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Trade Policy and Market Structure Interactions in Developing Countries

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Abstract

This paper shows that the presence of quotas on imported inputs that are based on installed capacity can lead to capacity underutilization in manufacturing industries of developing countries. A replacement of such quotas by tariffs leads to full capacity utilization under assumptions of both perfectly and imperfectly competitive markets. Furthermore, such a policy also eliminates strategic advantages for oligopolistic firms that arise in quota-based regimes.

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Summary

There is general consensus among international and development economists that there are substantial economic costs associated with restrictive trade regimes. While the focus has mainly been on studying the costs of protecting final output, an important cost that has not received sufficient attention is one that emerges in trade regimes with quotas on imported inputs. When these quotas are based on installed capacity, as they often are in developing countries, they encourage the creation of excess capacity. Creation of idle capacity, then, exacerbates the problem of capital shortages in developing economies.

In this paper, a simple model is developed to formally explain how excess capacity, observed to persist in the manufacturing sectors of many developing countries, could be a result of certain allocation rules used in distributing quotas on imported inputs. Futhermore, recent empirical studies reaffirm the view that most markets in developing countries are imperfectly competitive. In view of this evidence, the effects of input quotas in both perfectly competitive and imperfectly competitive markets are examined. By developing an oligopoly model it is possible to analyze the strategic advantages that arise in input quota regimes for oligopolistic firms as compared to perfectly competitive firms. The results show that excess capacity creation is less when strategic interactions between firms is taken into account.

The policy implications of this paper are fairly straightforward. A replacement of input quotas by input tariffs leads to full capacity utilization in both perfectly and imperfectly competitive markets. A developing country embarking on a trade liberalization process could therefore at the first stage eliminate excess capacity simply by replacing input quotas by input tariffs. This may be accomplished even without necessarily changing the degree of restrictions on imported intermediate inputs. It is also shown that introduction of secondary markets in quota-based regimes would lead to higher capacity utilization in the economy. Another policy implication of this paper is that tariffs in imperfectly competitive markets eliminate strategic advantages in quota allocations to oligopolistic firms. If the purpose of quota allocation rules based on installed capacity is to incorporate some notion of "fairness", then it is evident that governments are inadvertantly favoring industries which are more oligopolistic in nature. A replacement of input quotas by input tariffs would then ensure impartiality in the trade regime.

I. Introduction

There is broad consensus among international and development economists that there are substantial economic costs associated with restrictive trade policy regimes. Examples of the costs most frequently cited are higher domestic prices or inferior quality of products sold, inefficient resource allocation, administrative costs of policy implementation, and as has been more recently argued, the costs of lobbying for such polices. Consequently, economists have tended to agree that import liberalization, in general, would foster productive efficiency and increase consumer welfare. Relaxing or removing trade barriers is, therefore, now a key element in the advice given to developing countries by academics and international institutions alike.

While the focus has mainly been on studying the costs of protecting final output, an important cost that has not received attention in the theoretical literature is one that emerges in trade regimes with quotas on imported inputs. Quotas on imported inputs in manufacturing industries of developing countries are often based on installed capacity. A consequence is that firms in these industries create excess capacity which have been observed to persist for prolonged periods of time. This creation of idle capacity exacerbates the problem of capital shortages in developing countries. This paper presents a simple theoretical model to explain the relationship between excess capacity in these industries and quotas on imported inputs.

Explanations of capacity underutilization that are typically given are the variability in demand conditions coupled with the observation that capital investments are irreversible decisions. Such reasons are valid in explaining variability in capacity utilization, but are inadequate in explaining the persistence of excess capacity over time. We show, in this paper, that excess capacity is a natural outcome under certain trade regimes, irrespective of demand conditions or the reversibility of capital decisions. This study, therefore, is able to directly link input quotas with excess capacity in developing economies.

Many governments in developing countries issue licenses for imported inputs on the basis of installed capacity and not actual production undertaken. 1/ Two major empirical studies in the 1970s, the first by the OECD (Little et. al. (1970)) and subsequently by the NBER (Bhagwati, (1978)), highlight this fact for many countries. The countries studied include Argentina, Brazil, Chile, Colombia, Egypt, Ghana, India, Israel, Pakistan, Philippines, South Korea, Taiwan, and Turkey. These studies

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1/ Other rules that are sometimes used are input quotas based on past performance or labor employed. If input quotas are linked to employment creation the models presented below generate underutilization of labor in equilibrium.

note that the justification for the above mentioned allocation rule, given by governments in these developing countries, is to introduce some notion of "fairness" by allocating input quotas in some equitable, albeit arbitrary, manner. 1/ The consequence, as noted by Little et al. (1970, p. 226) is that firms "would invest in additional capacity, not because this was needed to produce the additional output but because it provided a basis for a more generous allocation of inputs".

Most markets in developing countries are also imperfectly competitive. Studies by Rodrik (1987) and Kirkpatrik et al. (1984) based on four-firm concentration ratios suggest that imperfect competition is not only prevalent in manufacturing sectors of developing countries, but appears to be even more pervasive than in developed countries. In view of this evidence we examine, in addition to the perfectly competitive model, an oligopoly model. By developing such a model we are able to analyze the strategic advantages that arise in input quota regimes in oligopolistic industries when compared to perfectly competitive ones.

The policy implications of this paper are fairly straightforward. A replacement of input quotas by input tariffs leads to full capacity utilization in both perfectly competitive and imperfectly competitive markets, and eliminates strategic advantages arising in quota regimes for oligopolistic firms. This study, consequently, has a bearing on the sequencing theory of trade reforms which is still in nascent form. 2/

This paper is organized as follows. In Section II, we describe briefly existing modeling approaches in the current literature and compare them to the approaches taken in this paper. In Section III, a theoretical model for analyzing tariffs and quotas on imported inputs is developed using a perfectly competitive framework. A comparison of input tariffs and input quotas in the perfectly competitive case reveals the existence of excess capacity under the quota regime alone. In addition to input tariffs, we show that excess capacity may also be eliminated by the introduction of secondary markets. In Section IV, input quotas under oligopoly and perfect competition are compared. Some concluding remarks close the paper.

