry output: *Real Domestic Product per Sector 61-71*, *Gross Domestic Output per Industry*, 1978 and 1984.
4. Alternative wage: *CANSIM University Base*, 1984, supplemented with *Bank of Canada Review*.

Notes:

[a] Sample Size is 1036. All the variables are expressed in first differences of their natural logarithms and are deflated by the CPI.

[b] National average of weekly earnings in the industrial composite.

Table 7: Effects of International Competition.

	100% Increase in Price of Imports	100% Increase in Price of Exports
Firm Real Sales	12.4%	2.8
Firm Specific Value Added per Worker	9.6%	21.7
Bargaining Pair Employment	2.4%	0.5%
Wage Settlements	2.4%	5.4%

Sources:

1. Results in Tables 2 to 6.

DATA APPENDIX

Imports and exports prices and quantities

The Laspeyres price indices and the trade value measures used were derived using **CANSIM** supplemented for 1967 and prior years from the **Bank of Canada Review**. The system of classification closest to standard industrial classifications (SIC), which is used by Labour Canada to classify the bargaining units, is the System of National Accounts (SNA) classification used to construct the Input-Output tables. Since the I-O tables contain measures of the value of imports and exports both in nominal and real terms, it is possible to construct price measures for both of them. International trade price and value data are available using the SNA classification; however, all source and destination countries are aggregated. Since we wanted to eliminate trade with the United States from the world price measures, we used the price and value measures available on **CANSIM** under the import commodity classification (MCC) and the export commodity classification (XCC), which are disaggregated by major countries. Unlike the SIC, the MCC and XCC classifications are systems of classification for products and not for industries. Using the Canadian Input-Output tables to provide the connection between products and industries, we developed a concordance between two digit SIC industries and the international trade measures obtained from the MCC and XCC.

Data on import and export prices for industrial sectors where the international trade flows are not very substantial are very aggregated. Only an aggregated measure of import (and export) prices was available for knitting industries, clothing industries, furniture and fixtures, publishing and printing and miscellaneous industries. For export prices, only an aggregated measure was available for leather industries, fabricated metal and non-metallic mineral products. Data for only seven and five aggregated sectors were available for import and export prices before 1968 (in the Bank of Canada Review).

The import price index is a combination of transaction prices and unit values. The short description given in CANSIM is "The Laspeyres price indexes are based on fixed weights derived from shipments 1971 quantities and hence reflect changes in prices alone. Most of the non-end products indexes are based on average prices derived from commodity import value and quantity data. The end product indexes are based on wholesale price indexes from Canadian, U.S. and foreign sources as proxies for import prices. For further details see the September 1976 supplement to the summary of external trade catalogue 65-001." (CANSIM 1984, matrix 003681). The technical documentation can be found in Statistics Canada 1976.

The series description for export prices is "The Laspeyres price indexes are based on fixed weights derived from shipments 1971 quantities and hence reflect changes in prices alone. Most of the non-end products indexes are based on average prices derived from commodity export value and quantity data. The end product indexes are based on Canadian industry selling price indexes as proxies for export prices. For further details see the September 1976 supplement to the summary of external trade catalogue 65-001." (CANSIM 1984, Statistics Canada 1976).

Input and output prices and quantities.

Data on output and material input price and values by industry were obtained from two publications of Statistics Canada: Real Domestic Product per Sector 61-71 and Gross Domestic Output per Industry (1978 and 1984 issues).

Average Manufacturing Wage

Average hourly earnings in manufacturing obtained from **CANSIM University Base** and the **Bank of Canada Review**. See Card (1988).

Industry Employment

Employment index by two digit SIC industry from **CANSIM University Base** for 1961 to March 1983 and the **Bank of Canada Review** thereafter.

GNP, unemployment and Consumer Price Index

Basic monthly, quarterly, and annual time series data were extracted from the **CANSIM University Base** for the years 1961 to 1984 and from the **Bank of Canada Review** thereafter.

Contract data

We used 2,258 collective bargaining agreements for 299 bargaining pairs in the manufacturing sector of Labour Canada's **Wage Tape**. The wage measure used is a base wage rate. For a description of the data set and of how the wage settlement variable was constructed, see Card (1988).

The employment variable provided on the **Wage Tape** is actually a measure of how many workers were covered by the collective bargaining agreement on the day of the agreement. Inspection of the data suggested that the employment data were substantially contaminated by measurement error. In an effort to reduce those measurement problems, we systematically compared the employment data from the **Collective Bargaining Review** to the numbers from the **Wage Tape** for all pairs where the employment was changing by 10% or more in absolute value between two agreements at some point of time. In cases of discrepancies between between the two numbers, the employment from the **Collective Bargaining Review** was used. More information is available from the **Collective Bargaining Review** about the structure of the bargaining pair (for example, which plants and which union locals are involved).

