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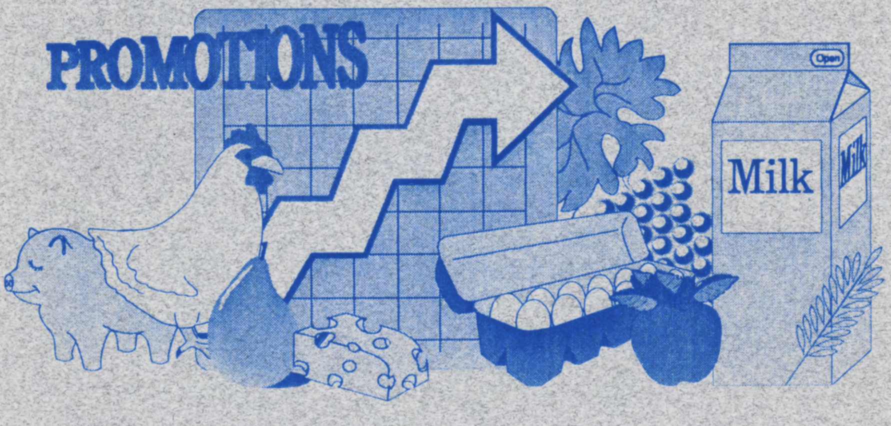

Strategic Export Promotion: An Introduction

Donald J. Liu

What does it mean when Massachusetts governor, William Weld, described Pete Wilson's decision to not take part in Iowa caucuses as a *"strategic"* political decision? What does the word "strategic" mean? The S-word has been uttered so many times that every kid (new and old) on the block knows about it, and it wouldn't have been at all shocking had Mike Tyson announced (after wining his $20 millions in 40 seconds) that when he was pumping iron in the big house, it was actually a strategic move. If we take the view of Friedman (p. 211), the strategy of a player is his total battle plan for the whole game. Thus, Pete Wilson's decision may be considered strategic if his intention was to conserve energy and increase his chances of capturing California further along the campaign trail. Following the same logic, in an attempt to better position itself in a diverse market environment, the recent break up of AT&T into three smaller units can be viewed as a strategic decision of the firm.

In addition to private agents and firms, governments and industrial organizations say the S-word as well. In this context, a strategic policy arises from the assumption that a government or industrial organization can credibly put itself in a position to be the first player in a multi-stage game and can, therefore, influence the equilibrium outcome of the subsequent game by altering the set of actions open to them (Spencer and Brander). Thus, the loan subsidy to Airbus (a four-nation consortium) provided by France, Germany, the U.K., and Spain can be regarded as a strategic policy because, as claimed by Boeing and others, Airbus probably would not have succeeded as a private project otherwise (Baldwin and Krugman).

One more example should be sufficient to make the point. While Beijing's decision on continuing its nuclear testing program regardless of complaints from its neighbors and the West may be considered strategic, its harassment and bullying of participants at the Fourth World Conference of Women can be described, at best, as sheer stupidity.

Our topic is about the strategic use of export promotion by commodity organizations. How should we proceed with the discussion? One might suggest we look at a couple of empirical studies involving strategic export promotion. Being a novice in this area, however, I know of few such studies that exist. Alternatively, we can sweat, get our good shirts wet, and get to the bare bones of strategic game playing by looking at a couple of theoretical pieces. This won't work either, given the diverse background of the conferees (besides, I don't have a good shirt). Rather, the approach we will be taking is to look at the basics, learn from simple examples, and focus on motivations and intuitions. We first introduce the seminal piece of Dorfman and Steiner. We argue that their monopolistic approach to advertising is not suitable for export promotion analyses, and then provide a motivation for why an oligopolistic type model accounting for strategic interaction among firms is more appropriate. We then discuss the essence of oligopolistic games, especially within the framework of two-stage games. The two-stage game procedure is then summarized through a presentation of a simple strategic export promotion model. Much of the discussion in this paper relies on materials in Tirole.

