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This paper contains preliminary findings from research work still in progress and should not be quoted without prior approval of the author.

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INTERNATIONAL COMPETITION AND THE UNIONIZED SECTOR*

by

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ABSTRACT

This paper studies the wage and employment behavior of a unionized sector that is confronted by an intensification of international competition. After developing a formal model of a monopoly union subject to majority rule, I study the response of a unionized sector operating under a seniority rule for layoffs and rehires to a trend decrease in the international price of its output. Conditions are provided to validate the casual argument that majority voting in unions and the seniority system together provide an explanation for the lack of union wage adjustment.

A modified version of the model allows the job queue to deviate from a strict seniority ranking. In this context I ask, What importance can be attached to the seniority system in determining the wage response to international competition?

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I. INTRODUCTION

International competition which takes the form of a decline in the price of a substitute foreign good often effects an increase in the level of industry unemployment, while sectoral wages are "sticky downward". This observation has led trade theorists to extend to an open economy context a model first developed by Harris and Todaro (1970), which incorporates a sector-specific rigid wage and associated industry-specific unemployment.[1] This model has been used extensively to investigate appropriate policy responses to international competition in this second-best setting.

A deficiency common to most of these analyses is that the level of the rigid wage is exogenously specified, and its cause is rarely discussed. For justification, appeal is sometimes made to the pressures of unions, but no attempt is made to model the union behavior that might give rise to the observed wage stickiness.[2] At a more informal level, however, an explanation for this phenomenon has been suggested. It is casually argued that in the face of increased international competition union wages do not fall because union votes are swayed by senior workers for whom the probability of layoff is quite small.[3]

The purpose of this paper is to investigate the wage and employment behavior of a unionized sector that is confronted by international competition. Two questions are addressed. First, how will a unionized sector operating under a seniority rule for layoffs and rehires respond to a trend decrease in the international price of its output? Second, what importance can be attached to the seniority system in determining this response? In other words, would wages respond more flexibly if criteria other than seniority extered into the layoff decision?

To answer these questions, a model of the unionized sector that I have developed in Grossman (1982) is adapted to an open economy setting. The salient features of this model, which is reviewed in Section II, are that (i) layoffs and rehires are based on seniority; (ii) the union wage demand emerges from a majority vote among union members; and (iii) the membership of the union is determined simultaneously with the wage demand by a free-entry condition. In Section III I apply this model to study how a fall in the international price of the sector's output will affect wages, union size and industry unemployment. Then in Section IV the model is extended to allow factors other than seniority to influence the order of layoffs, and I study how this change in specification alters the behavior of the union in response to international competition.

II. THE MODEL

This section develops the basic model of the unionized sector which I shall use in the following sections to investigate the effects of international competition. The model presented here modifies that in Grossman (1982) to allow for the existence of an internationally traded good which substitutes perfectly for the output of the unionized sector.

Consider, then, a small open economy that comprises two sectors. The outputs of both sectors are internationally traded, and the world prices are taken to be exogenous. In the nonunion sector, which is intentionally made as simple as possible, the numeraire good, X, is produced by labor alone, according to a constant returns to scale technology. One unit of good X is assumed to require $1/\bar{w}$ units of labor, so that $\bar{w}$ is the prevailing wage in the nonunion sector by the zero-profit condition.

The union-sector good has international price p*. Letting v(p, w) be the indirect utility function of all workers, the utility of nonunion labor is given by $v(p^*, \bar{w})$. To further simplify the analysis of the wage demands of the union, I assume that the union good constitutes a negligible fraction of the consumption basket. Thus, the indirect effect of international competition (i.e. changes in p*) on worker's utility as a function of consumption behavior can be ignored, and we concentrate instead on its direct effects on the factor income of union members. With this assumption, the utility of nonunion workers is now written simply as $v(\bar{w}) \equiv \bar{v}$.

Output in the union sector requires labor and sector-specific capital. The production function for good Y is

$$Y = \theta F(\bar{K}, E) \tag{1}$$

where $\bar{K}$ is the fixed stock of sector-specific capital, E is the level of sectoral employment, and θ is a stochastic variable, assumed to be uniformly distributed on [B - 1, B]. θ represents a random element in the production technology, and therefore the demand for labor, which is assumed to be unknown at the time of labor negotiations. Uncertainty is resolved prior to the time that hiring and output decisions are made, but while θ is then known by firms it is unobservable by workers during the current contract period. This implies that incentive compatible contracts cannot be state contingent, for otherwise firms would always plead an unfavorable draw of θ to extract concessions from the union.

