UNIVERSITY OF NOTTINGHAM

Discussion Papers in Economics

Discussion Paper
No. 10/15

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November 2010

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Abstract: Considering a move from monopoly to duopoly, Bastos et al. ("Open shop unions and product market competition", 2010, *Canadian Journal of Economics*) provides open-shop union, where the union density is less than one, as a theoretical reason for the evidence of a positive relationship between product market competition and unionized wage. We show that their theoretical result is very much sensitive to the assumption of initial monopoly. Using the right-to-manage-model of labor union and generalizing their work with multiple unionized and non-unionized firms, we show that if there are at least two firms initially, higher product market competition reduces unionized wage, irrespective of the union density, bargaining power of the union and the union's preference for wage and employment. We then provide a simple reason for the unionized wage increasing effect of product market competition based on external economies of scale.

Key Words: Competition; External economics of scale; Open shop union; Wage

JEL Classification: J51; J52; L13

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[*] I would thank Paulo Bastos, Udo Kreickemeier and Peter Wright for their comments and suggestions. The usual disclaimer applies.

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1. Introduction

What is the effect of product market competition on unionized wage? In an influential paper Dowrick (1989) shows that, under decentralized or firm-specific union-firm bargaining, an increase in the number of competing firms in an industry reduces wage. Even if the theoretical work of Dowrick (1989) shows a negative relationship between product market competition and unionized wage, the empirical evidence on this issue is mixed. Many studies on the US have found that decreased product market competition reduces unionized wage (Block and Kushin, 1978 and Freeman and Medoff, 1981). Abowd and Tracy (1989) show that the impact of higher concentration of sales on the unionized wage is positive at first, but it is negative after a certain level of concentration. Bratsberg and Ragan (2002) show that the effect of deregulation on the union wage premium vary considerably across industries. Stewart (1983), Macpherson and Stewart (1990) and Van Reenen (1996) show mixed evidences on the UK industry.

In a recent paper, considering a move from monopoly to duopoly, Bastos et al. (2010) provides open-shop union, where the union density is less than one, as a theoretical reason for the evidence of a positive relationship between product market competition and unionized wage. More specifically, considering a move from monopoly to duopoly product market structure, they show that the unionized wage is higher under the latter product market structure compared to the former if the union density is positive but very low. Thus, they conclude that the previous theoretical result showing a negative relationship between the number of firms and unionized wage is due to the assumption that union density is one, i.e., all workers are union members.

The purpose of this paper is two-fold. First, in Section 2, we generalize Bastos et al. (2010) with multiple unionized and non-unionized firms, and show that their theoretical result is very sensitive to their assumption of an initial monopoly. In their framework with a right-to-manage-model of labor union, we show that if there are either at least two unionized firms or at least one unionized firm and one non-unionized firm, higher product market competition reduces unionized wage, irrespective of the union density, bargaining power of the union and the union's preference for wage and employment. Thus, we show that, even if the theoretical observation of Bastos et al. (2010) is interesting, it holds under a very special case.

We then provide a simple reason in Section 3 for a positive relationship between number of firms and unionized wage based on external economies of scale. Considering union density is one, i.e., all workers are union members, we show that a non-monotonic relationship between product market competition and unionized wage occurs in the presence of external economies of scale. External economies of scale create a negative relationship between the number of firms and a firm's labor productivity. As the intensity of external economies of scale increases, it increases the possibility of a higher unionized wage following higher product market competition.

The consideration of external economies of scale has clear empirical relevance. Caballero and Lyons (1990) show the evidence of external economies of scale in the manufacturing industries of Belgium, France, the UK and former West Germany. Their study suggests that external economies of scale are more prominent than internal economies of scale. Broadberry and Marrison (2002) show the evidence of external economies of scale in the UK cotton industry.[1] The presence of externalities created by external economies of scale is also acknowledged by Choi and Yu (2002), Grossman and Rossi-Hansberg (2009) and several references therein.

We conclude in Section 4.

