Strategic managerial delegation and trade policy

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Abstract

This paper examines the implications of delegation of quantity or price setting power to the managers by the firm owners, for trade policy. Delegation reduces the scale of strategic trade policy in an exporting industry. In an import-competing oligopoly industry, the optimal tariff is less or greater than the standard optimal tariff depending on whether firms compete in quantity or price. A quantitative import restriction is collusive even when firms compete in quantities, and induces the home firm to become less sales-oriented and produce less. Delegation reduces the gains from integration of similar markets across countries.

1. Introduction

Recent advances in international trade theory emphasize strategic behavior among firms of different countries and its implication for trade policy. The firm itself is treated as a simple profit-maximizing entity and incentive structures within a firm are treated as exogenous. In the modern environment of intense competition in the global market, this is rather naive. With the separation of ownership, management and workers, various incentive structures exist within a modern corporation. There may be strategic roles for these incentives and they may change with changes in the market environment. In order to correctly assess the desirability and the scale of policy intervention in international trade, it is therefore important to understand how trade policies affect intra-firm incentives and vice versa.

This paper deals specifically with managerial incentive and trade policy. There are two aspects of managerial incentives analyzed in the principal-agent industrial

organization literature: (a) managerial effort and moral hazard, and (b) strategic delegation of price and quantity fixing decisions. In the former strand, the manager is an agent who dislikes effort, whereas effort is a normal input to the principal's profit function. Effort is unobservable. The principal designs a contract for the agent based on the observables (e.g. profits) that induces effort. This has been applied to the context of international trade policy recently by Campbell and Vousden (1994) and Horn, Lang and Lundgren (Horn et al., 1995). Other considerations aside, it has implications for trade policy as long as contracts are inefficient or incomplete.

Strategic delegation refers to the design of an incentive payment scheme to the manager to deal with oligopolistic rivalry in the market, independent of considerations like moral hazard or adverse selection; see Vickers (1985), Fershtman and Judd (1987), Sklivas (1987) and Katz (1991). If a homogeneous-product duopoly market consists of a profit-maximizing firm and a firm under the control of a manager who is instructed to maximize sales, the latter firm may earn higher profits even when both firms face the same cost function. Hence there is an incentive to set up a non-profit maximizing objective for the manager. In a noncooperative environment each firm's owner will do the same. In equilibrium the profits of the owners may be greater or less than the pure profit-maximizing case depending upon the type of oligopolistic competition (Cournot or Bertrand).

Along with an oligopoly market structure, the rationale for such "strategic distortion" rests critically on some form of an inefficient contract. As shown by Katz (1991), two other critical assumptions are needed, namely, (a) the contracts between the owner and the manager are public information and (b) those are not negotiable within the time frame assumed. He shows further that strategic distortion arises even in the presence of unobservable (private) contracts and the possibility of renegotiation as long as the agency relationship lacks perfect control or perfect delegation and renegotiation takes place under incomplete information. This strategic delegation paradigm has recently been extended by Szymanski (1994) to cost-reducing managerial negotiation with labor unions as well as market share competition. Furthermore, it provides a theoretical foundation to the assumption of sales maximization hypothesis in the so-called behavioral theory of the firm (Baumol, 1958; Simon, 1964 and Williamson, 1964).

Apart from managerial incentive and effort, there are studies dealing with trade policy in the presence of intrafirm decisions and incentive schemes such as union-management relations (Brander and Spencer (1988)) and incentive-pay to workers (Das, 1996). Brander and Spencer have shown that in an unionized oligopolistic export market, the optimal subsidy is likely to be higher than in the absence of labor unions; since profits are also shared by workers greater intervention is required to facilitate the exporting firm to gain strategic advantage in the product market. In the context of a small import-competing industry and moral hazard, Das considers the effect of trade policy on effort and welfare when

workers are offered incentive-pay such as piece-rate pay or a profit sharing scheme. The effect of trade policy on effort depends upon the degree of mobility of workers as well as the type of incentive-pay.