The Dorfman-Steiner Model

Dorfman and Steiner considered the problem of optimal advertising for a monopoly. Denoting the demand at price p and advertising level s by q = D(p,s) and production cost by C(q), the profit function were written as $\Pi^m(p,s) = p\,D(p,s) - C(D(p,s)) - s$. The first-order conditions with respect to p and s were:

$$(1) \quad D(p,s) - C'(q)D_p(p,s) = -pD_p(p,s)$$

$$(2) \quad pD_s(p,s) - C'(q)D_s(p,s) = 1$$

where $C' \equiv \dfrac{dC}{dq}$, $D_p \equiv \dfrac{\partial D}{\partial p}$, and $D_s \equiv \dfrac{\partial D}{\partial s}$. The first two terms in (1) gave the profitability of an extra unit of output, while the third term reflected the effect of this extra unit on the profitability of inframarginal units. Likewise, the first two terms in (2) yielded the benefits of an additional unit of advertising, while the last term the cost of that unit of advertising (which was one dollar).

Dorfman and Steiner manipulated the above two first-order conditions to yield

$$(3) \quad \frac{s}{pq} = \frac{\epsilon_s}{\epsilon_p}$$

where $\epsilon_p \equiv -\frac{\partial D}{\partial p}\frac{p}{q}$ and $\epsilon_s \equiv \frac{\partial D}{\partial s}\frac{s}{q}$, denoting the elasticities of demand with respect to price and advertising, respectively. Equation (3) dictated that the monopolist's optimal advertising/sales ratio was equal to the ratio of the elasticities of demand with respect to advertising and price. In particular, if the two demand elasticities were approximately constant, then the advertising/sales ratio was also a constant and was independent of the cost structure. The result was interesting because there was some empirical evidence supporting the constancy of advertising as a fraction of sales (Schmalensee).

The Dorfman and Steiner approach suffers at least two drawbacks. First, the model is static and, hence, is not capable of capturing such dynamic issues as the delay response and carry-over effect of advertising (Kinnucan). A dynamic version of Dorfman and Steiner has been developed by Nerlove and Arrow, in which a firm's advertising expenditures contribute to a capital like goodwill which, in turn, affects demand. A second drawback of the Dorfman and Steiner model is its monopolistic treatment of the underlying market structure within which the firm operates.[1] As far as our export promotion topic is concerned, the second drawback is serious because, rather than being a single seller, an exporting firm typically faces several major competitors coming from various exporting countries. Accordingly, an oligopolistic framework accounting for strategic interaction among major players in the field is more appropriate for export promotion analyses.

Prisoner's Dilemma

The importance of allowing for strategic interaction in a model when there are few players is well understood in literature and can be sufficiently illustrated by the famous game of prisoner's dilemma. The story behind this game is that two prisoners are suspected of having carried out a double murder and are placed in separate cells (perhaps, to keep the more economically disadvantaged one from finding out that his[2] wealthier partner has a home theater installed in the cell and has been consuming brandy of an XO caliber). Knowing that the DNA evidence is, at best, circumstantial, the prosecutors offer each of the two prisoners the following deal. If the prisoner and his accomplice both confess to the crime, each will receive a sentence of three years; but if one prisoner alone confesses and his accomplice does not, he will receive an even shorter sentence of one year and his accomplice will receive a ten-year sentence.

If the two prisoners are able to collude, it is clear that the best strategy for them is to deny the charge because they will both go free if neither of them confesses. However, neither prisoner has any way of knowing that his accomplice will remain silent (as they are kept in different cells). Thus, what preoccupies each prisoner is the chilly notion that he would be in bad shape if he denies the charge and his partner confesses. The prisoner would be "done in" under this situation because he would receive the more severe punishment of ten years (and his partner would receive only one year). The payoff of this game is such that the dominant strategy for each player is to confess! That is, each prisoner decides to confess in the hope of getting just one year (provided that his partner does not confess) but knowing that he will get three years if his accomplice also confesses.