2. The model and the results

Assume that there are *m* unionized firms and *n* non-unionized firm compete in an industry like Cournot oligopolists with homogeneous products. We denote the firms *1, 2, …, m* as unionized firms and the firms *m+1, m+2, …, m+n* as non-unionized firms. All firms require only labor for production. For simplicity, we assume that each firm requires 1 worker to produce 1 unit of output, and the reservation wages of the workers are zero. Hence, each of the non-unionized firm pays zero as the wage to its workers. In contrast, the union-firm bargaining determines wage in the unionized firms. We consider the right-to-manage model of labor union, as in Bughin and Vannini (1995), Vannini and Bughin (2000), López and Naylor (2004), Mukherjee (2008) and Bastos et al. (2010), to name a few, where the union-firm bargaining determines wage and the firms hire workers according to their requirements.[2] However, we assume that the unions are open shops, and the fraction of workers who are union members are determined by $\mu \in (0,1]$. We assume that the union densities are same in all firms. The firms pay the same wage to the union and non-union members.

[1] See, Mukherjee (2010) for a recent theoretical work showing the welfare effects of entry in the presence of external economies of scale.
[2] Bastos et al. (2009) also consider the implications of "efficient bargaining" model, which stipulates that the firms and unions bargain over wages and employment. They show that a move from monopoly to duopoly increases unionized wage under efficient bargaining if the entrant is non-unionized. Hence, it is immediate that under efficient bargaining, higher product market competition can reduce unionized wage even if there are multiple unionized and non-unionized firms. Due to this observation, we concentrate only on the right-to-manage model of union-firm bargaining. Further, see, Layard et al. (1991) for arguments in favor of the right-to-manage models.

Following Naylor and Cripps (1993), Naylor and Raaum (1993) and Bastos et al. (2010), we consider the following sequence of contract periods. In each contract period, the model can be described as a two-stage game. At stage 1, firms and unions bargain over wages, for a given level of union density. At stage 2, firms decide on their level of production, and hence employment, taking as given the wage and the labor demand schedule of other firms. We solve the game through backward induction.

The inverse market demand function is $P = a - q$, where P is price and q is the total output.[3]

Given m unionized and n non-unionized firms, and w_i as the wage in the ith unionized firm, $i = 1, 2, \ldots, m$, the equilibrium output of the ith unionized firm is

$$q_i = \frac{a-(m+n)w_i + \sum_{\substack{k=1 \\ i\neq k}}^{n} w_j}{m+n+1}, \tag{1}$$

where $i, k = 1, 2, \ldots, m$.

We assume that the utility of the ith union is[4]

$$U_i = w_i^{\theta} q_i^{(1-\theta)} = w_i^{\theta}\left(\frac{a-(m+n)w_i + \sum_{\substack{j=1 \\ i\neq j}}^{n} w_k}{m+n+1}\right)^{(1-\theta)}. \tag{2}$$

As in Bastos et al. (2010), it is clear from (2) that the union is taking into account the interests of all workers, whether or not they are union members. It is worth mentioning that if the union considers the interest of the union members only so that

[3] This is similar to the demand function considered in Bastos et al. (2009), with the exception that we normalize the slope parameter to 1, since it does not affect wage comparison.

[4] Since we consider that one worker is required to produce one unit of output, we have $L_i = q_i$, where L_i is the ith firm's labor demand, $i = 1, 2, \ldots, m$.

the union utility is $U_i = w_i^{\theta} (\mu q_i)^{(1-\theta)}$, it will not affect the equilibrium wage, since μ acts just like a scale factor.

The *i*th union bargains with the *i*th firm to determine w_i, *i = 1, 2, …, m*. We assume that bargaining powers of all unions are β and that of all firms are ($1-\beta$). Therefore, w_i is determined by maximizing the following expression:

$$\underset{w_i}{Max}\left(U_i - \overline{U_i}\right)^{\beta} (\pi_i - \overline{\pi_i})^{1-\beta}, \qquad (3)$$

where $\overline{U_i}$ and $\overline{\pi_i}$ are respectively the disagreement utility of the *i*th union and the disagreement profit of the *i*th firm. That is, the utility of the *i*th union and the profit of the *i*th firm, when there is a disagreement between the *i*th union and the *i*th firm but the other unions and firms agree to bargained wages.