I assume that all workers have identical skills, and that job sharing is ruled out with reference to a non-convexity in the technology. Then E represents the number of jobs in addition to the labor input. Define

$f(E) \equiv \partial F(\bar{K}, E)/\partial E$, with decreasing returns to labor for fixed capital input implying that $f'(E) < 0$. Then the marginal value product of labor is given by $p^*\theta f(E)$.

The union in this sector is assumed to have monopoly power vis-a-vis the large number of perfectly competitive firms in the industry.[4] The union specifies a state-independent wage, referred to as the wage demand, subject to the constraint imposed by the demand-for-labor schedule. Firms choose the level of employment once the state of nature is realized. Note that this latter assumption does imply some limitation on the monopoly power of the union, for otherwise the union could demand a wage-employment package as "take-it-or-leave-it", subject only to a zero-profit constraint. The specification that the union chooses the wage and the firm selects $E(\theta)$ is admittedly somewhat ad hoc, but has the virtue of according well with observed behavior.[5]

Union members are indexed by $i \in [0, L]$, where L is the size of the union. The index i represents seniority, with $i = 0$ the most senior member and $i = L$ the least senior, and all workers are aware of their location in the seniority quene. It is assumed in this section and the next that layoffs and rehires are based solely on seniority. This assumption will be relaxed in Section IV.

Labor is assumed to be perfectly mobile ex ante, i.e. workers have the choice whether to enter the union sector (given their seniority ranking) or accept employment in the nonunion sector. Thus, I suppose that ex ante there is free entry into the union. This assumption is best justified if we think of an industrial (as opposed to craft) union operating in a multi-period world, of which the present paper studies one representative period. Then any worker who is offered employment in some period (i.e. for some

realization of θ) must be admitted into the union according to U.S. law which forbids "closed shops." Workers who are never offered employment by any firm need not be permitted to become union members, but these workers are of no concern because they would not choose to enter the union sector given the alternative of nonunion employment.

Once the contract period has begun, i.e. ex post, labor is completely immobile. This means that all workers who do not gain employment in the union sector once the state of nature is realized remain unemployed for the duration of the contract period.[6] Unemployment in this model, as in the Harris-Todaro model, is industry specific and its proximate cause is the state-independent wage in conjunction with the assumed ex post immobility of labor. It is not claimed that either the union or the seniority system is the cause of the unemployment. It is nonetheless interesting to study how the industry-specific unemployment described here is affected by international competition.[7]

The final assumption of the model concerns the process by which the union generates its wage demand. Following Atherton (1973) and especially Farber (1978), I suppose this process to be one of majority voting. In principle the union might then choose an entire wage schedule with payment a function of place in the seniority queue. In this way the union could act as a discriminating monopolist. However, such wage schedules are ruled out by appeal to their high cost of negotiation.[8] Thus, the union demand that emerges from the majority vote is by assumption a single wage payable to all employed workers during the contract period. Since union member preferences are single-peaked, a unique voting equilibrium exists, and the wage demanded is the one that maximizes the utility of the median (in terms of seniority) worker.[9]

It is now straightforward to describe the equilibrium in this economy. The probability of employment of a union member with seniority index $\underline{i}$, π_i, given the union wage demand w, is

$$\begin{aligned} \pi_i &= pr\{p^*\theta f(i) \geq w\} \\ &= pr\{\theta \geq w/p^*f(i)\} \\ &= \min[B - w/p^*f(i), 1] \end{aligned} \tag{2}$$

The expected utility of a worker with index i is

$$u(i) = \pi_i \, v(w) + (1 - \pi_i)v_o \tag{3}$$

where v_o is the utility associated with unemployment, deriving from unemployment benefits, trade adjustment assistance and leisure.

The union maximizes the utility of the median worker, who has index L/2. The solution to this maximization is illustrated in Figure 1. The indifference