II. The Modeling Framework

Most studies on trade of developing countries have focused on trade in final goods. A very important aspect in the problem of trade deficits is ignored if imports of intermediate inputs are not taken into consideration. The reason is that a developing country facing balance of

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1/ Even though auctioning of import quotas is the most efficient way of allocating them, it is hardly ever used in developing countries.

2/ By sequencing, we mean the successive steps taken in the transition from a highly distortionary trade regime to a less distortionary one, with the final objective of complete liberalization.

payments deficits may be willing to reduce its imports of final goods, especially luxury consumer goods (whose demand elasticity is high) but would be reluctant to forgo the imports of intermediate inputs if the industries which use these inputs have already been established. Many industries have become so dependent on technology-embodied foreign inputs to sustain their production process that any decrease in these inputs is likely to have a direct adverse impact on GDP. Given that imported inputs are considered "essentials", devising optimal trade policies in intermediate inputs is important for those countries facing severe balance of payments problems. 1/

The current literature on traded inputs in developing countries has been limited to neoclassical theories of effective protection (Corden (1971)), or immiserizing foreign (Brecher and Findlay (1983)) and domestic (Johnson (1967)) investment in the presence of domestic distortions. A basic limitation of conventional neoclassical theories is their inability to capture underutilization of factors of production without imposing price rigidities.

Abel (1981) develops a dynamic model of a firm with varying capacity utilization. He explains variations in utilization rates by assuming both capital and labor as quasi-fixed factors. At any instant these factors of production are fixed and only utilization rates are varied in response to given demand conditions. In models developed below, an explicitly defined quota allocation rule linking the two factors (capital and the intermediate input on which the quota is imposed) is sufficient to generate excess capacity. In other words, excess capacity is shown to emerge even if demand is unchanged.

The possibility of excess capacity as a means of deterring entry has been well documented in the Industrial Organization literature. Spence (1977), and Bulow et al. (1985), among others, have shown that because investments in capital are irreversible decisions and represent preemptive commitments to the industry, they can be used to discourage entry. 2/ An empirical implication would be to expect concentrated industries to have lower capacity utilization. Our model predicts a reverse relationship in countries which have inputs linked to capacity creation. Even though installed capacity in these developing countries is used as a strategic variable, it is not used for deterring entry but for optimizing input quota allocations.

1/ See Little et al. (1970, p. 225) and Bhagwati and Srinivasan (1975, p. 37).

2/ On the other hand, Dixit (1980), among others, has argued for cases where it is possible to have a credible threat to deter entry without actually installing excess capacity. Nevertheless, if excess capacity is observed, it is likely to occur in oligopolistic industries for reasons argued by Spence (1977).

The theoretical equivalence of tariffs and quotas under the assumption of perfect competition has been proven by a number of writers (e.g., Bhagwati (1969)). On the other hand, non-equivalence has been shown in the presence of existing distortions, for example, under uncertainty (Fishelson et al. (1975)), under monopoly in the domestic market (Panagariya (1980)), among others. Krishna (1983) was among the first to demonstrate the non-equivalence of tariffs and quotas in a game-theoretic framework. She shows that when oligopolistic firms took government actions as given, a quota could be used as a facilitating instrument but a tariff could not. More recently, Reitzes (1989) demonstrates the non-equivalence when R & D behavior is used as a strategic variable. In the presence of rent-seeking activities, the equivalence can still be shown (Bhagwati and Srinivasan (1980)) although the welfare loss is greater than without rent-seeking activities. This occurs because the act of lobbying for quotas or tariffs reduces the production possibility set for the economy as a whole (Krueger (1974); Bhagwati and Srinivasan (1980)).

In the models developed in this paper, we demonstrate the non-equivalence of tariffs and quotas under both perfect and imperfect competition. In addition, we show that excess capacity is less when strategic interactions between firms is taken into account. It is worth mentioning that our models demonstrate a special kind of rent-seeking activity, whereby the existence of controls on input quotas gives rise to rent-seeking behavior in the form of excess capacity creation. 1/

III. Quotas and Excess Capacity Under Perfect Competition

This section models the existence of excess capacity in manufacturing industries of developing countries. Quantitative restrictions on imported inputs are the key to explaining this phenomenon. This model allows us to: first, examine the existence of excess capacity despite unchanged demand for the final output; and second, to illustrate the inefficiencies of quantitative versus price controls in a new perspective -- quotas lead to capacity underutilization while tariffs do not.

1. The basic model

We develop a one-period model with many industries, each producing a final output with two kinds of inputs. There is an imported intermediate input (x) and a domestically produced input, capital (k).

1/ Rent-seeking, as defined by Bhagwati (1982), are activities which represent ways of making profits but do not produce goods and services that enter a utility function directly or indirectly via increased production. This concept of rent-seeking was first introduced by Krueger (1974).

The principal idea is to study import-competing industries in developing countries which are protected by prohibitive tariffs on the import of final outputs, but face a quota on the imports of scarce factor inputs. This is a realistic scenario for many developing countries protecting consumable manufacturing goods and importing industrial inputs. The justification is to encourage the growth of domestic industry by protecting them from foreign competition in final output but permitting limited imports of technology-embodied inputs. Thus domestic demand-supply conditions affect the price of the final output in each industry.

The number of sellers in a typical industry, g, are fixed at a level n_g. The sellers in each industry, g, produce a standardized product, y_g. To capture the "essentiality" of imported inputs in production, we study the case in which there are no substitution possibilities for imported inputs. 1/ In some sense, this assumption is a limiting case of a situation where domestic inputs cannot compete with foreign inputs either on price or quality grounds; or, alternatively, foreign inputs are technology-embodied with no domestic substitutes.