This paper is concerned with strategic managerial delegation and its implications for international trade policy. Corporate firms, with separation of management and ownership, compete in international markets. In many important industries, they operate in oligopolistic international markets. In the business world there is growing realization that managerial performance is a major key to the overall performance of the firm. In general, managerial performance is dependent upon managerial effort as well as strategic delegation of price and quantity setting decisions to managers. This paper deals with the latter. The issue is obviously related to strategic trade policy, but there is an important difference. That is, not only prices and quantities are set strategically, so are managerial objectives. We ask (a) how trade policy affects the incentive to managers, which in turn affects the impact of trade policy on prices and quantities, and (b) how optimal trade policy may be designed in the light of changes in managerial incentive contracts.

In what follows, we adapt the Vickers–Fershtman–Judd–Sklivas (VFJS) model for analyzing exporting and import-competing industries. Despite criticisms on grounds of observability of contracts by rival firms and lack of renegotiation, the advantage of using this model is that it captures the notion of delegation in a simple, intuitive way and, in the present context, brings out the role of managerial delegation for trade policy in a transparent manner.[1]

Strategic managerial delegation has two basic implications that guide policy implications. (1) Delegation itself is a profit-shifting mechanism. (2) It affects the elasticity of output with respect to marginal cost (or the "supply elasticity"). The main findings are the following:

(a) Strategic delegation reduces the scale of policy intervention in the export market irrespective of whether firms compete in quantities or prices. The intuition is that delegation itself is a profit-shifting mechanism. Delegation does not however eliminate oligopolistic rivalry among firms; nor is it equivalent to consistent conjectures. Hence there is still some role left for trade policy.
(b) The implication for trade policy in an import-competing industry depends on the type of competition. If firms compete in quantities, the optimal tariff is lower compared to the standard profit-maximizing case. If they compete in prices, the optimal tariff is higher. Although, from the welfare perspective,

[1]Besides, as shown by Katz and discussed earlier, the main feature of this model is borne out even in the absence of observability and presence of renegotiation as long as delegation is imperfect and renegotiation occurs under incomplete information.

profit-shifting remains as a motive in an import-competing oligopoly market as well, it is the terms-of-trade motive (effect) that dominates. The magnitude of the latter—as is well-known—is dependent on the magnitude of the elasticity of foreign supply to a change in tariff. With strategic delegation, this elasticity, compared to the standard profit-maximizing case, is greater in the presence of quantity competition and less in the presence of price competition. This explains why the optimal tariff is lower in the former case and higher in the latter.

(c) A marginal quota or VER on imports acts as a collusive agent even when firms compete in quantities, and, moreover, induces the home firm to reduce its output. Hence the very protective effect of trade intervention in the form of quantity restriction is in question.

(d) Results (b) and (c) concern unilateral trade policy intervention. Consider economic integration of similar countries. When markets are noncompetitive, there may be, in general, gains from trade due to increased product variety and scale economies (Krugman, 1979 and Dixit and Norman, 1980) and increased (Cournot) oligopolistic competition (Markusen, 1981). Assuming a homogeneous product and no entry/exit—thus ignoring product variety and scale economies—our analysis shows that gains from trade, stylized by a movement from autarky to free trade, are less with strategic managerial incentive than without. In other words, strategic managerial incentive tends to reduce gains from economic integration.[2]

The paper is organized as follows. The VFJS model is briefly outlined in Section 2. Section 3 and Section 4 deal with export and import-competing industry respectively. The results in case of Cournot competition are formally derived, while, for the sake of brevity, those in case of Bertrand competition are stated without proof.[3] Autarky and free trade in a similar industry across countries are compared in Section 5. Section 6 concludes the paper.

[2]It may be noted that there is an equivalence between the strategic delegation model and the simple profit-maximizing model together with nonzero conjectural variation. Thus the same results would obtain between the two cases. For example, Mai and Hwang (1988) have shown that quantity restriction on imports acts as a collusion-facilitating arrangement even when firms compete in quantities for some conjectural variation other than Cournot–Nash. However, there are two problems with the conjectural variations approach. First, as is well-known, the notion of conjectural variation lacks game-theoretic foundation and hence is ad hoc. Second, the conjectural variation approach will not contain any prediction about the effect of parametric changes on the form of managerial compensation, whereas the strategic delegation model will.