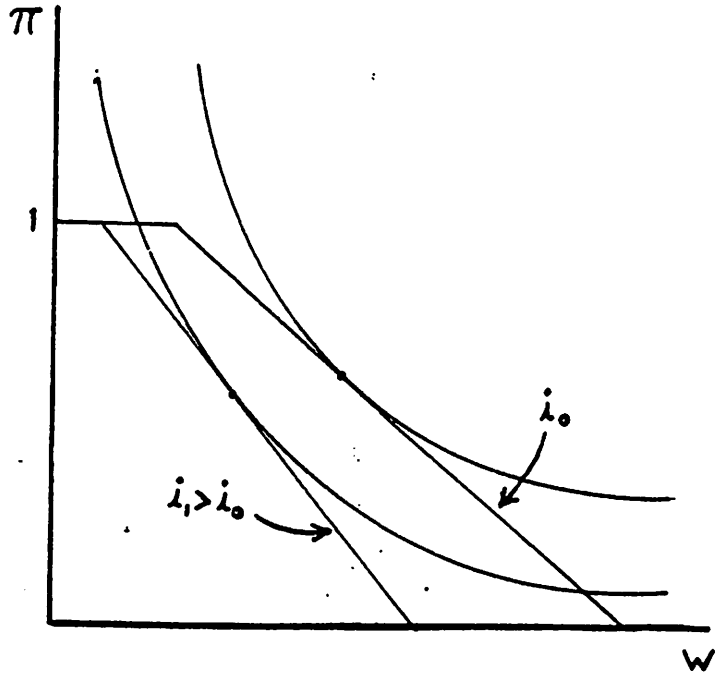

Figure 1: Worker's Most-Preferred Wage

curves deriving from (3), for any given worker, are downward sloping and convex. Utility is maximizes where the constraint relating the wage to probability of employment, as expressed in (2), is tangent to the indifference curve.

The union's wage demand depends on who is the median worker, and therefore on the size of the union. Referring once again to Figure 1, we see that a less senior worker with index $i_1 > i_0$ faces a worse trade-off between wage and probability of employment, and prefers a lower wage. More formally, the first order condition for the maximization of the utility of the median worker is

$$[Bp^*f(L/2) - w]v'(w) = v(w) - v_o \qquad (4)$$

The median worker is just indifferent between an increase in wage, which raises utility in employed periods, and the accompanying decrease in the probability of employment.

If the union were to expand in size slightly, then the "new" median worker, who is less senior then the "old" median, and therefore marginally more concerned with his employment prospects, will prefer a slightly lower wage. This relationship between union size and the wage demand is termed the voting schedule, and depicted as the downward sloping curve, VV, in Figure 2. The curve has slope

$$\left.\frac{dw}{dL}\right|_{VV} = \frac{B/2p^*f'(L/2)}{\frac{v(w) - v_o}{wv'(w)} R + 2} < 0$$

where R is the coefficient of relative risk aversion defined to be positive. When risk averion is great, so that a marginal increase in the probability of

unemployment has a large negative effect on utility, workers have approximately the same most-preferred wage, and the voting schedule is relatively flat.

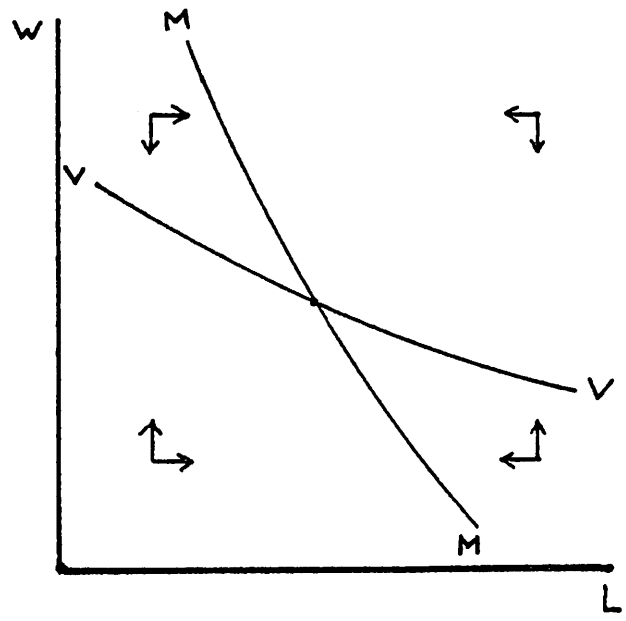

Figure 2: Unionized-Sector Equilibrium

The second equilibrium relationship follows from the ex ante perfect mobility assumption. With free entry into the union sector the least senior worker must be indifferent between the utility he achieves by joining the union and that available to him in the nonunion sector.[10] This membership schedule is given by

$$\pi_L \, v(w) + (1 - \pi_L) v_o = \bar{v} \, ,$$

or substituting equation (2),

$$(v(w) - v_o)[B - w/p^* f(L)] = (\bar{v} - v_o) . \qquad (5)$$

It is depicted as MM in Figure 2 and has slope

$$\left.\frac{dw}{dL}\right|_{MM} = \frac{-(v(w) - v_o)wf'(L)/f(L)}{[Bp^*f(L) - w]v'(w) - [v(w) - v_o]}$$

This is negative in the neighborhood of the VV curve, because an increase in wage lowers the utility of the least senior worker (who is most concerned with employment prospects) and causes the union to contract.