Following the previous works (Naylor and Cripps, 1993, Naylor and Raaum, 1993 and Bastos et al., 2010), we assume that the steady-state Nash bargained wage in the *i*th firm, *i = 1, 2, …, m*, is determined in a two-step process. First, we maximize (3), taking as given the wages negotiated in the previous contract period, given by $\overline{w_i}$ for the *i*th unionized firm, *i = 1, 2, …, m*, and 0 for the *j*th non-unionized firm, *j = m+1, m+2, …, m+n*, and the contemporaneous wages of other unionized firms, which are w_k, $i \neq k$ and *k = 1, 2, …, m*, and other non-unionized firms, which are 0. Second, we solve the steady-state bargained wages by imposing that $w_i = \overline{w_i}$, *i = 1, 2, …, m*.

We assume that if there is disagreement between firm *i* and union *i*, the utility of the *i*th union is zero. However, it should be noted that if the union density is less than 1, the disagreement profit of the *i*th firm would be positive. Following the previous works (Naylor and Cripps, 1993, Naylor and Raaaum, 1993 and Bastos et al., 2010), we assume that, in the case of a disagreement between the *i*th union and the

ith firm, the firm continues production with its non-unionized workers under the terms of the contract negotiated in the previous period, and the firms are myopic in the sense that it ignores the effect of its current employments on future wage negotiations.

Hence, the output of the ith firm under disagreement is $\overline{q_i} = (1-\mu)\overline{q_i^*} = (1-\mu)\left(\dfrac{a-(m+n)\overline{w_i}+\sum_{\substack{k=1\\ i\neq k}}^{m-1}\overline{w_k}}{m+n+1}\right)$, where $i, j = 1, 2, \ldots, m$. However, to find out the disagreement profit of the ith firm, we need to look at the best responses of other unionized and non-unionized firms corresponding to this output level of the ith firm. The best response function of the kth unionized firm and the jth non-unionized firm are respectively $\overline{q_k} = \dfrac{a - w_k - \overline{q_i} - \sum_{\substack{s=1\\ s\neq k, s\neq i}}^{m} q_s - \sum_{j=m+1}^{m+n} q_j}{2} \equiv \overline{q_k}(\overline{q_i})$ and $\overline{q_j} = \dfrac{a - \overline{q_i} - \sum_{\substack{s=1\\ s\neq i}}^{m} q_s - \sum_{\substack{t=m+1\\ t\neq j}}^{m+n} q_t}{2} \equiv \overline{q_j}(\overline{q_i})$. Solving these expressions, we get the disagreement profit of the ith firm, $i = 1, 2, \ldots, m$, as

$$\overline{\pi_i} = [a - \overline{q_i} - \sum_{\substack{k=1\\ k\neq i}}^{m} \overline{q_k}(\overline{q_i}) - \sum_{j=m+1}^{m+n} \overline{q_j}(\overline{q_i})]\overline{q_i}\,. \tag{4}$$

Substituting (4) in (3) and using symmetry between the unionized and the non-unionized firms, the wage in a unionized firm in the steady-state can be found as

$$w_i^* = \frac{a\theta\beta\mu(m+n+\mu-1)}{2(1-\beta)(m+n)^2 + \mu\beta(m+n+\mu-1)(m+n+\theta-m\theta)}\,, \tag{5}$$

where $i = 1, 2, \ldots, m$.

It is now easy to derive the results of Bastos et al. (2010), where the initial market structure is a unionized monopoly. In this situation, wage is

$w_i^*(m=1, n=0) = \dfrac{a\theta\beta\mu^2}{2-\beta(2-\mu^2)}$. Now, entry of a non-unionized firm will create the unionized wage as $w_i^*(m=1, n=1) = \dfrac{a\theta\beta\mu(1+\mu)}{8-\beta(8-2\mu(1+\mu))}$. The comparison of these values shows that $w_i^*(m=1, n=0)$ can be lower than $w_i^*(m=1, n=1)$, thus showing that entry of a non-unionized firm may increase unionized wage.

