Hitotsubashi Journal of Economics 37 (1996) 185–188.

NOTES AND DISCUSSION

DIAGRAMMATIC DEMONSTRATION OF OLIGOPSONIES: AN ALTERNATIVE METHOD

JOTA ISHIKAWA*

Abstract

This note presents a new diagrammatic method that allows us to directly find oligopsony equilibria on the *price-quantity* plane and directly deal with the relationship between prices and quantities.

The purpose of this note is to present an alternative diagrammatic method to illustrate oligopsony equilibria on the *price-quantity* plane.[1] We particularly deal with the Cournot oligopsony equilibrium and the Stackelberg duopsony equilibrium. In the traditional diagrammatic analysis, the monopsony equilibrium has been demonstrated on the price-quantity plane, while the oligopsony equilibria have been illustrated on the quantity-quantity plane by using reaction curves. We cannot directly examine the relationship between prices and quantities in the diagram of reaction curves. Our new method allows us to directly find oligopsony equilibria on the price-quantitiy plane and directly deal with the relationship between prices and quantities. This makes the analysis much more convenient.

In order to demonstrate the oligopsony equilibria, we first consider a monopsonist who has the following linear inverse demand function:

$$P=A-aX \tag{1}$$

and faces the following linear inverse supply function:[2]

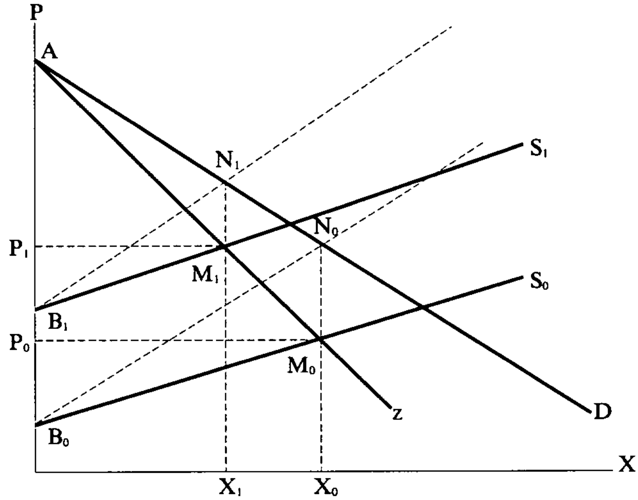
$$P=B+bX, \tag{2}$$

* I wish to thank Makoto Ikema for helpful discussions. All remaining errors are, of course, my own responsibility. The final version of this note was completed while I was visiting Faculty of Commerce and Business Administration at University of British Columbia. I am grateful for their support. I also gratefully acknowledge financial support from Kajima Foundation and both Canadian and Japanese governments.

[1] Ikema (1990, 1991) and Ishikawa (1995) deal with the diagrammatic demonstration of *oligopoly* equilibria on the price-quantity plane.

[2] The following method is, of course, effective with general demand and supply functions.

FIGURE 1



where P and X are, respectively, the price and the market demand or supply and where A, a, B and b are parameters. Figure 1 shows the standard diagrammatic solution for the monopsonist. Given the supply curve B_0S_0, the marginal cost curve (for the monopsonist) associated with B_0S_0 intersects the demand curve AD at point N_0. Then, the monopsonist chooses the price and the amount of purchase given by point M_0. We refer this point as the "monopsony-equilibrium" point with the supply curve B_0S_0. Suppose, now, a change in supply causes a parallel shift of the supply curve in Figure 1 from B_0S_0 to B_1S_1. Then, the marginal cost curve associated with B_1S_1 intersects the demand curve AD at point N_1. The monopsonist chooses the price and the amount of purchase indicated by point M_1. Thus, the monopsony-equilibrium point with the supply curve B_1S_1 is point M_1. We define the "monopsony-equilibrium" curve as the locus of all the monopsony-equilibrium points corresponding with different supply sizes. That is, the monopsony-equilibrium curve shows the combinations of equilibrium purchase and price of the monopsonist in response to parallel shifts of the supply curve. With (1) and (2), the coordinate of M_i ($i=0$, 1) is $([A-B_i]/[a+2b], \{bA+[a+b]B_i\}/[a+2b])$. Eliminating B_i, we can derive the monopsony-equilibrium curve (Az in Figure 1) as follows:

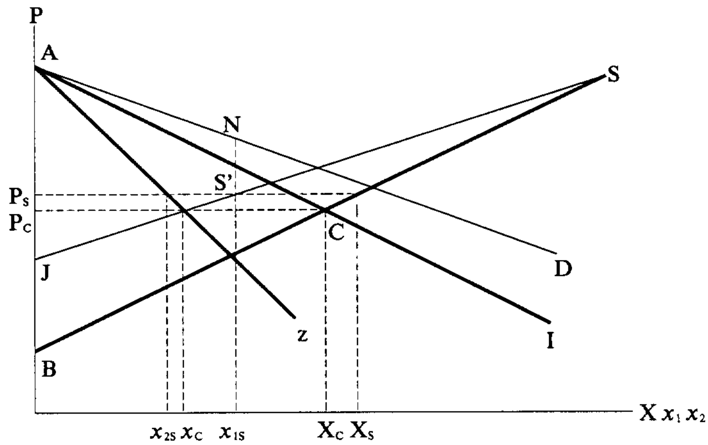
$$P=A-(a+b)X.$$

Using the monopsony-equilibrium curve, we can easily find the Cournot duopsony equilibrium on the price-quantity plane. We consider a duopsony model where two economic agents (say, firm 1 and firm 2) purchase a good or factor under the following inverse demand functions:

$$P=A_i-a_ix_i \quad (i=1, 2)$$

(where x_i is the amount of purchase of firm i and A_i and a_i are parameters) and face the inverse supply function (2).