The outcome of the game is unfortunate for both parties; by not confessing, each would be able to go free instead of getting three years. Obviously, the outcome depends crucially on the assumption of the game. In particular, it would have been a completely different story if the defense had the benefit of competent legal counseling, such as the guidance provided to Orenthal James Simpson by his dream team. However, the moral of the story is clear. In the Simpson case, the best strategy for the defendant was to deny the charge and blame it on Rio (or more precisely, on Detective Fuhrman), as there existed no co-defendant that could possibly "do him in."[3] In our prisoner's dilemma case, on the other hand, it is not possible for each defendant to act unilaterally without worrying about the ramification of his co-defendant's potential uncollegial behavior. Figuring into the calculation (of the decision-making process) the effect of another player's actions on one's payoff is the essence of strategic interaction.

The Bertrand Paradox

Consider the case of a one-shot duopoly game in which a homogenous product is produced by two firms using a constant return to scale technology. The key assumptions of the model are underlined. The profit of firm i (i = 1,2) is:

(4) $\Pi^i(p_i,p_j) = (p_i - c)\, D_i(p_i,p_j)$

where c is the unit cost of production, p_i is the price charged by firm i, and D_i is the demand for its output and is given by:

$$(5)\quad D_i(p_i,p_j) = \begin{cases} D(p_i) & \text{if } p_i < p_j \\ \tfrac{1}{2} D(p_i) & \text{if } p_i = p_j \\ 0 & \text{if } p_i > p_j \end{cases}$$

The demand function in (5) says that consumers buy from the firm with the lower price and if the firms charge the same price, they split the market. In maximizing (4), the firms choose their prices simultaneously and noncooperatively. A Nash equilibrium in prices--a Bertrand equilibrium--can be formally stated as: $\Pi^i(p_i^*,p_j^*) \geq \Pi^i(p_i,p_j^*)$, for all i = 1,2, and for all $p_i \in R_+$. One can think of the equilibrium as being characterized by a pair of prices (p_1^*,p_2^*) such that each firm's price maximizes its own profit, given the firm's correct anticipation of the other firm's price at equilibrium.

The Bertrand equilibrium for the above problem is to have the two firms charge the competitive equilibrium price: $p_1^* = p_2^* = c$. The intuition behind this result is that, for any other price p greater than c, a firm is always willing to undercut the price slightly (say, $p - \epsilon$) so that the firm can take over the entire market demand at that price, $D(p-\epsilon)$. Therefore, firms price at marginal cost and do not make profits. This conclusion is extremely odd, and is referred to as the Bertrand paradox, because it suggests that the well-known price distortion associated with monopoly is only a special case as even a duopoly would suffice to restore competition and set the price right (Tirole, p. 210).

The Bertrand paradox can be resolved by relaxing any of the key assumptions of the model. For example, relaxing the static game assumption suffices. In the one-shot game, firms simultaneously quoted their prices and then "disappeared." Hence, the best strategy for the firm would be to grab as large a portion of the market as possible immediately by charging the lowest possible price (i.e., $p = c$). However, the reality is that firms interact repeatedly and therefore have to be concerned about the subsequent reprisal of other firms when engaging in predatory pricing behavior. That is, oligopolistic firms should recognize their interdependence in a dynamic world and should be able to sustain a price higher than marginal cost. This is exactly the tacit collusion of oligopolists that Chamberlin was concerned about. Any firm contemplating undercutting the colluded price ($p > c$) would have to compare the short-run gain (arising from the increase in its market share) to the longer-run loss (due to the subsequent price war in which all firms revert to competitive pricing).

The above trade-off problem facing oligopolistic firms interacting in a setting of perpetual time has been rigorously studied by supergame theorists (e.g., Green and Porter, and Rotemberg and Saloner). This literature is complex due to the fact that the dynamics of price behavior are hard to analyze. Instead of muddling into this uncharted territory, we will resort to the more pragmatic framework of two-stage games.