Equations (4) and (5) together determine the allocation of resources between the union and nonunion sectors, the wage in the union sector, and the employment (and hence unemployment) there in all states of nature. The equilibrium shown in Figure 2 is stable under the assumption that the wage adjusts according to the voting schedule and the union size adjusts according to the membership schedule, so long as the MM curve is steeper than the VV curve. I assume this to be the case throughout.

III. THE EFFECTS OF INTERNATIONAL COMPETITION

We are now prepared to answer the first question raised in the introduction namely: what effect does a permanent increase in international competition have on the long-run equilibrium in an industry with unionized workers and a layoff and rehire rule based solely on seniority? To do so, we perturb the equilibrium described in Section II by chaning the international price of the sector's output to a new (and lower) level, $p_1^* = p_0^* + dp^*$.

The intensification of international competition affects both the voting and membership schedules. The fall in p*, ceteris paribus decreases the probability of employment of the original median worker at the intial equilibrium wage. Therefore, at the new price, the original median worker prefers a lower wage, to partially offset this worsening of his employment

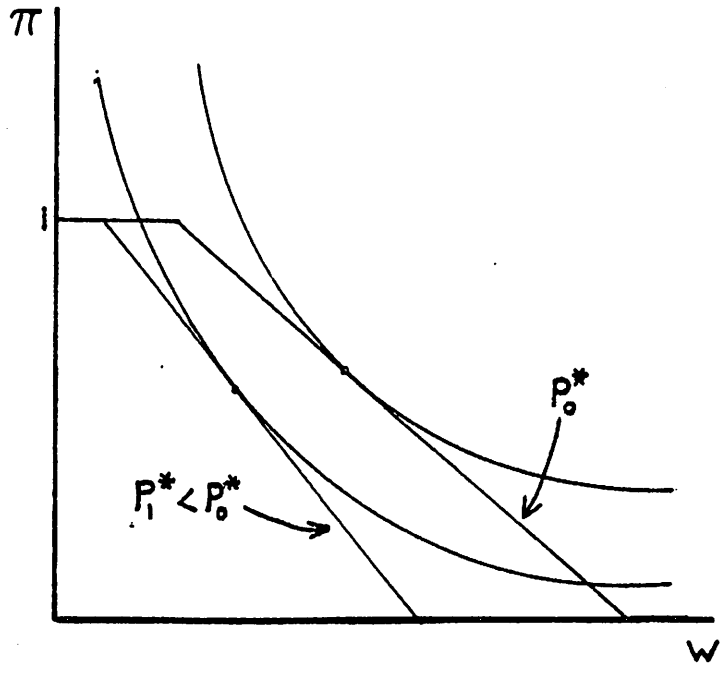

Figure 3: International Competition Lowers the Most-Preferred Wage

prospects (see Figure 3). The upshot is a downward shift of the VV schedule as shown in Figure 4, by an amount

$$\left.\frac{\hat{w}}{\hat{p}^*}\right|_{VV,\ dL=0} = \frac{Bp^*f(L/2)}{Bp^*f(L/2) + \pi_{L/2}(R-1) + w} > 0$$

where a circumflex indicates a proportional derivative. Note that a sufficient condition for the fall in the most-preferred wage of a given worker to less than fully compensate for the price decline, is $R > 1$. In this case the <u>real</u> wage rises and the probability of employment falls (as drawn in Figure 3).

It will prove useful below to have the expression for the leftward shift of the VV curve (i.e. at constant wage). It is given by

$$\left.\frac{\hat{L}}{\hat{p}^*}\right|_{VV,\ dw=0} = \frac{1}{\varepsilon(L/2)}$$

where $\varepsilon(i) = -if'(i)/f(i)$, the elasticity of the marginal product of labor schedule. We can interpret this expression as the amount that the union would have to shrink such that the smaller union, with a more senior median worker, would vote for the same wage at the lower international price as the larger union did at the initial price. Note that $\varepsilon(E)$ is the reciprocal of the elasticity of demand for labor, so that the leftward shift of the VV curve is just this elasticity evaluated at the point where the median worker is marginally employed.