If we now consider entry of a unionized firm, the relevant wage after entry is $w_i^*(m=2, n=0) = \dfrac{a\theta\beta\mu(1+\mu)}{8-\beta(8-\mu(1+\mu)(2-\theta))}$. The comparison of $w_i^*(m=1, n=0)$ and $w_i^*(m=2, n=0)$ shows that entry of a unionized firm can increase unionized wage.

Let us now consider the general case where we have *m* unionized and *n* non-unionized firms. We see how the unionized wage changes if the number of non-unionized firm increases. We get from (5) that $\frac{\partial w_i^*}{\partial n} \begin{smallmatrix}\geq\\ <\end{smallmatrix} 0$ if

$$-2(1-\beta)(m+n)(m+n-2+2\mu) - \mu\beta(m+n+\mu-1)^2 \begin{smallmatrix}\geq\\ <\end{smallmatrix} 0\,. \qquad (6)$$

It is straightforward to see that left hand side (LHS) of (6) is negative as long as $m+n \geq 2$. Since there must be at least one unionized firm to start with, it implies that if there are either at least two unionized firms or at least one unionized and one non-unionized firms competing in the product market, an increase in the number of non-unionized firms reduces the unionized wage, irrespective of union density, bargaining power and the union’s preference for wage and employment.

Now we want to see how the unionized wage changes if the number of unionized firm increases. We get from (5) that $\frac{\partial w_i^*}{\partial m} \begin{smallmatrix}\geq\\ <\end{smallmatrix} 0$ if

$$-2(1-\beta)(m+n)(m+n-2+2\mu) - \mu\beta(1-\theta)(m+n+\mu-1)^2 \begin{smallmatrix}\geq\\ <\end{smallmatrix} 0\,. \qquad (7)$$

LHS of (7) is negative for $m+n\geq 2$. Therefore, if there are either at least two unionized firms or at least one unionized and one non-unionized firms competing in the product market, an increase in the number of unionized firms reduces the unionized wage, irrespective of union density, bargaining power and the union's preference for wage and employment.

The above discussion gives the following proposition immediately.

Proposition 1: *If there are either at least two unionized firms or at least one unionized firm and one non-unionized firm in the product market, an increase in the number of firms (either unionized or non-unionized firm) reduces the unionized wage.*

The intuition for the above result will be clear once we look at the first order condition for wage determination, which is

$$\beta\left(\frac{\pi_i-\overline{\pi_i}}{U_i}\right)^{1-\beta}\frac{\partial U_i}{\partial w_i}+(1-\beta)\left(\frac{U_i}{\pi_i-\overline{\pi_i}}\right)^{\beta}\frac{\partial \pi_i}{\partial w_i}=0\,. \tag{8}$$

It follows from (8) that, ceteris paribus, whether higher product market competition increases or reduces wage depends on $\frac{\pi_i-\overline{\pi_i}}{U_i}$. If $\frac{\pi_i-\overline{\pi_i}}{U_i}$ falls, it reduces the equilibrium wage. Higher product market competition reduces π_i, $\overline{\pi_i}$ and U_i, and its effect on $\frac{\pi_i-\overline{\pi_i}}{U_i}$ is not clear. If the initial market structure is duopoly, higher product market competition reduces $\frac{\pi_i-\overline{\pi_i}}{U_i}$, thus reducing the unionized wage following higher product market competition. However, if the initial market structure is monopoly, entry of either a unionized firm or a non-unionized firm may increase $\frac{\pi_i - \overline{\pi_i}}{U_i}$, and the equilibrium wage.

3. The effect of external economies of scale

Now we want to provide a simple reason for the unionized wage raising effect of higher product market competition. We show that higher product market competition may increase unionized wage in the presence of external economies scale. We consider that due to the presence of external economies of scale, the labor productivity of each firm increases (or the labor requirement of each firm reduces) as the number of firms in the industry increases.