[3]The derivations of the Bertrand equilibrium are much more complex algebraically compared to the Cournot equilibrium. They are contained in an earlier version of the paper, Das (1995), available from the author on request.

2. An outline of the VFJS model

Consider a duopoly industry. The owner is defined as one whose objective is to maximize profits. The manager, the agent of the owner, executes output, sales and pricing decisions.

There are two stages. In stage I the owners noncooperatively determine the structure of incentive pay to be offered to their managers. The manager of firm i is paid $w_i + \mu_i \pi_i + \beta_i S_i$, where w_i, μ_i, and β_i are constants, and π_i and S_i stand respectively for profits and revenues. The owner chooses w_i, μ_i and β_i. Define $\alpha_i \equiv \mu_i/(\mu_i + \beta_i)$. α_i and $1 - \alpha_i$ can be respectively interpreted as the relative profit incentive and relative sales incentive. These contracts are public knowledge and nonrenewable.[4]

In stage II, given w_i, μ_i and β_i, the managers of the competing firms noncooperatively set output or price. They are assumed to be risk-neutral and to maximize $\alpha_i \pi_i + (1 - \alpha_i) S_i$. Hence the relative profit or sales incentive, not the absolute weights, governs the performance of the firm.

It is assumed that either there is no uncertainty (in the demand and cost functions), or, if there is, the strategic variable—quantity or price—is chosen before the uncertainty is resolved. Similar to Vickers and Sklivas it is further assumed that the owner cannot directly verify price or quantity and therefore offers a contract indexed to profits and revenues. Inclusion of uncertainty and choice of the strategic variable after the resolution of uncertainty—as in Fershtman and Judd—would provide a more natural rationale for the unobservability of quantity or price. But it would unfortunately mix up the implications of strategic delegation on the role of trade policy with those of uncertainty per se as in Cooper and Riezman (1989). Exclusion of uncertainty keeps these separate.

2.1. Quantity competition

Let $p = a - Q$, $Q \equiv x_1 + x_2$, be the inverse demand function in a duopoly market where x_i's are the outputs of the two firms.[5] Let c_i be the marginal cost independent of the output. It is assumed that the market demand is not too small: more precisely, $a - \max(c_1, c_2) > 2|c_2 - c_1|$, which ensures positive quantities in equilibrium.

[4] As implied in Katz (1991), the strategic distortion emerges (i.e. $\mu_i \neq 1$) even under private information and renegotiation as long as delegation is imperfect and renegotiation occurs under incomplete information. Modelling of these elements would obviously complicate the analysis considerably and at the same time does not seem to offer further insights in our context.

[5] More generally, we may specify $p = a + \epsilon - Q$, ϵ being a random term. All results go through as long as outputs are chosen before ϵ is realized.

In stage II the manager of firm i maximizes $(a - x_1 - x_2 - \alpha_i c_i)x_i$. Notice that the relative profit incentive acts essentially as a shift parameter of the marginal cost function. The Cournot–Nash outputs and price solutions are:

$$x_i = \frac{a - 2\alpha_i c_i + \alpha_j c_j}{3}, \quad p = \frac{a + \alpha_1 c_1 + \alpha_2 c_2}{3}. \tag{1}$$

In stage I the owners choose the respective α_i in the noncooperative Nash-fashion. It is assumed that managerial services are available in a competitive market and the opportunity cost of a manager is given. The incentive solutions and the reduced-form solutions of quantities and the market price are

$$\alpha_i = \frac{8}{5} - \frac{a + 2c_j}{5c_i}; \quad x_{iC}^{I} = \frac{2a - 6c_i + 4c_j}{5}, \tag{2}$$

$$p_C^I = \frac{a + 2c_1 + 2c_2}{5}. \tag{3}$$

The superscript I denotes competition in incentive and the subscript C denotes Cournot competition among the managers.