The production function of each firm in each industry is

$$y_g = \min[\alpha_g x_g, \beta_g k_g], \qquad g = 1, 2, \ldots\ldots\ldots, G.$$

where y_g is output of a representative firm in the gth industry, x_g is the intermediate input of this firm in the gth industry, and k_g is the capital stock of this firm in the gth industry. The significance of subscripting the input coefficients α and β with g implies that we could allow the technological coefficients to be different across industries while assuming that they are same for firms within the same industry. For notational convenience we will drop the subscript g and assume that we are looking at a typical industry. Henceforth,

$$y = \min[\alpha x, \beta k].$$

The industry's inverse demand function is given by

$$P = D(Y), \text{ where } D'(Y) < 0, \text{ and } Y = \textstyle\sum_n y.$$

We assume that inputs are purchased at given prices, P_x and P_k.

1/ The assumption of fixed technology is frequently used in the Industrial Organization literature; see Dixit (1980) and Dixit and Grossman (1984).

Three trade regimes are analyzed in the model of perfect competition: free trade, a tariff on the intermediate input, and a quota on the same input.

(a) Free trade case

This is the case with no tariffs or quotas on the intermediate input. The firms solve the following problem: 1/

$$\underset{y,x,k}{\text{Max}}\ \pi = Py - P_x x - P_k k. \tag{1}$$

From cost minimization, we determine the optimum levels of x and k used in producing any arbitrary level of y. Firms minimize total costs, C, where

$$C = P_x x + P_k k, \tag{2}$$

subject to the production constraint

$$\bar{y} \geq \min[\alpha x,\ \beta k], \tag{3}$$

where $\bar{y}$ is any arbitrary level of y. The solution to this problem can be illustrated graphically. In Figure 1, the production constraint (3) is given by the shaded region, M. The appropriate cost curve, given P_x and P_k, which minimizes costs in the shaded region M is C^F. Hence, cost minimization implies the point A. Moreover, at the point A,

$$x = \bar{y}/\alpha, \tag{4}$$

and

$$k = \bar{y}/\beta. \tag{5}$$

1/ Investment in capital is assumed to be a reversible decision here, in the sense that capital can be costlessly traded and firms rent it at a price, P_k. This is the least restrictive assumption that can be made in the context of explaining underutilization of capacity. The point is that even if capital investment was a reversible decision, we could still have excess capacity in equilibrium.

FIG. 1.

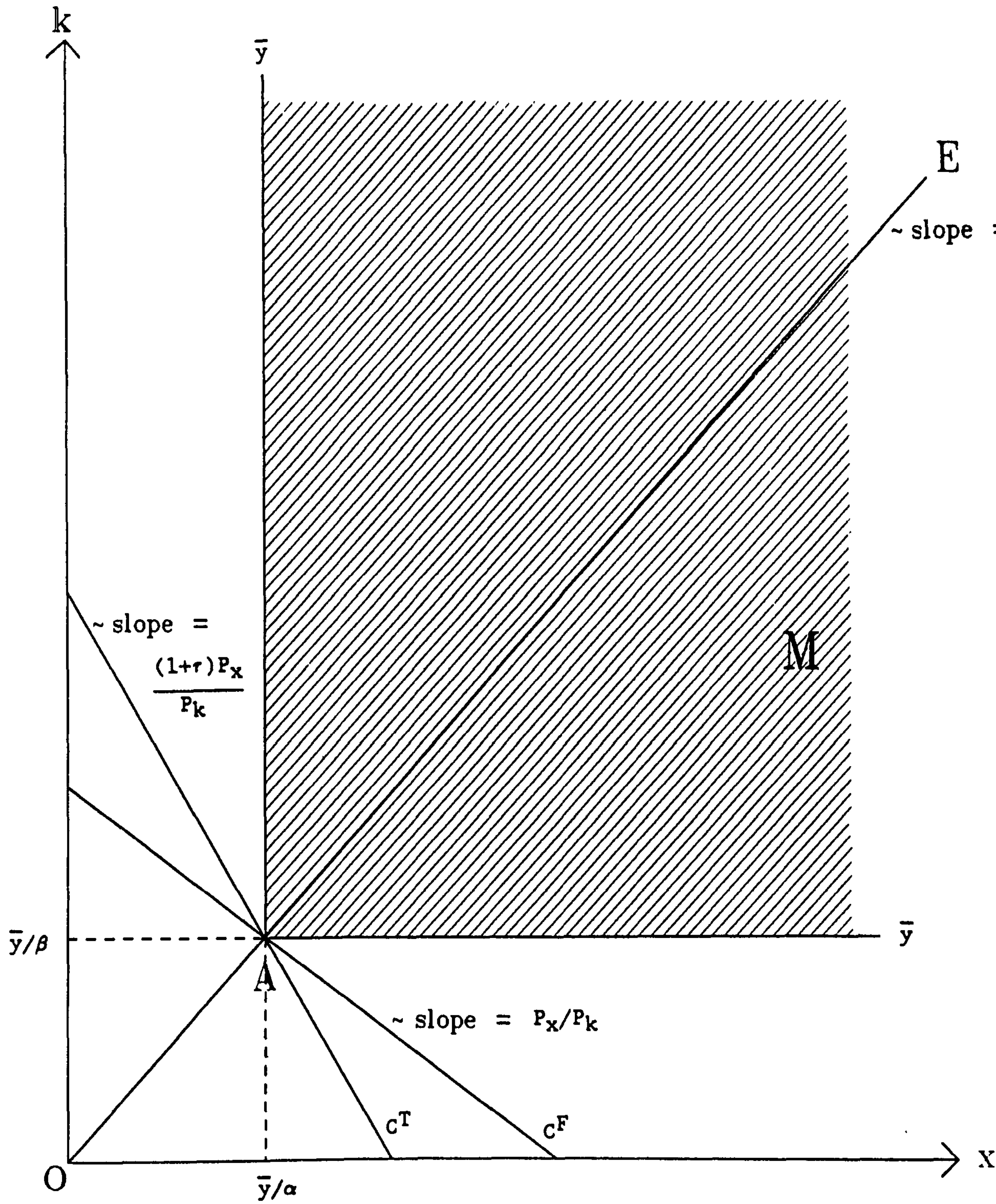

Figure 1.