We consider the following set up in this section. Assume that there are m unionized firms, each of them requires λ workers to produce one unit of output. However, as the number of firm, increases, it reduces labor requirement. Hence, we consider that $\lambda(m)$ with $\frac{\partial \lambda}{\partial m} < 0$. To show our results in the simplest way, we ignore non-unionized firms. Also assume that the union density is one in all firms, which helps us to abstract away the role of union density shown in Bastos et al. (2010).

The move of the game is as follows. Given the number of firms, at stage 1, firm-specific unions and the firms bargain for wages simultaneously. At stage 2, the firms produce like Cournot duopolists. We solve the game through backward induction.

The inverse market demand function is given by $P = a - q$.

Given the wages, the equilibrium output of the ith firm is

$$q_i = \frac{a - m\lambda(m)w_i + \sum_{\substack{j=1 \\ j\neq i}}^{m} \lambda(m)w_j}{m+1}. \tag{9}$$

The union utility is

$$U_i = w_i^{\theta} q_i^{(1-\theta)} = w_i^{\theta} \left(\frac{a - m\lambda(m)w_i + \sum_{\substack{j=1 \\ j\neq i}}^{m} \lambda(m)w_j}{m+1} \right)^{(1-\theta)}, \tag{10}$$

The *i*th union bargains with the *i*th firm to determine w_i, *i = 1, 2, …, m*. We assume that bargaining powers of all unions are β and that of all firms are $(1-\beta)$. Therefore, w_i is determined by maximizing the following expression:

$$\underset{w_i}{Max}\left(U_i - \overline{U_i}\right)^{\beta} (\pi_i - \overline{\pi_i})^{1-\beta}, \tag{11}$$

In the case of disagreement, the utility of the union is zero. Since we are considering that the union density is one, the disagreement profit of the firms is also zero. Hence, we have $\overline{U_i} = \overline{\pi_i} = 0$.

Due to the symmetry of the firms and the unions, we get that the equilibrium wage that maximizes (11) with $\overline{U_i} = \overline{\pi_i} = 0$ is

$$w_i^* = \frac{a\theta\beta}{\lambda(m)[2m - \beta(m + \theta m - \theta)]}. \tag{12}$$

It follows from (12) that if λ does not depend on *m*, an increase in *m* reduces the equilibrium unionized wage. However, if λ falls with higher *m*, it creates a counter force, and tends to increase the equilibrium unionized wage. Therefore, the net effect of *m* on the equilibrium unionized wage depends on the strengths of the two opposing effects.

Proposition 2: We get $\frac{\partial w_i^*}{\partial m} \gtreqless 0$ if $-\frac{\partial \lambda}{\partial m} \gtreqless \frac{\lambda(m)(2-\beta-\theta\beta)}{2m-\beta(m+\theta\beta-\theta)}$.

Proof: Straightforward calculation from (12) gives the result. ■

Note that the second order condition for maximizing (11) implies that $[2m-\beta(m+\theta\beta-\theta)]>0$. Further, $(2-\beta-\theta\beta)>0$ for $\theta,\beta<1$. Therefore, $\frac{\lambda(m)(2-\beta-\theta\beta)}{2m-\beta(m+\theta\beta-\theta)}>0$, and Proposition 2 implies that if the external economies of scale are sufficiently strong, higher product market competition increases unionized wage. In general, Proposition 2 shows that there can be a non-monotonic relationship between product market competition and unionized wage.

As an example, consider that $\lambda(m)=\frac{\lambda}{m}$. Hence, the equilibrium wage is $w_i^*=\frac{a\theta\beta}{\lambda[2-\beta(1+\theta-\frac{\theta}{m})]}$, which immediately implies that as *m* increases, it increases the equilibrium unionized wage.