Two-Stage Games

The second crucial assumption behind the Bertrand Paradox is the consistent return to scale of technology. The paradox can be resolved by the introduction of capacity constraints (or more generally, a decreasing return to scale technology). The intuition is that when firms cannot sell more than what is dictated by their capacities, there is no point for them to engage in cutthroat price competition, as an undercutting firm would only find itself facing the entire market demand which its capacity cannot satisfy.

In fact, since each firm wishes only to sell at its capacity (that is all it has), price competition can often be subsumed in a manner in which firms choose the price ($p > c$) that allows them to dump their capacities on the market (Tirole, pp. 215-216). This is insightful because it suggests that one should look further into an underlying two-stage game model in which firms choose capacity in the first stage and then, upon observing each other's capacity, choose prices in the second stage. Since the preceding discussion presumes a binding capacity in the second-stage price game, the solution for the first stage requires firms to accumulate low capacities (relative to the entire market size). As mentioned, the low capacity, in turn, softens price competition (i.e., $p > c$) in the second stage of the game.

Kreps and Scheinkman have shown that the outcome of the capacity-price type two-stage game is the same as that of the one-stage Cournot game. A Cournot equilibrium is such that each firm chooses its quantity given the quantity chosen by the other firm (thus, Nash in quantities). In a sense, the Cournot firms choose quantities and an auctioneer determines the market price that clears the market. This interpretation has given rise to criticism about the Cournot assumption, because it is thought that prices are ultimately chosen by firms, not by auctioneers The result of Kreps and Scheinkman suggests that it may be possible to vindicate Cournot by introducing capacity constraints and considering the Cournot profit function as a reduced form profit function in which second stage price competition has been subsumed (Tirole, p. 217). We will invoke this vindication later when presenting our export promotion model.[4]

The two-stage game approach is attractive because it formalizes the idea that investment decision is generally made before price decision.[5] Also, it has broad applications because the investment decision in the first stage doesn't need to be restricted only to capacity choices; it can be the choice of entry, location, product quality, etc. As pointed out in Tirole (pp. 216-217), these games often share a similar feature because firms try to differentiate themselves from others in order to avoid the intense Bertrand competition associated with homogeneous goods (in the same way that firms avoid accumulating "too much capacity" in order to soften price competition).

Product Differentiation

The third assumption underlying the Bertrand paradox is that firms produce a homogeneous product. Under this condition, no firm can raise its price above marginal cost without losing its entire market share. In reality, however, this is not the case as some consumers are willing to buy from the higher price firm because, for example, it might be available at a closer distance. The case of differentiated products is of interest to us because the intent of many advertising and promotion activities is to distinguish the advertised product from any competitors. We now use a differentiated product example

(Tirole, pp. 279-282) to illustrate the two-stage game approach discussed in the previous section.

Consider a "linear city" of length which lies on a line and consumers are uniformly distributed with equal density along this interval. There are two firms with the location of Firm 1 at point a ≥ 0 and Firm 2 at point 1 - b, where b ≥ 0. For clarity, assume that firm 1 is to the left of Firm 2 (i.e., 1 - b - a ≥ 0). In buying the product, consumers incur a transportation cost which is assumed to be a quadratic function of the distance traveled. For simplicity, let each consumer consume exactly one unit of the good[6] and let the unit cost of production for each firm be a constant, c.

A consumer who is indifferent between the two firms is located at point x, where x is given by equating net prices that the consumer has to pay when buying from Firm 1 and Firm 2; i.e.,

$$(6)\quad p_1 + t(x-a)^2 = p_2 + t(1-b-x)^2$$

where t is the transportation cost for one unit of distance traveled. Solving (6) one obtains the demand for Firm 1:

$$(7)\quad D_1(p_1,p_2) \equiv x = a + \frac{1-a-b}{2} + \frac{p_2 - p_1}{2t(1-a-b)}$$

Hence, the demand for Firm 2 is:

$$(8)\quad D_2(p_1,p_2) \equiv 1-x = b + \frac{1-a-b}{2} + \frac{p_1-p_2}{2t(1-a-b)}$$

The above two demand equations say that for equal prices, Firm 1 and Firm 2 control their own turfs (or back yards, if you prefer) of size a and b, respectively, and split the market area located between them (i.e., $\frac{1-b-a}{2}$). The third term of each equation captures the effect on demand of the price differential.