FIGURE 2



Under Cournot conjectures, each firm maximizes its profits by choosing its own amount of purchase, taking its rival firm's amount of purchase as given. We can regard the parallel shifts of the supply curve from the point of view of a firm as the shifts in the amount of purchase of its rival firm. Thus, we can apply the monopsony-equilibrium curve to find the Cournot duopsony equilibrium. The monopsony-equilibrium curve for an individual firm is not affected by the presence of other firms.

Figure 2 shows a case where two firms are identical, that is, the inverse demand functions are identical. *AD* and *BS* are, respectively, the demand curve for each firm and the market supply curve. Then, the monopsony-equilibrium curve for each firm is given by *Az*. Horizontal summation of these two monopsony-equilibrium curves yields the equilibrium curve for the whole duopsonic industry, or, the "duopsony-equilibrium" curve, *AI*.[3] Then, the Cournot duopsony equilibrium is given by point *C* where *AI* intersects the market supply, *BS*.[4] The equilibrium purchase of each firm is x_C. The equilibrium price is P_C. The total amount of purchase of the industry is X_C $(=2x_C)$. Since the monopsony-equilibrium curve for an individual firm is not affected by the presence of other firms, the equilibrium curve for the whole oligopsonic industry, or, the "oligopsony-equilibrium" curve with *n* firms can similarly be drawn. Thus, the Cournot oligopsony equilibrium with *n* firms can similarly be obtained.

Figure 3 shows a case where firm 1 and firm 2 are not identical. In the figure, A_iD_i $(i = 1, 2)$ is the demand curve for firm *i*. A_iz_i $(i = 1, 2)$ is the monopsony-equilibrium curve for firm *i* and horizontal summation of these two curves, $A_1I'I$, is the duopsony-equilibrium curve. The Cournot duopsony equilibrium is then given by point *C*. The equilibrium price is P_C. The equilibrium purchase of firm 1 is x_{1C}, while that of firm 2 is x_{2C}. The total equilibrium purchase of the industry is X_C $(=x_{1C}+x_{2C})$.

Next we find the Stackelberg equilibrium for a duopsony in Figure 2.[5] For this, we assume that firm 1 is the leader and firm 2 is the follower. Since the Cournot duopsony is a case where

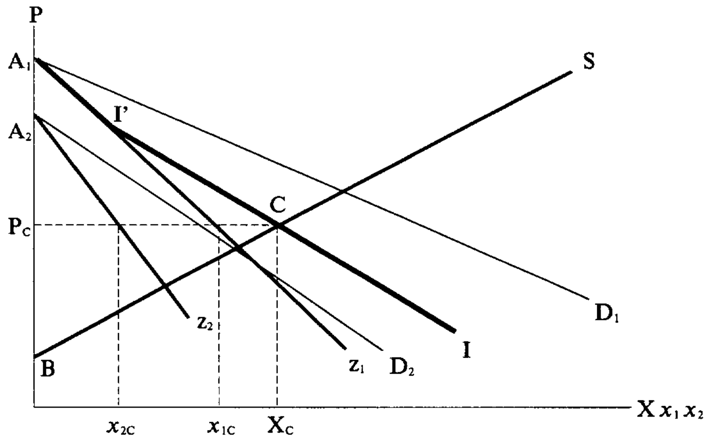
---

[3] *AI* is located inside *AD* if $a > b$ and outside if $a < b$; and coincides with *AD* if $a = b$.

[4] The coordinate of *C* is $(X_C, P_C) = (2[A-B]/[a+3b], \{2bA+[a+b]B\}/[a+3b])$.

[5] The Stackelberg equilibrium in Figure 3 can similarly be found.

FIGURE 3



both firms act as followers, firm 2's monopsony-equilibrium curve shown by Az in Figure 2 is still effective to derive the Stackelberg equilibrium. Firm 1 knows that the relationship between the price and the amount of purchase of firm 2 is given by Az. Thus, the supply curve faced by firm 1 is given by horizontally subtracting the monopsony-equilibrium curve of firm 2 from the market supply curve. In Figure 2, JS shows the supply curve faced by firm 1 with which firm 1 maximizes its profits. The marginal cost curve associated with JS (which is not drawn) intersects the demand curve for firm 1 at point N. Then, the Stackelberg equilibrium is established at point S' on JS.[6] The equilibrium purchase of firm 1 is x_{1S}, while that of firm 2 is x_{2S}. The equilibrium price is P_S and the total equilibrium purchase of the industry is X_S $(=x_{1S}+x_{2S})$.

HITOTSUBASHI UNIVERSITY

REFERANCES

Ikema, M. (1990), "An Alternative Geometrical Representation of a Cournot Duopoly," Unpublished Manuscript, Hitotsubashi University.

Ikema, M. (1991), *Kokusai fukusen kyoso-he-no riron* [A theory towards an international duopoly], Tokyo, Bunshindo.

Ishikawa, J. (1995), "A Note on the Diagrammatic Demonstration of the Cournot Equilibrium," forthcoming in *Japanese Economic Review*.

[6] JS is given by $P=[(a+b)b/(a+2b)]x_1+[bA+(a+b)B]/(a+2b)$. The coordinate of S' is $(x_{1S}, P_S)=([a+b][A-B]/a[a+2b]+2b[a+b],\ \{[a+b]b/[a+2b]\}x_{1S}+\{bA+[a+b]B\}/[a+2b])$.