Using equations (4) and (5) to express x and k in terms of y, in equation (1), we get: 1/

$$\max_{y} \pi = Py - P_x y/\alpha - P_k y/\beta.$$

Competitive equilibrium implies:

$$P = P_x/\alpha + P_k/\beta,$$

or,

$$D(Y^*) = P_x/\alpha + P_k/\beta, \tag{6}$$

where Y^* is the equilibrium level of aggregate output in the industry. In other words, the price of the final output is simply a linear combination of the input prices adjusted for their respective technological coefficients. Equation (6) is the benchmark case against which subsequent comparisons of price and output levels in input tariff and input quota regimes will be made.

(b) <u>Tariff on imported intermediate input case</u>

Let τ be the tariff levied on input x. Therefore, if ρ_x is the tariff inclusive input price, we have,

$$\rho_x = (1+\tau)P_x.$$

The firms now face the following problem:

$$\max_{y} \pi = Py - \rho_x x - P_k k. \tag{7}$$

From cost minimization we determine the optimal levels of x and k used for any arbitrary level of y. Firms minimize total cost, C, where

$$C = \rho_x x + P_k k, \tag{8}$$

1/ Note that since $\bar{y}$ is some arbitrary level of y, it holds for all possible y values. Hence we substitute y for $\bar{y}$ without any loss of meaning.

subject to the production constraint in equation (3). In Figure 1, the appropriate cost curve, given ρ_x and P_k, which minimize costs in the shaded region M, is C^T. Equilibrium, once again, occurs at point A. Equation (2) (the free trade case), of course implies a lower cost than equation (8) (the input tariff case).

Substituting equation (4) and (5) in equation (7), the firm's maximization problem now is:

$$\underset{y}{\text{Max}}\ \pi = Py - \rho_x y/\alpha - P_k y/\beta.$$

In equilibrium,

$$P = \rho_x/\alpha + P_k/\beta,$$

or,

$$D(Y_{(T)}*) = (1+\tau)P_x/\alpha + P_k/\beta, \tag{9}$$

where $Y_{(T)}*$ is the equilibrium level of aggregate output in the industry under the tariff regime.

Comparing the free trade case with the tariff case we can clearly say that price of the final output is higher under the tariff regime. That is, since $\tau > 0$, $D(Y_{(T)}*) > D(Y*)$. Also, since $D'(..) < 0$, we get $Y* > Y_{(T)}*$.

Moreover, regardless of input costs, we observe that cost minimization in the free trade case and the input tariff case implies point A. At A, firms utilize their capacity fully. That is, if y* is the optimal level of output for each firm, then installed capacity $(y*/\beta)$ equals used capacity $(y*/\beta)$, and, therefore, capacity is fully utilized. Hence there is no excess capacity under either the free trade case or the input tariff case.

(c) <u>Quotas on imported intermediate input case</u>

The quota on input x, is based on capacity creation. Let the quota allocation rule be,

$$x \le \theta k, \tag{10}$$

where θ is a policy parameter, exogenously set by the government, which determines the level of imports of x based on installed capacity. We will only study the interesting case where the quota is binding. 1/ The problem a typical firm faces is:

$$\max_{y,x,k} \pi = Py - P_x x - P_k k. \tag{11}$$

Once again from cost minimization we determine the optimal levels of x and k used for any arbitrary level of y. The firms now minimize total cost (equation (2)), subject to two constraints. The two constraints are the production function (equation (3)) and the quota allocation rule (equation (10)).

In Figure 2, the shaded region N represents the constraint (10) when the input quota is binding. The intersection of region M with region N which minimizes cost for $\bar{y}$ is given by the point B. The total cost line which goes through B is C^Q and has the same slope as C^F in Figure 1. Also, note that the slope of OD (which goes through B) is greater than the slope of OE (which goes through A). Since the slope of OD equals $1/\theta$, and the slope of OE equals α/β, a binding quota implies

$$\beta > \alpha\theta. \tag{12}$$

At point B in Figure 2,

$$x = \bar{y}/\alpha, \tag{4'}$$

which is the same as in the cases of free trade and input tariffs for arbitrary levels of y. However, the optimal k is different in the input quota case. Since we are analyzing the case where the input quota is binding, at point B,

$$k = x/\theta, \tag{10'}$$

where equation (10') is a rearrangement of equation (10) when it holds with equality, or,

$$k = \bar{y}/\alpha\theta. \tag{13}$$

1/ If the input quota were not binding, the solution would be the same as the free trade case.

Substituting equation (4') and equation (13) in equation (11), we obtain

$$\max_{y} \pi = Py - P_x y/\alpha - P_k y/\alpha\theta.$$

Thus in equilibrium,

$$P = P_x/\alpha + P_k/\alpha\theta,$$

or,

$$D(Y_{(Q)}^*) = P_x/\alpha + P_k/\alpha\theta, \tag{14}$$

where $Y_{(Q)}^*$ is the equilibrium level of aggregate output in the industry under the quota regime.

The existence of excess capacity under the quota regime is now fairly easy to establish. From equation (13) we have installed capacity $= y/\alpha\theta$, and from the production function (equation (3)) we know that used capacity $= y/\beta$. Hence,

$$\text{Capacity utilization} = \frac{\text{Used Capacity}}{\text{Installed Capacity}} = \frac{\alpha\theta}{\beta} \tag{15}$$

Since we are interested in analyzing the case where the input quota binds, we know from equation (12) that $\beta > \alpha\theta$. Given α, θ, $\beta > 0$, equation (15) shows that excess capacity is being created. Figure 2 illustrates the extent of excess capacity for any arbitrary level of y in the quota regime.