Each firm chooses its price so as to maximize profit, given the price charged by the other firm. The profit functions are:

$$(9)\quad \Pi^1(p_1,p_2) = (p_1-c)\left(a + \frac{1-a-b}{2} + \frac{p_2-p_1}{2t(1-a-b)}\right)$$

$$(10)\quad \Pi^2(p_1,p_2) = (p_2-c)\left(b + \frac{1-a-b}{2} + \frac{p_1-p_2}{2t(1-a-b)}\right)$$

Differentiating (9) with respect to p_1 and (10) with respect to p_2, the two firms' first-order conditions are:

$$(11)\quad a + \frac{1-a-b}{2} + \frac{p_2-p_1}{2t(1-a-b)} - \frac{p_1-c}{2t(1-a-b)} = 0$$

$$(12)\quad b + \frac{1-a-b}{2} + \frac{p_1-p_2}{2t(1-a-b)} - \frac{p_2-c}{2t(1-a-b)} = 0$$

Solving the first-order conditions in (11) and (12) as a system, one obtains the Nash equilibrium in prices:

$$(13)\ p_1^*(a,b) = c + t(1 - a - b)\left(1 + \frac{a - b}{3}\right)$$

$$(14)\ p_2^*(a,b) = c + t(1 - a - b)\left(1 + \frac{b - a}{3}\right)$$

Notice that consumers differentiate the two products based on transportation costs. Thus, the higher the transportation costs, the greater the product differentiation. The equilibrium solutions in (13) and (14) indicate that the Bertrand result of marginal cost pricing is once again obtained if there are no transportation costs (i.e., t = 0). The solution also indicates that, when t increases, both firms compete less strenuously for the same consumers and, thus, charge higher prices.

The above price game on differentiated products represents the second stage of the two-stage game. The two-stage game is the following: Firms choose their locations in the first stage, then, given the locations, they choose price in the second stage. For any given pair of locations, the price rules are in (13) and (14). We now "fold back the game" to the first stage by substituting the second stage price rules into the profit functions in (9) and (10) to obtain the associated reduced form profit functions:

$$(15)\quad \Pi^i(a,b) = \left\{p_i^*(a,b) - c\right\} D_i\left[a,b,p_1^*(a,b),p_2^*(a,b)\right]$$

where D_i are in (7) and (8) and p_i^* in (13) and (14). A Nash equilibrium in locations is such that each firm maximizes its $\Pi^i(a,b)$ with respect to its location choice variable (*a* or *b*), given the other firm's location. The solution can be found by deriving the first-order condition for each firm from the reduced form profit function in (15) and then solving the first-order conditions as a system to obtain the equilibrium a^* and b^*. The location policy obtained is said to be *credible* because it takes into account the effect on second stage optimization, and the associated equilibrium is said to be *subgame perfect*.[7]

The location problem has been solved by d'Aspremont et al., showing that equilibrium requires the two firms to locate themselves at the two extreme ends of the city to maximize the extent of product differentiation and, hence, minimize price competition. The maximum differentiation result of d'Aspremont et al. is reproduced by Tirole using a simpler, yet insightful, approach. Let's focus on the first firm and differentiate its reduced form profit function in (15) with respect to *a*:

$$(16)\quad \frac{d\Pi^1}{da} = \frac{\partial\Pi^1}{\partial p_1}\frac{\partial p_1^*}{\partial a} + (p_1^* - c)\left(\frac{\partial D_1}{\partial a} + \frac{\partial D_1}{\partial p_2}\frac{\partial p_2^*}{\partial a}\right)$$