We may call this two-stage subgame perfect equilibrium the Cournot incentive equilibrium as opposed to the simple Cournot equilibrium where $\alpha_i = 1$. x_{iC}^{I} can be compared to its analog in the simple Cournot equilibrium: $x_{iC} = (a - 2c_i + c_j)/3$.

We note the following:

Result 1. $\partial\alpha_i/\partial c_i > 0$ and $\partial\alpha_j/\partial c_i < 0$. i.e., an increase in the marginal cost increases the relative profit incentive offered to the own manager (makes the firm more profit oriented) but reduces that offered to the manager of the rival firm. Result 1 can be turned around in the international trade context as follows:

Proposition 1. When firms compete in quantities, protection of an industry—in the form of import tariff, production subsidy or export subsidy—makes the home (protected) firm more sales-oriented and the rival foreign firm more profit-oriented.

Comparing output solutions in the incentive equilibrium and simple Cournot equilibrium,

Result 2. The output is more sensitive to a change in the marginal cost in the Cournot incentive equilibrium than in the simple Cournot equilibrium.

In the simple Cournot equilibrium a change in marginal cost affects output through the shift in the best response function in the output space. In the Cournot incentive equilibrium there is an additional effect through a change in the managerial incentive which reinforces the standard effect. As c_i increases, α_i

increases, that is, the firm becomes less sales-oriented. This has a negative effect on output.

2.2. Price competition

When firms compete in prices, the implications are just the opposite. Consider a differential product industry. Firms 1 and 2 produce goods 1 and 2 respectively, which are substitutes of each other. Let the demand functions be given by $x_i = a - p_i + bp_j$, where $0 < b < 1$. Let the rest of the specifications be analogous to the quantity-competition case. Similar to the quantity competition case, we distinguish between the Bertrand incentive equilibrium and the simple Bertrand equilibrium. The model yields

Result 3. $\partial\alpha_i/\partial c_i < 0$ *and* $\partial\alpha_j/\partial c_i > 0$.

It is well-known that the Bertrand competition is more fierce and closer to perfect competition than the Cournot competition. In the face of severe price competition, an increase in the marginal cost induces the firm to be more sales oriented (more aggressive).

Result 3 implies the following proposition in the context of international trade.

Proposition 2. If firms compete in prices, protection to the domestic firm it makes more profit-oriented and the rival foreign firm more sales-oriented.

We also obtain the following analog of Result 2.

Result 4. The output is less sensitive to a change in the marginal cost in the Bertrand incentive equilibrium than in the simple Bertrand equilibrium.

Besides the standard negative effect on output, an increase in c_i induces the owner to lower the relative profit incentive, forces the manager to be more sales-oriented and thereby tends to increase output. The resultant decrease in output is smaller.

The review of the VFJS model is complete. Now we move on to examine the implications of trade policy for export and import-competing industries.

3. The export rivalry model

Consider the export rivalry model of Brander and Spencer (1985). Let 1 and 2 also represent two countries, firm i belonging to country i. The firms compete, a la Cournot, in a third market. There are three stages now. In stage I the governments simultaneously choose (specific) subsidies, say s_i. In stage II the owners offer

incentives to their managers. In stage III managers choose output. Stages II and III here are same as stages I and II in the last section. The assumption that decisions by firms follow the policy decisions amounts to policy commitment by the governments. The issue of commitment versus no commitment is beyond the scope of this paper.