We now compare the level and price of the final output, and capacity utilization, under input quotas with the free trade and input tariff cases. Comparing equations (6) and (14) we see that since $\beta > \alpha\theta$, $D(Y^*) < D(Y_{(Q)}^*)$, and $Y^* > Y_{(Q)}^*$. In addition, since $K^* = Y^*/\beta$ and

FIG. 2. ILLUSTRATION OF A BINDING QUOTA ON INPUT X

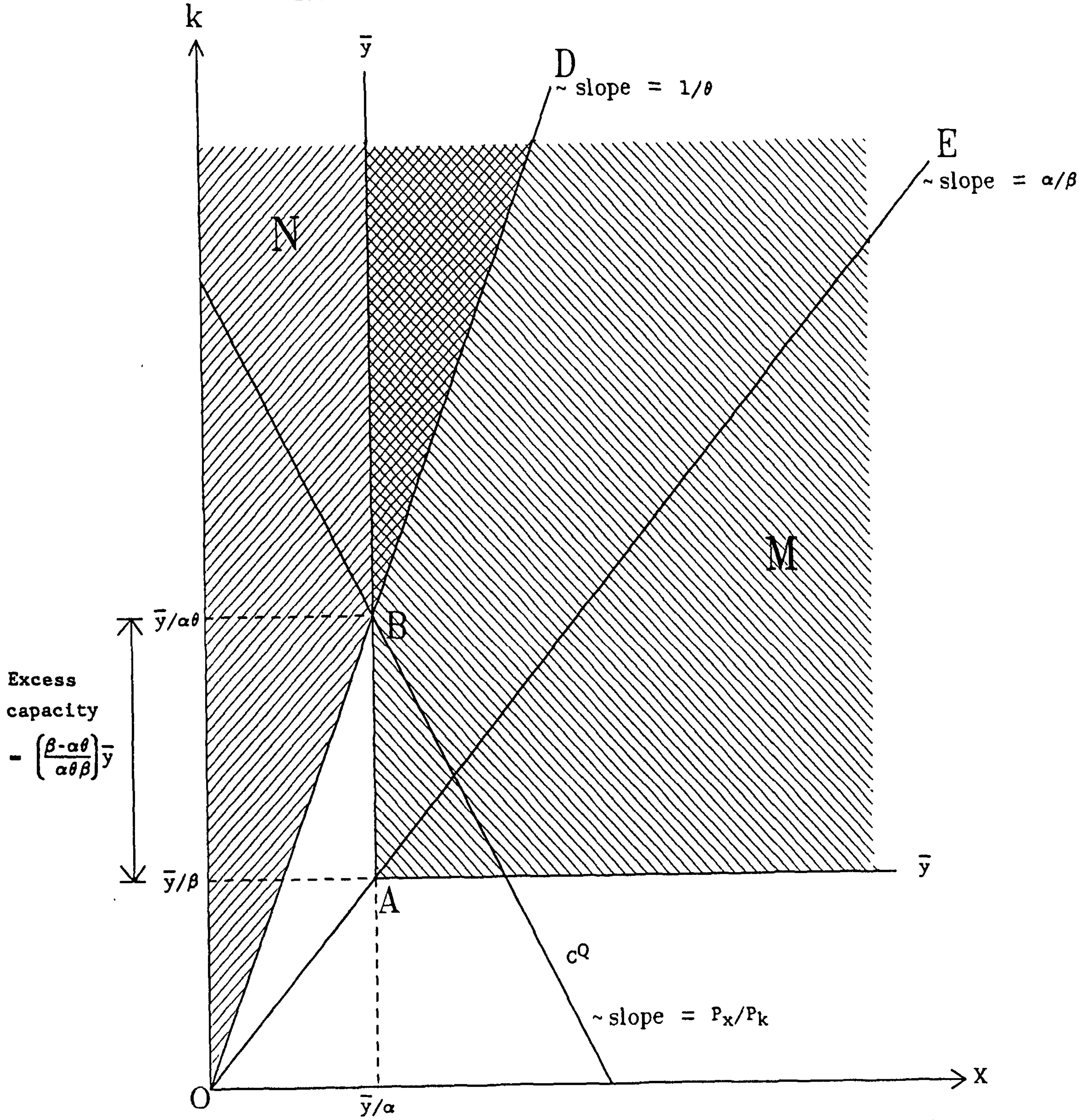

Figure 2: Illustration of a binding quota on input x

$K_{(Q)}* = Y_{(Q)}*/\alpha\theta$, 1/ the relative size of the installed capacity in the industry cannot be determined. This is because $Y_{(Q)}* < Y*$ but $\beta > \alpha\theta$. Nevertheless, the quota regime leads to capacity underutilization while the free trade regime does not.

In order to make a comparison between the input quota and the input tariff regimes which is meaningful in welfare terms, we can determine the tariff equivalent of the quota which implies the same level of final output and price. A comparison of equations (9) and (14) reveals that this condition is met when $\tau = (P_k/P_x)((\beta-\alpha\theta)/\theta\beta)$. In this case, even though the output price is the same under the two regimes, the quota regime alone creates idle capacity which is clearly a waste in any developing economy. A replacement of input quotas by input tariffs, however, leads to full capacity utilization in equilibrium.

In summary, we can say that capacity underutilization is unique to the input quota case. As expected, the output price is the lowest (and correspondingly, level of output is the highest), under a free trade regime.

2. <u>The basic model with secondary markets for input quotas</u> 2/

We show in this sub-section that even if input quotas are binding, firms in some industries may utilize their installed capacity fully in equilibrium when secondary markets for input quotas exist.

Let $P_x^s = P_x^f + R_x$, where P_x^s is the price of input x in the secondary market, P_x^f is the free trade price of input x, and R_x is the premium paid on input x. We will assume that for the economy as a whole (as opposed to a particular industry), the input quota binds. That is $R_x > 0$.

Define $x = x^f + x^s$, where x is the quantity of the intermediate input used in production, x^f is quantity purchased at the free trade price, P_x^f. By definition, then, $x^f \leq \theta k$. Finally, x^s is that part of x which is traded in the secondary market for quotas. It follows from our definitions, then, that if $x^s > 0$, firms buy the input in the secondary market and if $x^s < 0$, firms sell this input.