The first term on the right-hand side of (16) measures the indirect effect of *a* on Π^1 through the change in own price. The second term on the right-hand side of (16) is the *market-share effect* capturing the direct impact of a on Π^1, while the third term the *strategic effect* accounting for the indirect effect of a on Π^1 through the change in the rival's price. Due to the envelope theorem, the first term on the right-hand side of (16) is zero because Firm 1 maximizes Π^1 with respect to p_1 in the second stage (i.e., $\frac{\partial \Pi^1}{\partial p_1} = 0$). Using (7), (13), and (14), one obtains

$$(17) \quad \frac{\partial D_1}{\partial a} = \frac{3 - 5a - b}{6(1 - a - b)} > 0 \quad \textit{if } a < \tfrac{1}{2} \ (\textit{hence } b < \tfrac{1}{2} \textit{ as well})$$

$$(18) \quad \frac{\partial D_1}{\partial p_2} \frac{\partial p_2^*}{\partial a} = \frac{a - 2}{3(1 - a - b)} < 0 \quad \textit{if } a < \tfrac{1}{2}$$

Substituting (17), (18), and $\frac{\partial \Pi^1}{\partial p_1} = 0$ into (16) one verifies that $\frac{d\Pi^1}{da} < 0$. Therefore, Firm 1 always wants to move to the left, consistent with the maximum differentiation principle obtained by d'Aspremont et al. Notice that equations (17) and (18) exhibit an interesting conflict between the market-share effect and the strategic effect of the location choice. On the one hand, (17) indicates the desire of the firm to move toward the center of the linear city so as to increase its market share given the prices. On the other hand, (18) acknowledges the firm's wish to move away from its rival to increase product differentiation and, hence, raise the price. The net result shows that the strategic effect dominates the market-share effect.

Strategic Export Promotion

In the previous example of two-stage games, firms compete in both stages. In literature on the strategic use of trade and industrial policies, however, the setting is slightly different. Typically, one has a situation in which firms from different countries play a Nash type game (e.g., Nash in quantities or Nash in prices) in the second stage, given government policies. To give its firms a strategic advantage in marketing their products, each government precommits to its policy by playing the game against other governments in the first stage (i.e., Nash in policies). In other words, firms play Nash against other firms, and governments play Stackelberg against firms and Nash against other governments. For example, in a model in which one home firm and one foreign firm (both Cournot firms) produce a homogeneous product and compete in a third-country market, Brander and Spencer find that if the home country's government can credibly precommit itself to pursue a particular trade policy before firms make production decisions, then an export subsidy is optimal. Extensions of Brander and Spencer's model are abundant (e.g., see Eaton and Grossman, and Cheng, and the citations therein).

The success story of applying the two-stage game framework to identify optimal trade and industrial policies is encouraging, because it points to a new direction for future export promotion research. The traditional approach for export promotion study is to focus exclusively on the effect of promotion activity on the foreign demand in question. This approach ignores the basic reality that there are also other exporting countries competing directly with the country sponsoring the promotion. For example, the U.S. and Australia have been competing directly in the Japanese beef market, and the U.S. and Canada (among others) in the Japanese pork market. It is naive to ignore the action of one's arch rival when devising an export promotion policy.

As a way of summarizing the procedure, consider the following two-stage game in which the U.S. and Australia are competing in the Japanese beef market. For simplicity, assume there is only one exporting firm in each exporting country.[8] In the second stage of the game, the exporting firm from each country chooses its export volume, given the demand condition for its product in Japan. In the first stage of the game, the commodity organization in each exporting country chooses its promotion activity mix and level, attempting to shift the Japanese beef demand to its constituent firm's favor.[9] In other words, the commodity unit chooses its export promotion policy strategically so that the activity of its constituent exporting firm at a later time is facilitated.