The specific subsidies are accommodated in the duopoly model by simply redefining $c_i = \bar{c}_i - s_i$, where $\bar{c}_i$ is the marginal cost of production. Substituting (2)–(3)

$$\pi_i = \tfrac{2}{25}[a - 3(\bar{c}_i - s_i) + 2(\bar{c}_j - s_j)]^2 \equiv \bar{\pi}_i(s_i, s_j). \tag{4}$$

The welfare of the country i is given by the profit of its firm net of the cost of subsidy, i.e., $W_i = \bar{\pi}_i(s_i, s_j) - s_i x_i$, where $x_i = x_{iC}^I$. In the noncooperative subsidy game in stage I, W_i is maximized with respect to s_i at given s_j. The first-order conditions are[6]

$$\frac{\partial W_i}{\partial s_i} = 0 \Leftrightarrow a - 3\bar{c}_i + 2\bar{c}_j - 12s_i - 2s_j = 0, \tag{5}$$

solving which

$$s_{iC}^I = \frac{a - 4\bar{c}_i + 3\bar{c}_j}{14} > 0. \tag{6}$$

Compare this to the simple Cournot solution: $s_{iC} = (a - 3\bar{c}_i + 2c_j)/5$. Clearly, $s_{iC}^I < s_{iC}$. Hence the optimal policy is an export subsidy but the magnitude of the subsidy is less than in the simple Cournot equilibrium.

The rationale for export subsidies lies in the profit-shifting motive, which is well-known. The new element here is that delegation to managers, being a profit-shifting mechanism by the owners, reduces the scale of intervention by the government. However, to the extent that delegation is not a perfect substitute of oligopolistic rivalry, some role for strategic trade policy still remains.

Indeed, s_{iC}^I can be substantially lower than s_{iC}. For example, in the symmetric case, the former equals $(a - \bar{c})/14$ where the latter equals $(a - \bar{c})/5$. Thus s_{iC}^I is about one-third of s_{iC}.

Turning to price competition, as shown by Eaton and Grossman (1986), an export tax emerges as the equilibrium policy. Strategic delegation tends to reduce the scale of trade intervention here also, i.e., the equilibrium export tax is smaller. The intuition is the same: Whether with quantity or price competition, delegation to managers is a profit-shifting device. Formally this result holds under fairly minor restrictions (Das, 1995). Thus

[6]It is straightforward to check that the second-order condition is met.

Proposition 3. The equilibrium export subsidy or tax is less in the presence of strategic managerial delegation than if the firms were simple profit-maximizers.

We now turn to analyze an import-competing industry.

4. An import-competing industry

The implications of managerial delegation for an import-competing industry are quite different from those for an exporting industry. In what follows, we examine the optimal tariff issue as well as quantitative restrictions on imports. The optimal tariff, as is well-known, results primarily from the terms-of-trade effect, not from the profit-shifting effect, because of the inclusion of consumer surplus in the aggregate welfare. In the presence of managerial delegation, the magnitude of the terms-of-trade effect, as will be seen, depends on whether firms engage in quantity or price competition. Hence the implication of managerial delegation for tariff depends on the type of oligopolistic competition. Moreover, as we will see, a quantity restriction on imports exerts unusual effects.

4.1. Optimal tariff

Let the import-competing industry consist of two firms, a home firm (firm 1) and a foreign firm (firm 2). Both sell a homogeneous product in the home market. Their behavior in other markets, if they operate, is exogenous to the model. The home demand function is assumed linear. Let t denote a specific tariff imposed on the foreign firm. Accordingly we redefine $c_2 \equiv \bar{c}_2 + t$.

We first consider quantity competition. The equilibrium incentives, the domestic output and imports are given in (2). (3) is the solution of the domestic market price; the terms of trade equal $p_c^I - t$. As noted in Proposition 1, an increase in tariff protection implies a decrease in α_1 and an increase in α_2; in other words, the domestic firm adopts a more sales-oriented and the foreign firm a more profit-oriented managerial incentive scheme.

Domestic welfare equals $W = \int_0^Q (a - z)\, dz - c_1 x_1 - (p - t) x_2$. The first term is the gross surplus, and the second and third terms are respectively the total cost of obtaining the product using domestic resources and imports. Totally differentiating W

$$\frac{dW}{dt} = p \frac{dQ}{dt} - c_1 \frac{dx_1}{dt} - (p - t) \frac{dx_2}{dt} - x_2 \left(\frac{dp}{dt} - 1 \right),$$

where the last term is the terms-of-trade gain. Using (2)–(3) again

$$\frac{dW}{dt} = \frac{2}{5}(a - \bar{c}_2 - 4t) \Rightarrow t_c^I = \frac{a - \bar{c}_2}{4}. \tag{7}$$

t_C^1 being the optimal tariff. This is smaller than the optimal tariff in the simple Cournot model, equal to $t_C = (a - \bar{c}_2)/3$. Hence

Proposition 4. When firms compete in quantities, the optimal tariff is less than in the simple Cournot equilibrium.