The trend worsening of the industry's condition also causes the union to shrink (at a given wage). Given the wage, the decrease in employment probability of the original least senior worker lowers his expected utility and causes him to leave the union sector. The result is a leftward shift of the MM schedule (see Figure 4) given by

$$\left.\frac{\hat{L}}{\hat{p}^*}\right|_{MM,\ dw=0} = \frac{1}{\varepsilon(L)}$$

where we recognize that $1/\varepsilon(L)$ is the elasticity of demand for labor at the point where the least senior worker is just employed. If the demand for labor is elastic (i.e. the marginal product schedule is inelastic). Then as the price falls the decline in employment in any given state of nature will be large, the probability of employment for less senior workers will decrease precipitously, and the MM curve will shift by a large amount.

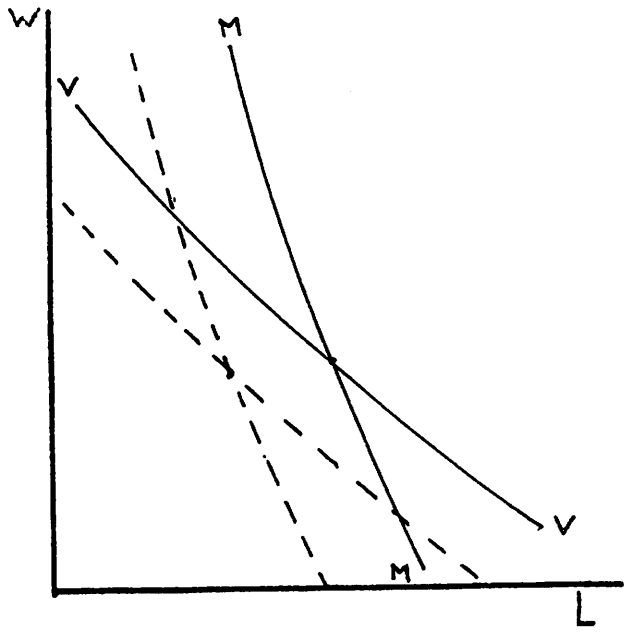

Figure 4: Effect of International Competition on Unionized Sector Equilibrium

Evidently, international competition has two offsetting effects on the equilibrium wage rate in the unionized sector. On the one hand, a union of given size will vote for a lower wage because at least some of the workers will find that the likelihood of their being laid off has increased. But at the same time, international competition tends ceteris paribus to cause the union to contract, leaving a union of higher (on average) seniority, which therefore tends to vote for a higher wage. The net effect is ambiguous, but has an interesting interpretation.

It is straightforward to show (by total differentiation of (4) and (5)), that

$$\text{sgn}\left\{\frac{\hat{w}}{\hat{p}^*}\right\} = \text{sgn}\left\{\varepsilon(L) - \varepsilon(L/2)\right\} .$$

When $\varepsilon(L) > \varepsilon(L/2)$ the leftward shift of the VV curve is greater than the leftward shift of the MM curve, and a lower union-sector wage obtains in the new equilibrium. In this case the effect of the international competition on the employment prospect of the median worker exceeds the effect on that of the least senior worker. It can be shown that $R > 1$ is sufficient for wages to fall proportionately less than does the international price, i.e. that the wage adjustment is less than complete. Since employment and hence output in any state of nature is a decreasing function of the real wage, this condition guarantees a normal output-price response.

When $\varepsilon(L/2) = \varepsilon(L)$, as certainly holds, for example, if the labor demand schedule has constant elasticity, the long-run wage in the unionized sector is completely inelastic with respect to changes in the price of the good produced in the sector. In this case all adjustment to international competition takes place through movements of workers into and out of the sector. Whereas the short-run wage within a contract period is rigid by assumption, the constant elasticity of labor demand case gives rise here to a long run wage in the sector that is endogenously sticky.[11]

Finally, if $\varepsilon(L/2) > \varepsilon(L)$ the wage will actually rise when the price falls, forcing even greater adjustment in the size of the sector. In this case the decline in each worker's individual most-perferred wage is more than offset by the increase in the median seniority of the union. A majority of the more senior union is sufficiently less concerned with layoffs that a higher wage demand emerges from the union vote.

It is perhaps useful to relate the conditions on the elasticity of the marginal product of labor schedule to the parameters of the underlying production function in the industry. Consider the case where that function has

constant elasticity of substitution, σ, between capital and labor. Then partial wage adjustment occurs for $\sigma < 1$, wage movement in the opposite direction from that of prices occurs for $\sigma > 1$, and endogenous wage stickiness corresponds to the Cobb-Douglas ($\sigma = 1$) case.