Also, define $k = k^U + k^I$, where k is the capital installed by the firm, k^U is capital utilized in production, and k^I is idle capacity. The representative firm now faces the following maximization problem:

1/ K* and K*(Q) are defined as aggregate levels of capital installed in the industry in the free trade and input quota cases, respectively.
2/ The author is grateful to Elhanan Helpman for suggesting the idea of introducing secondary markets in the input quota regime.

$$\max_{y,x^f,x^s,k} \pi = Py - P_x^f x^f - P_x^s x^s - P_k k \tag{16}$$

subject to the following constraints: 1/

$$x^f = \theta k, \tag{16a}$$

$$k = k^U + k^I, \tag{16b}$$

$$x^s = x - x^f, \tag{16c}$$

$$P_x^s = P_x^f + R_x, \tag{16d}$$

Given our production constraint, we also know that for any arbitrary level of y,

$$x = y/\alpha, \tag{16e}$$

and $k^U = y/\beta,$ (16f)

since x and k^U are defined as the levels of intermediate input and capital utilized in production, respectively.

Substituting (16a) through (16f) in equation (16) and setting up our maximization problem with Kuhn-Tucker conditions, we get

$$\max_{y,\ k^I} \pi = Py - P_x^s\ y/\alpha - P_k\ y/\beta + R_x\theta\ y/\beta + R_x\theta k^I - P_k\ k^I$$

subject to $y \geq 0$ and $k^I \geq 0$.

1/ Equation (16a) will always hold with strict equality as long as $R_x > 0$. This occurs because even when the quotas do not bind, reselling of inputs in excess of production needs would always increase profits.

There are four solutions to this problem, of which we ignore the trivial one where $y = 0$ and $k^I = 0$. The others are:

<u>Solution 1</u>: $y > 0$ and $k^I = 0$. In this case we get

$$P = P_X^s/\alpha + (P_k - \theta R_X)/\beta , \tag{17}$$

and

$$\theta R_X \leq P_k.$$

The economic interpretation of equation (17) is that the two terms on the right-hand side of the equation reflect the shadow prices of the intermediate input and capital, respectively.

Using the relationship that $P_X^s = P_X^f + R_X$, equation (17) may be rearranged to yield,

$$P = P_x^f/\alpha + P_k/\beta + \frac{R_x(\beta-\alpha\theta)}{\alpha\beta} . \tag{17'}$$

If quotas bind then we know that $\beta > \alpha\theta$ (from equation (12)). Firms buy the input quotas in the secondary market in addition to those available at the free trade price to meet their production needs. Moreover, a comparison of equation (6) and (17') reveals that, as expected, the output price is higher under the quota case than under the free trade case. On the other hand, if $\beta < \alpha\theta$ and the quotas do not bind, firms would still buy inputs at the free trade price to the maximum limit imposed by the allocation rule, that is $x^f = \theta k$, and resell those quantities not used in production. Also, as is evident from equation (17'), the equilibrium price of the final output is lower than the price under free trade (equation (6)). The reason for this surprising result is that by earning rents on the non-binding quotas in the secondary markets, the firms in this particular industry are able to reduce their effective cost of capital.

<u>Solution 2</u>: $y > 0$ and $k^I > 0$. Now,

$$P = P_X^s/\alpha + (P_k-\theta R_X)/\beta , \tag{18}$$

and

$$\theta R_X = P_k .$$

Equation (18) may be rewritten as,

$$P = P_x^s/\alpha \tag{18'}$$

since we know that $\theta R_x = P_k$.

Equation (18') may be rewritten by adding and subtracting P_k/β to yield

$$P = P_x^f/\alpha + P_k/\beta + (R_x/\alpha - P_k/\beta) \ . \tag{18"}$$

Comparing equation (6) and (18"), we can say that the price under the quota regime will be higher (or lower) than the free trade price, depending on whether $(R_x/\alpha - P_k/\beta)$ is positive or negative. Using the relationship that $\theta R_x = P_k$, we can once again see that when the quota binds (i.e., $\beta > \alpha\theta$), the free trade price of the output is higher than the price of the output under the quota regime. Similarly, if the quota does not bind (i.e., $\beta < \alpha\theta$), the reverse is true.

<u>Solution 3</u>: $y = 0$ and $k^I > 0$. In this case,

$$P \leq P_x^s/\alpha + (P_k - \theta R_x)/\beta, \tag{19}$$

and

$$\theta R_x = P_k.$$

This is the interesting case that is often cited in developing countries, where the firms simply install capacity without producing any final output. Their motivation is to get the input quotas based on installed capacity, so that they can resell in the secondary market at a premium.

We can clearly see that in each of the possible solutions, the profits made from selling input quotas in the secondary market can never exceed the cost of installing capital, that is, $\theta R_x \leq P_k$. This condition basically rules out the possibility of firms having infinite excess capacity in equilibrium. In addition, it is also evident that if the θ's varied across all industries and if the input quotas were binding in each industry, the premium, R_x, on the input quotas would be determined by the industry with the highest θ. Since $\theta R_x \leq P_k$ for all industries, and since all industries face the same price for capital and the same premium on input x, it must be the case that θR_x will equal P_k for the industry with the highest θ. That is, in the economy,

$$R_x = \theta_j^{-1} P_k \quad \text{where } \theta_j = \max_g (\theta_g)$$

$$g = 1, \ldots, G.$$

For all other industries we would find

$$R_x < \theta_i^{-1} P_k \text{ where } \theta_i = \theta_1, \ldots, \theta_{j-1}, \theta_{j+1}, \ldots, \theta_G.$$

The solution that will actually prevail in a particular economy with many industries will depend on the specific case in hand. For example, when θ's bind and vary across all industries, the jth industry (the industry with the highest θ) will not only determine R_x, but will be the only industry with excess capacity in equilibrium (Solution 2 or Solution 3). Also, it will be the sole supplier of input x in the secondary market. The economic intuition for the jth industry to be the sole supplier is, of course, that firms in this industry have the lowest effective cost of installing capital. 1/ All other industries will satisfy their demand for additional units of x by buying in the secondary market instead of installing excess capacity since it is cheaper to do so (Solution 1). 2/

On the other hand, if θ's vary across industries and are not binding for some, then the sellers in the secondary market are those with non-binding quotas and the rest are buyers. Capacity in all industries may be fully utilized in this situation (Solution 1 for all industries).