Conditional on the promotion level conducted in the first stage, the Japanese inverse demand equation for Firm I's beef (I = u and a) can be specified as $p_i = p_i(q_u, q_a \mid s_u, s_a)$, where subscripts u and a denote the U.S. and Australia, respectively. Thus, the firm's profit function in the second-stage quantity game can be written as:

$\Pi^i = \Pi^i(q_u, q_a \mid s_u, s_a)$. The associated first-order condition can be written as $\Phi^i(q_u, q_a \mid s_u, s_a) = 0$, where Φ^i denotes $\frac{\partial \Pi^i}{\partial q_i}$. The effect of s_i on the equilibrium export volume can be assessed by totally differentiating $\Phi^u = 0$ and $\Phi^a = 0$ with respect to q_u, q_a, and s_i, and then solving the resulting system for $\frac{\partial q_k}{\partial s_i}$ (K = u and a). Alternatively, through solving the firms' first-order conditions as a system, one obtains the equilibrium export volume as a function of the promotion levels: $q_i^* = q_i(s_u, s_a)$, $i = u, a$.

Having obtained the quantity rule for the second stage of the game, one proceeds to the first stage. It is assumed that the objective of the commodity unit is to maximize industry profit. Then, the reduced form objective function of the ith commodity unit can be written as $V^i = V^i(q_u^*, q_a^*, s_u, s_a \mid \zeta_i)$, where ζ_i represents exogenous parameters facing unit i. The associated first-order condition can be written as $\Psi^i(q_u^*, q_a^*, s_u, s_a \mid \zeta_i) = 0$, where Ψ^i denotes $\frac{\partial V^i}{\partial s_i}$. The effect of ζ_i on the equilibrium promotion level can be assessed by totally differentiating $\Psi^u = 0$ and $\Psi^a = 0$ with respect to s_u, s_a, and ζ_i, and then solving the resulting system for $\frac{\partial s_k}{\partial \zeta_i}$ (K = u and a). Alternatively, through solving the commodity units' first-order conditions as a system, one obtains the equilibrium promotion level as a function of the exogenous parameters facing the units: $s_i^* = s_i(\zeta_u, \zeta_a)$, $i = u, a$. Now, let's go to the end game.

Summary

It is the strategic policy of a firm when the firm bases its location choice not just on where the demand is, but also on how the choice will affect the extent of price competition among rivals. It is the strategic policy of a government when the government credibly precommits itself to a level of export subsidy before firms make production decisions. The analysis of strategic policy can be conveniently conducted within a multi-stage game framework, in which emphasis is on the role of firm or government's irreversible investments in establishing market power for private agents by enlarging the opportunity set that the agents will face. The multi-stage game approach is attractive not only because it formalizes the idea that investment decision is generally made before price or quantity decision, but also because it has broad applications attested to by the trade and I.O. literature. The success story of the multi-stage game approach points to a new direction for future export promotion research. In particular, one can think of a framework showing how a commodity organization precommits to its export promotion policy strategically so as to facilitate the export activity of its constituent firms at a latter stage. Having introduced this game-theoretical approach to export promotion, it is now up to you to sweat, get your good shirts wet, and get to the bare bones of it. You do have a good shirt, don't you?

Endnotes

1. This is also a drawback of Nerlove and Arrow.

2. The usage of pronoun "his" is not meant to imply that men are more violent than women, though empirical evidence tends to support this stereotype.

3. The use of the analogy is by no means asserting that Mr. Simpson is guilty. By the same token, this disclaimer should not be taken as asserting his innocence. He is presumed innocent.

4. Specifically, see Endnote 9.

5. The game need not be restricted to only two stages. For example, Spencer and Brander consider a three-stage game in which competing firms are located in different countries. In the first stage, the governments make a prior commitment to subsidize R & D. In the second stage, firms choose R & D levels, given government subsidies announced. In the third stage, firms choose output levels, taking R & D levels as given by the preceding stage.

6. Thus, we are assuming a unit demand function and the market is covered.

7. A subgame perfect equilibrium is a set of strategies for each player such that in any subgame the strategies (truncated to this subgame) form a Nash equilibrium.

8. For a more general case of many exporting firms, see Liu.

9. By invoking the Cournot justification discussed previously, behind this two-stage export promotion model is a (perhaps, more realistic) three-stage game: the commodity units play Nash policy in the first stage, the firms play Nash (export) capacity in the second stage and Nash price in the third stage.

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