The adjustment of union size in response to international competition is given by the solution, after totally differentiating (4) and (5), for $\hat{L}/\hat{p}^*$. As can be seen from the diagram (Fig. 4), an increase in union size is possible only if the leftward shift of the VV curve is much greater than that of the MM curve, and if the VV curve is relatively steep. The algebra confirms this, and shows the $\varepsilon(L/2) \gtrless \varepsilon(L)$ or $R > 1$ is sufficient for the union to shrink. Only if the elasticity of substition between capital and labor is very low and workers are very tolerant of risk can the union expand when competition intensifies.

A final variable of interest is the unemployment rate in the industry. Unemployment occurs because the wage is rigid within the contract period, and ex post mobility is absent. Thus, unemployment is a function most directly of the value taken by the random technology variable. However, changes in the extent of international competition influence the level of industry unemployment for any given realization of the random variable, via their affect on both the supply of and demand for labor in the sector.

Define the industry unemployment rate in state of nature θ as $z(\theta) = \max\{0, [L - E(\theta)]/L\}$. Then for periods in which unemployment is positive we have

$$p^* \frac{dz(\theta)}{p^*} = \frac{E(\theta)}{L}\left[\frac{\hat{L}}{\hat{p}^*} + \frac{1}{\varepsilon(E(\theta))}\left(\frac{\hat{w}}{\hat{p}^*} - 1\right)\right] \quad . \tag{5}$$

Consider first the Cobb-Douglas case, for which the elasticity of the marginal

product of labor schedule is constant. Then a fall in the international price causes the union to contract by $(1/\varepsilon)dp^*$. But since in this case, as we have seen, the wage rate remains constant, labor demand in every state of nature also falls by $(1/\varepsilon)dp^*$. Thus, when the production function is Cobb-Douglas, international competition has no effect on the rate of industry unemployment in the unionized sector in any state of nature.

For more general production functions the analysis is rather complicated. After substitution in (5), it can be shown that

$$\operatorname{sgn}\left\{\frac{dz(\theta)}{dp^*}\right\} = \operatorname{sgn}\left\{\frac{w[v(w) - v_o]^2}{v'(w)}(R - 1)\left[1 - \frac{\varepsilon(L)}{\varepsilon(E)}\right]\right.$$

$$+ w^2[v(w) - v_o]\left[1 - \frac{\varepsilon(L)}{\varepsilon(E)}\right]$$

$$\left. + Bp^*f(L/2)\,[Bp^*f(L) - w]wv'(w)\left[1 - \frac{\varepsilon(L/2)}{\varepsilon(E)}\right]\right\}.$$

If R is large and $\varepsilon(E)$ is an increasing (decreasing) function (e.g. $\sigma < 1$ (> 1) in the CES case) then the industry unemployment rate is likely to increase (decrease) when p^* falls in all states of nature except those with nearly full employment. Unfortunately, not much more can be said about unemployment, even in the CES case.

To summarize, we have seen that casual arguments to the effect that union voting behavior gives rise to wage stickiness in the face of inter-ntational competition may indeed contain an element of truth for some production technologies. In fact, for unionized sectors with elasticities of substitution between labor and other fixed factors greater than one, the direction of union wage movement can be opposite to that of the price of the sector's output. In these cases large adjustments in sectoral allocation

of labor are necessitated, with the attendant political problems. For almost all reasonable parameter values international competition does cause the union sector to contract, a plausible conclusion regarding resource reallocation. Finally, a permanent change in international competition may increase, decrease or leave unchanged the average long-run rate of industry unemployment.

IV. DOES THE SENIORITY RULE CONTRIBUTE TO WAGE STICKINESS?

Can the blame for wage sluggishness in unionized sectors following a fall in the international price be attributed to the seniority system? In order to answer this question we must investigate the behavior of a unionized sector which is in every way identical to that studied in the preceding sections, expect as regards the extent to which seniority rules layoff decisions.

Suppose workers are indexed by i representing seniority, as before, but let $i \in [\delta, L - \delta]$, so that the most senior worker has index δ. Assume that there are $L/L - 2\delta$ workers with each seniority index, and therefore a total union membership of L.

Now let the order of layoffs and rehires be indexed by j, with the job quene running from $j=0$ to $j=L$. We assumed in the previous sections that the seniority ordering was identical to the job queue, but here we wish to modify this assumption to allow for the possibility that other criteria enter employment decisions. Suppose that a worker with seniority index i has a job queue index somewhere between $j = i - \delta$ and $j = i + \delta$, and that every union member has a uniform subjective prior over this range defined in part by his seniority ranking. Then the larger is δ the smaller is the role of seniority in the determination of the employment ordering.[12]

I take δ as a measure of the (decreasing) extent of seniority rule.