In the situation where the θ's are the same across all industries and the input quotas are binding in each industry then, in equilibrium,

$$R_x = \theta_i^{-1} P_k \quad \forall\ i = 1, 2, \ldots, G.$$

In this case, firms in all industries are indifferent between having excess capacity and buying inputs in the secondary market. In equilibrium, then, some will be suppliers while others buyers of input x in the secondary market (all solutions discussed above are now possible in the economy). On the other hand if quotas did not bind for firms in some industries but they did for others, then full utilization of capacity is

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1/ Recall from the economic interpretation of equation (17) that the shadow price of capital is $(P_k - \theta R_x)$.

2/ We also have the possibility that some industries (excluding the jth industry) may not find it profitable to produce any output and to hold excess capacity. That is, $y = 0$, $k^I = 0$ for firms in this industry.

a possibility in all industries. 1/ And finally, if quotas did not bind in each industry then all industries utilize their capacity fully. In fact, this case (Solution 1, equation (17′), with $R_x = 0$.) is the same as the free trade case (equation (6)).

In this section we have shown that the existence of secondary markets for input quotas would create incentives for, at least, some industries to utilize their capacity fully. Consequently, we would observe an increase in the capacity utilization rate for the economy as a whole.

IV. A Strategic Framework for Analyzing Input Quotas 2/

So far we have dealt only with the perfectly competitive case. It would obviously be interesting and relevant to determine if the results of the perfectly competitive case would carry over to the imperfectly competitive case. 3/ This section shows that under similar conditions, capacity utilization under input quotas is higher in oligopolistic industries when compared to perfectly competitive ones.

All assumptions made in the first section are retained. In addition, we specify that the total amount of the input quota available for the industry is fixed at a predetermined level, $\bar{X}$. (This may occur when, for example, foreign exchange shortages in the economy set the limits on the intermediate imports of each industry).

1. The basic model

Once again we examine three trade regimes under oligopoly. The three regimes are free trade, a tariff on the intermediate input, and a quota on the same input.

The production function is now defined as:

$$y_i = \min\ [\alpha x_i,\ \beta k_i] \qquad\qquad i = 1, 2, \ldots\ldots\ n.$$

where the subscript i now stands for the ith firm in a particular industry, y_i is output of the ith firm, x_i is its intermediate input, and k_i, the capital stock.

1/ If θ's are the same across industries, the reason why quotas bind for some but not others is because the production technological coefficients (α's and β's) are different across industries.

2/ This section arose in part from Sahay (1989).

3/ The imperfectly competitive case, as noted in the introductory section, is probably the more realistic one to consider.

The total output in the industry concerned is denoted by:

$Y = \sum_j^n y_j \qquad\qquad j = 1, 2, \ldots i, \ldots n.$

where the subscript j also stands for a firm and the summation is over all firms including the ith firm. 1/

In the case where an input quota is imposed, the quota allocation rule is

$x_i \leq \theta k_i$ for each firm i,

where $\theta = \bar{X}/K$,

$K = \sum_j^n k_j \qquad\qquad j = 1, 2, \ldots, n.$

and $\sum x_i \leq \bar{X}$.

We assume that there are n firms in a typical industry which play a Cournot game, i.e., each firm conjectures that when it changes its output the other firms will hold their output fixed.

(a) Free trade case

This is the benchmark case with no tariff or quota on the imported input, x.

$$\max_{y_i, x_i, k_i} \pi_i = Py_i - P_x x_i - P_k k_i$$

Since cost minimization implies $x_i = y_i/\alpha$ and $k_i = y_i/\beta$, we get

1/ The need for this distinction will be obvious when we discuss the input quota case below.

$$\max_{y_i} \pi_i = Py_i - P_x y_i/\alpha - P_k y_i/\beta.$$

In equilibrium,

$$P + y^* D'(Y^*) - P_x/\alpha - P_k/\beta = 0,$$

or,

$$D(Y^*) = P_x/\alpha + P_k/\beta - y^* D'(Y^*) \tag{20}$$

where Y^* and y^* are the equilibrium output levels in the industry and firm, respectively.

Comparing the free trade price under the perfectly competitive case and the oligopoly case, we note, as expected, that price is higher and output lower under oligopoly.

(b) Tariff on imported intermediate input case

A tariff, τ, is imposed on input x. Then,

$\rho_x = (1+\tau)P_x$.

The firms solve the following problem:

$$\max_{y_i} \pi_i = Py_i - \rho_x y_i/\alpha - P_k y_i/\beta.$$

In equilibrium,

$$D(Y_{(T)}^*) = (1+\tau)P_x/\alpha + P_k/\beta - y^* D'(Y_{(T)}^*). \tag{21}$$

The net effect on the output price under oligopoly is similar to that under perfect competition. That is, the output price under tariff is just a 'mark-up' over the free trade price by the extent of the tariff. As will be apparent soon, unlike the input quota case, a tariff on input x, does not give a comparative advantage to oligopolistic firms as opposed to perfectly competitive firms.

(c) Quotas on imported intermediate input case

In this case firms realize they have a strategic advantage vis-a-vis the quota allocation rule. Since θ depends on $\overline{X}$ and K, and $K = \sum_j^n k_j$, each firm is able to affect θ, as each is large enough to affect K.