3. Conclusion

The influential theoretical work of Dowrick (1989) shows that higher product market competition reduces unionized wage in the presence of firm-specific union-firm bargaining. Recently, Bastos et al. (2010) show that if the union density is less than one, the unionized wage in a duopoly market structure can be higher than the unionized wage under a monopoly. We first show that the result of Bastos et al. (2010) is very much sensitive to their assumption of an initial monopoly market structure. Generalizing their work with multiple unionized and non-unionized firms, we show that if there are either at least two unionized firms or one unionized and one non-unionized firm, an increase in the number of unionized or non-unionized firms reduces the unionized wage, irrespective of the union density, bargaining power of the union and the union's preference for wage and employment.

We then provide a simple reason for unionized wage increasing effect of higher product market competition based on external economies of scale. We show that in the presence of external economies of scale, where more firms increases labor productivity of each firm, higher product market competition may increase unionized wage.

References

Abowd, J.M. and J.S. Tracy, 1989, ‘Market structure, strike activity, and union wage settlements’, *Industrial Relations*, 28: 227-50.

Bastos, P., U. Kreickemeier and P.W. Wright, 2010, ‘Open shop unions and product market competition’, *Canadian Journal of Economics*, 43: 640-62.

Block, F.E. and M.S. Kushkin, 1978, ‘Wage determination in union and non-union sectors’, *Industrial and Labor Relations Review*, 31: 183-92.

Bratsberg, B. and J.F. Ragan, 2002, ‘Changes in the union wage premium by industry’, *Industrial and Labor Relations Review*, 56: 65-83.

Broadberry, S. and A.J. Marrison, 2002, ‘External economies of scale in the Lancashire cotton industry’, *Economic History Review*, 55: 51-77.

Bughin, J and S. Vannini, 1995, ‘Strategic direct investment under unionized oligopoly’, *International Journal of Industrial Organization*, 13: 127-45.

Caballero, R. J. and R. K. Lyons, 1990, ‘Internal versus external economies in European industry’, *European Economic Review*, 34: 805-30.

Choi, J.-Y. and E.S.H. Yu, 2002, ‘External economies in the international trade theory: a survey’, *Review of International Economics*, 10: 708-28.

Dowrick, S., 1989, ‘Union-oligopoly bargaining’, *The Economic Journal*, 99: 1123-42.

Freeman, R.B. and J.L. Medoff, 1981, ‘The impact of the percentage organized on union and nonunion wages’, *The Review of Economics and Statistics*, 63: 561-72.

Grossman, G.M. and Rossi-Hansberg, E., 2009, ‘External economies and international trade redux’, *Mimeo*, Princeton University.

Layard, R., S. Nickell and R. Jackman, 1991, *Unemployment, macroeconomic performance and the labour market*, Oxford University Press, Oxford.

López, M. C. and R. A. Naylor, 2004, ‘The Cournot-Bertrand profit differential: A reversal result in a differentiated duopoly with wage bargaining’, *European Economic Review*, 48: 681-96.

Macpherson, D.A. and J.B. Stewart, 1990, ‘The effect of international competition on union and nonunion wages’, *Industrial and Labor Relations Review,* 43: 434-46.

Mukherjee, A., 2008, ‘Unionised labour market and strategic production decision of a multinational’, *The Economic Journal*, 118: 1621-39.

Mukherjee, A., 2010, ‘External economies of scale and insufficient entry’, *Journal of Industry, Competition and Trade*, 10: 365-71.

Naylor, R. and M. Cripps, 1993, ‘An economic theory of the open shop trade union’, *European Economic Review*, 37: 1599-620.

Naylor, R. and O. Raaum, 1993, ‘The open shop union, wages, and management opposition’, *Oxford Economic Papers*, 45: 589-604.

Stewart, M.B., 1983, ‘Relative earnings and individual union membership in the United Kingdom’, *Economica*, 50: 111-25.

Van Reenen, J., 1996, ‘The creation and capture of rents: wages and innovation in a panel of U.K. companies’, *The Quarterly Journal of Economics*, 111: 195-26.

Vannini, S. and J. Bughin, 2000, ‘To be (unionized) or not to be? a case for cost-raising strategies under Cournot oligopoly’, *European Economic Review*, 44: 1763-81.