The voting and membership schedules are analogous to those above. A union member with seniority index i has a subjective probability of employment, given the wage, of

$$\pi_i = \int_{i-\delta}^{i+\delta} \frac{1}{2\delta} \left[B - \frac{w}{p^* f(j)}\right] dj \tag{6}$$

The voting schedule is derived by maximizing the expected utility of the median worker, who still has index $i = L/2$, with respect to the choice of wage. The membership schedule equates the expected utility of the least senior worker, who has index $i = L - \delta$, to the utility of employment in the nonunion sector. The equations for the VV and MM curves, analagous to (4) and (5) above, are

$$\int_{\frac{L}{2}-\delta}^{\frac{L}{2}+\delta} [B - w/p^* f(j)] \frac{1}{\delta} dj = \frac{v(w) - v_o}{v'(w)} \int_{\frac{L}{2}-\delta}^{\frac{L}{2}+\delta} \frac{1}{\delta p^* f(j)} dj \tag{7}$$

and

$$\left[\int_{L-2\delta}^{L} \{B - w/p^* f(j)\} \frac{1}{2\delta} dj\right][v(w) - v_o] = \bar{v} - v_o \tag{8}$$

We are now in a position to pose formally the question raised at the outset of this section. The responsiveness of wages to price changes is given by dw/dp^*. If the seniority system contributes to the failure of wages to adjust to international competition then we should find $d^2w/dp^*d\delta > 0$. Alternatively, if this cross second derivative is negative, then we must conclude that the seniority system actually contributes to wage adjustment.

It is tedious but straightforward to show that[13]

$$\text{sgn}\{\frac{d^2w}{dp^*d\delta}\} = -\text{sgn}\{\frac{dw}{d\delta}\}$$

In words, the seniority system (or more precisely, a marginal increase in reliance on seniority for layoff decisions) contributes to wage sluggishness in the face of increased international competition if and only if for a given international price the seniority system also causes a higher sectoral wage to obtain than would otherwise. This latter issue was investigated in Grossman (1982), so the results and intuition for that analysis will only be reviewed briefly here.

An increase in the importance of seniority unambiguously shifts the MM curve to the left. At a given wage the least senior worker, who obviously can be no worse than last on the job queue, must have a greater probability of employment and therefore greater utility the more considerations other than seniority enter into employment decisions. A decrease in δ lowers the expected utility of a given least senior worker, and ceteris paribus causes the union to contract.

Thus, a sufficient though by no means necessary condition for the seniority system to raise the wage is for it to effect an upward shift in the VV curve. The voting schedule shifts up if the initial median worker experiences an increased probability of employment at a given wage when δ decreases. This in turn requires that the probability of employment be a concave function of place in the job queue.

The reason as an follows. From the perspective of the median worker, the mean of his subjective probability distribution over his possible locations in the job queue is L/2. This is true irrespective of the

degree of reliance on seniority, and thus is perserved by charges in δ. A decrease in δ represents to the median worker a mean-preserving contraction in the subjective distribution he holds over his job queue index. His subjective probability of employment is thus raised by an decrease in δ if and only if probability of employment is a convex function of level of employment. Finally, if employment prospects are improved ceteris paribus, then an upward adjustment in his most-preferred wage results.

The probability of employment function is given by $\pi_j = B - w/p^*f(j)$. This is a linear and decreasing function of $1/f(j)$. Therefore, the probability of employment function is convex if and only if the reciprocal of the marginal product of labor function is concave. For the CES production function this condition is easily interpretable. If α is the elasticity of output with respect to labor, then a necessary and sufficient condition for $1/f(j)$ concave is $\sigma \leq 1/(1 + \alpha)$. For small elasticities of substitution between labor and the fixed factor the VV curve does shift upward in response to a decrease in δ, and the seniority system does increase the union wage.

For the CES case a bit more can be established. It can be shown that for $1/(1 + \alpha) < \sigma \leq 1$, although the VV curve shifts downward as δ decreases, the net result of the shifts in both curves is nonetheless an increase in the equilibrium wage. We can conclude in such cases that the seniority system does contribute to wage sluggishness. Recall that when $\sigma \leq 1$ the wage falls to partially offset the fall is p^*. It is thus established that the responsiveness of the equilibrium wage is greater the smaller is the role played by the seniority system. Note that this result includes the Cobb-Douglas case, for which the wage response under complete seniority rule is zero.