The firms solve the following maximization problem:

$$\max_{y_i, x_i, k_i} \pi_i = Py_i - P_x x_i - P_k k_i.$$

Again we analyze only the interesting case when the input quota binds. Expressing x_i and y_i in terms of k_i, we know

$$x_i = \theta k_i$$

and,

$$y_i = \alpha x_i = \alpha\theta k_i.$$

So the optimization problem now is

$$\max_{k_i} \pi_i = D(\Sigma\alpha\theta k_j)\alpha\theta k_i - P_x\theta k_i - P_k k_i.$$

Since the firms know that $\theta = \overline{X}/\Sigma k_j$, the problem can be expressed as

$$\max_{k_i} \pi_i = D(\Sigma\alpha(\overline{X}/\Sigma k_j)k_j)\alpha(\overline{X}/\Sigma k_j)k_i - P_x(\overline{X}/\Sigma k_j)k_i.$$

The first order condition is:

$$D(..)\alpha\bar{X}[\Sigma k_j - k_i]/(\Sigma k_j)^2 + \alpha(\bar{X}/\Sigma k_j)k_i D'(..)[\alpha\bar{X}(\Sigma k_j - k_i - \Sigma_{j\neq i}k_j)/(\Sigma k_j)^2]$$
$$- P_x\bar{X}(\Sigma k_j - k_i)/(\Sigma k_j)^2 - P_k = 0. \qquad (22a)$$

Letting k* be the optimal level of capital for a representative firm, and knowing that $k^* = K/n = \bar{X}/\theta n$ in equilibrium when the quota binds, with some rearrangement equation (22a) may be simplified to

$$D(Y_{(Q)}^*) = P_x/\alpha + (P_k/\alpha\theta)(n/n-1). \qquad (22b)$$

Solving for θ,

$$\theta = (n/n-1)P_k/(\alpha P - P_x) = (n/n-1)P_k/[\alpha D(\alpha\bar{X}) - P_x]. \qquad (23)$$

Moreover, as installed capacity $= y^*/\alpha\theta$ and used capacity $= y^*/\beta$, we have capacity utilization $= \alpha\theta/\beta$.

We can now also compare the value of the quota allocation rule, θ, under the two market structures. In the perfectly competitive case, each firm is too small to affect the value of θ, even though $\theta = \Sigma k_j$. Hence, for our analytical purposes here, θ is fixed.

We know from equation (14) that in the perfectly competitive case,

$$D(Y_{(Q)}^*) = P_x/\alpha + P_k/\alpha\theta, \qquad (14')$$

where $D(Y_{(Q)}^*)$ is the price of the output under the quota regime.

Moreover since, $Y_{(Q)}^* = \sum y_{(Q)j}^* = \Sigma\alpha x_{(Q)j}^* = \alpha\bar{X}$, or,

$$D(\alpha\bar{X}) = P_x/\alpha + P_k/\alpha\theta. \qquad (24)$$

Solving for θ from equation (24),

$$\theta = P_k/[\alpha D(\alpha\bar{X}) - P_x], \qquad (25)$$

Hence,

$$\theta_{\text{perfect competition}} = P_k/[\alpha D(\alpha\overline{X}) - P_x]$$

$$\theta_{\text{oligopoly}} = (n/n\text{-}1)P_k/[\alpha D(\alpha\overline{X}) - P_x]$$

or,

$$\theta_o/\theta_{pc} = n/n\text{-}1. \tag{26}$$

We know that as n becomes very large, oligopoly outcomes should tend to perfectly competitive outcomes. We thus verify,

$$\lim_{n \to \infty} (\theta_o/\theta_{pc}) = 1.$$

Given θ, the capacity utilization under both market structures is the same. That is,

Capacity utilization $= \alpha\theta/\beta$.

Since equation (26) implies $\theta_o > \theta_{pc}$, we conclude the following:

> Given a finite n, and given that an input quota is binding under a quota regime, capacity utilization is higher under oligopoly than under perfect competition.

This is a classic application of the theory of the second-best. In the presence of input quotas (a policy-induced distortion), the presence of oligopolistic markets (a market distortion) is a preferred alternative to perfectly competitive markets.

When the input quota binds, or when $x = \theta k$, any firm can get more x when either θ or k increases. In the oligopoly case, since firms know that the quota allocation rule, θ, depends on the aggregate amount of capital, K, in the industry, and since each firm can affect K, these firms are able to increase θ by reducing k (as $\theta = \overline{X}/K$). This is the indirect effect of k on x. On the other hand an increase in k leads directly to greater allocations of x. Hence, the equilibrium k in oligopolistic industries, is the solution of these two opposing forces. Under perfect competition even though the firms know that the quota allocation rule, θ, depends on K, they are too small to affect K and are, therefore, unable to influence θ. Hence, in order to get more x, the only option they have is to increase k. This is the intuition behind the result that there is more excess capacity in perfectly competitive industries.

V. Conclusions

In a trade model the introduction of quotas on imported inputs clearly illustrates new distortions that are created under certain quota allocation rules. Capacity underutilization becomes the natural outcome in equilibrium when quotas are based on installed capacity. In addition to generating excess capacity, we have shown that a quota allocation rule based on installed capacity allows for strategic advantages to firms in oligopolistic competition as compared to those under perfect competition. The result is less excess capacity in equilibrium for firms under oligopoly.

This paper also throws some light on a possible sequencing of trade reforms in developing countries. It is often argued that a developing country embarking on a trade liberalization process should, at the first stage, replace import quotas by tariffs. Our analysis indicates that such a policy directed at imported inputs will have the added benefit of eliminating excess capacity in the manufacturing sector. This may be accomplished even without changing the degree of restrictions on the imported intermediate input. Furthermore, a tariff in imperfectly competitive markets eliminates strategic advantages to oligopolistic firms in input quota regimes. If the purpose of quota allocation rules based on installed capacity is to incorporate some notion of "fairness" then it is evident that governments are inadvertently favoring industries which are more oligopolistic in nature. A replacement of input quotas by input tariffs would then ensure impartiality in the trade regime.

In conclusion, we can consider some possible extensions of our modeling framework and the consequences of altering some of its basic assumptions. The assumption of fixed technological coefficients is the most noteworthy. One way of generating excess capacity within the framework of some degree of substitutability between factors of production could be to assume "lumpiness" in installing capital. 1/ Secondly, we could change the quota allocation rule by making input quotas a function of past production instead of installed capacity. Our intuition is that by introducing these dynamics we would be able to show industrial concentration over time, since the incumbents would then receive a larger share of input quotas. And finally, we could generalize the models presented so far by introducing quotas on many intermediate inputs. This would enrich the analysis by isolating those inputs which impose the greatest restriction on capacity utilization. Such extensions, while generalizing our results, would not necessarily alter the qualitative nature of the conclusions of this paper.

1/ That is, to drop the conventional assumption of perfect divisibility of capital.

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