Two levels of correction were performed. The first level consisted of identifying the number of employees from the **Collective Bargaining Review** when the only identifiable source of discrepancies between the two data sources was pure reporting error. Employment data for 175 contracts was corrected on this criterion. Employment from 28 contracts was discarded because of major changes in the definition of the bargaining pair.

Second, when the information from the **Collective Bargaining Review** indicated that the structure of the bargaining pair changed over time, the following rule was applied: if enough information was available from the **Collective Bargaining Review** to construct a consistent series for a specific pair, such information was used. Otherwise, the changes in employment that could have been explained by changes in the structure of the bargaining pair, e.g. one local drops off, were eliminated. Employment data for 131 contracts were adjusted and employment data for 176 contracts were discarded due to this correction. Finally, nine additional outliers were eliminated after inspecting the employment and quasi-rent data.

Financial Information

We matched the contract data to a set of financial variables obtained from various data sources: the **Canadian File of COMPUSTAT**, the **Financial Post Survey of Industrials**, **Moody's International and Industrial Manuals**, **Consumption and Corporations Canada's Bulletin of Corporations and Microfiches**, **Dunn's Principal International Business** and miscellaneous companies' annual reports. We used two variables from these data sources for the empirical analysis, namely total sales and total employment for the corporation.

To obtain the sales and employment data, we first identified the firm that was bargaining with the union for each contract. Since no identifier such as a CUSIP is provided on the **Wage Tape**, we matched the name and location of the bargaining pair to a firm for which some financial data were available. The matching was performed manually using Statistics Canada's Inter-Corporate Ownership manual and Dun and Bradstreet's Who Owns Who to identify the firm that was related to the name that was provided on the Wage Tape.

We then merged the contract data and the financial data for the firm that was as close as possible (from an ownership point of view) to the party involved in collective bargaining. The rule we used was to match each contract to the closest parent Canadian firm for which financial data was available, provided that a such firm was operating in the same two digit SIC industry than the bargaining pair. In most cases, the financial data came from the firm whose name appeared on the Wage Tape or from its mother company in the case of wholly owned subsidiaries.

We extracted the financial variables from various data sources. Data on 65 firms was obtained from COMPUSTAT's Canadian File. These 65 firms were mainly large Canadian companies traded on some American Stock exchange. The main advantage of COMPUSTAT is that it is a machine readable longitudinal data set that contains a large number of financial variables. Its disadvantage is that it only covers the period from 1967 to 1986.

We obtained some additional financial information from the Financial Post' Survey of Industrials, Moody's International and Industrial Manuals, and the Financial Post's Cards. Financial information for 44 additional firms was obtained from these data sources. We also used these data sources to extend the Canadian File before 1967 and to complete the employment series for many firms in the Canadian File.[1]

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1 The Moody's data are the most useful for that purpose since no employment data are recorded in the Financial Post Cards or in the Survey of Industrials before 1978. Linear interpolations were used when firm-level employment was missing from all data sources.

Most of the firms in COMPUSTAT, the Financial Post or Moody's are listed on some Canadian or American stock exchange. We used some further data sources to get additional information on private companies, including wholly-owned subsidiaries of foreign companies. These data sources were miscellaneous annual reports as well as various pieces of information reported to the Bureau of Corporations under the Corporations and Labour Unions Returns Act (CALURA). The financial information reported under CALURA was obtained from Consumption and Corporations (C&C) Canada's Bulletin of Corporations and from copies of the financial reports to the Bureau of Corporations on C&C microfiches. Firm-level employment was usually not available from those sources. Some employment measures were available from Dunn's Principal International Business, but their accuracy was questionable. Partial information was obtained for 57 additional firms from these data sources.

Overall, we were able to find some financial data for 2,613 observations on 166 firms involved in collective bargaining. For 2,590 of these 2,613 observations, it was possible to construct some measures of value added per worker. We were then able to match the financial data from the 166 firms to 213 of the 299 bargaining pairs. Note that 34 of the 86 bargaining pairs for which no financial data was available were subsidiaries of foreign companies, while 4 were part of large Canadian conglomerates, 4 were owned by the federal or some provincial government, and 34 were associations of manufacturers. In the end, measures of value added per worker were available for 1,384 of the 2,258 original contracts.

ADDITIONAL REFERENCES

Consumption and Corporations Canada. Bulletin of Corporations. (Ottawa: Minister of Supply and Services) various issues from 1975 to 1979.

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