For more general production functions the seniority system need not be the correct explanation for the failure of union sector wages to respond to international competition. Indeed, under conditions such that the probability of employment of the median worker would increase significantly were the seniority system to be abandoned, wage adjustment in the direction of sectoral price changes is greater under the seniority system than it would be otherwise.

V. CONCLUSIONS

In this paper I have investigated the casual argument that majority voting in unions and the seniority system together provide an explanation for the failure of union wages to adjust in response to intensification of international competition. In the context of a formal model of a small union sector embedded in a two-sector economy I have shown that the elasticity of the union sector wage with respect to changes in the international price of the sector's output depends critically on the production technology in that sector. In the Cobb-Douglas case the long-run equilibrium wage in the union sector is "endogenously sticky." A perhaps surprising result is that when the elasticity of the marginal product of labor schedule is a decreasing function of the level of employment a decline in the international price of the union-sector good causes the wage rate in that sector to rise.

The model was modified to allow the job queue to deviate from a strict seniority ranking. By doing so I was able to isolate the role played by the seniority system in the determination of the wage adjustment. Sufficient conditions were derived under which greater reliance on the seniority criterion for layoffs implies less wage responsiveness.

Welfare statements do not follow immediately from the analysis. Here I have been concerned solely with positive questions of the effect of international competition on union wages, union size and sectoral unemployment. But the potential scope for trade policy is evident, if the market distortions described here accurately reflect aspects of the real world. An advantage that the present formulation offers for studying trade policy is its ability to incorporate the effects of anticipated government intervention on the wage demands set by unions. The normative questions are left for future research.

FOOTNOTES

1. See, for example, Bhagwati and Srinivasan (1974), Srinivasan and Bhagwati (1975), Corden and Findlay (1975) and Khan (1980).

2. An exception is Calvo (1978). However, Calvo does not attempt to explain industry wage stickiness, focusing instead on general equilibrium resource allocation issues under the assumption that unions seek to maximize the urban-rural wage differential.

3. The prototypical example of this occurence might be the United Auto Workers settlement of 1979 when, amidst increased competition from Japanese cars, the union negotiated a wage pact calling for an approximately 35% expected nominal wage increase which translated to a small expected increase in real wages. At the time, the industry unemployement rate was in excess of fifteen percent.

4. It would be possible to model the bargaining process, as for example do McDonald and Solow (1981), but that would add further complication, and does not seem essential to the issues addressed here.

5. See Hall and Lillien (1979) for an analysis of efficient bargains and a discussion of conditions under which unilateral employment determination is likely to arise.

6. While this mobility assumption is somewhat extreme, it is quite common in the contract theory literature. See, for example, Azariadis (1975) and Grossman and Hart (1981). It would be possible to relax this assumption in a multi-period formulation, with only minor changes in the results, if workers who leave the union to accept nonunion employment lose their position in the seniority queue. The some workers who are laid off will remain unemployed rather than leave the union sector in order to protect their future rents to seniority.

7. In Grossman (1982) I investigate the conditions under which industry unemployment is greater when a seniority system is operative relative to that which results with a similar set of assumptions about union behavior, but with the addition of other criteria for layoff decisions. This is further discussed in Section IV below.

8. This assumption is consistent with the observation that wage gradients in union sectors (and sectors with collective bargaining generally) are flatter than those in nonunion sectors. See Bloch and Kuskin (1978) and Freeman (1978).

9. See Blair and Crawford (1981) for more discussion of the existence of a unique equilibrium in the context of the union voting problem.

10. Note that (5) does not imply the absence of a utility premium for workers in a monopoly-union sector. Ex ante all workers except the least senior have higher expected utility than that available in the nonunion sector. And once the state of nature is realized, every employed worker has higher utility than that available outside the sector. Thus, the free entry assumption is not inconsistent with the observation, by for example Abowd and Farber (1979), that union workers earn a premium, or that there is often a queue for union jobs.

11. This result would need to be modified if the unionized sector were "large," so that the allocation of workers into or out of this sector would affect labor's marginal product in the rest of the economy.

12. When $\delta = 0$ the model of this section is exactly as in previous sections. The maximum allowable value for δ is $L/2$, in which case all workers are identical, and each acts as if layoffs will be made by random draw. This is effectively the model of union behavior of McDonald and Solow (1981), Oswald (1981) and others.

13. Details are available from the author upon request.

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