The key to this result lies in the magnitude of the terms-of-trade gain—which depends on the sensitivity of the export supply with respect to tariff. Note that, to the foreign firm, an increase in tariff is equivalent to an increase in its marginal cost. Consider how a change in t or the marginal cost would affect x_2—the amount exported—through the change in managerial incentive. Result 1 implies that an increase in t increases α_2 and reduces α_1. Result 2 implies that the export supply is therefore more sensitive to a change in tariff. Hence the terms-of-trade gains due to an increase in tariff are less, implying a smaller optimal tariff.

In the case of price competition, the implication is just the opposite. As Results 3 and 4 show, a tariff, under price competition, induces the foreign firm to become more sales-oriented and the home firm more profit-oriented, thereby tending to increase exports into the market. This partially offsets the direct negative effect of tariff on export supply. Hence export supply is less elastic. The terms-of-trade effects of a tariff are larger and the optimal tariff is higher (Das, 1995).

Proposition 5. When firms compete in prices, the optimal tariff is greater than in the simple Bertrand equilibrium.

4.2. Quantity restriction on imports

In the standard profit-maximizing duopoly framework, a quantity restriction on imports in a market inhabited by quantity-setting Cournot firms has similar effects on output, market price and profits as does a specific tariff. The domestic price rises, the domestic firm's output and profit increase, whereas the foreign firm's profit falls. It is because the strategic behavior of the domestic firm, essentially, does not change. However, as shown by Harris (1985) and Krishna (1989), a quantity restriction has very different implications if firms compete in prices instead of quantities. Besides increasing the profit of the domestic firm, it can also increase the foreign firm's profit, i.e., the quantity restriction acts as a collusion-facilitating device.

In this model a quantity restriction has a collusive implication even when firms compete in quantities. This is because it changes the strategic behavior in setting the managerial incentives. Let firm 1 and firm 2 represent, as before, the home and the foreign firm respectively. As shown in Das (1995)

Proposition 6. A quantity restriction on imports arbitrarily close to the free trade level of imports implies $\alpha_1 = 1$ and $\alpha_2 \leq 1$.

The intuition is that a quantity restriction eliminates quantity competition and induces the home-firm owner to remove any sales incentive, i.e., the relative profit incentive increases from $\alpha_1 < 1$ to $\alpha_1 = 1$. The home firm's manager becomes less aggressive in sales, implying, paradoxically, a reduction in the home firm's output (Das, 1995). In the process, market price rises, and the profit of the home firm as well as that of the foreign firm increase. Managerial delegation thus provides a new rationale for quantity restriction as a collusion-facilitating mechanism.

The model thus casts doubts on the protective impact of quantity restrictions on imports in terms of output and employment in an import-competing industry. There is indeed some empirical evidence to this effect. For example, Boonekamp (Boonekamp, 1990, p. 32) writes that "A recent GATT report shows that VERs have not prevented a loss of employment in the textile, clothing, and steel industries in the protecting countries. In the period 1973–84, employment in the steel sectors of the European Community and the United States declined by 42 percent and 54 percent, respectively; in textiles and clothing the declines were 46 percent and 43 percent, respectively, in the European Community, and 22 percent and 18, respectively, in the United States." The observed decline in jobs in protected sectors is commonly attributed to adverse macroeconomic conditions, productivity changes etc. Moreover, these industries might be close to being competitive industries. But to the extent that there is some product differentiation and existence of market power, our analysis implies that the form of import protection itself may be a contributing factor. It suggests an empirically testable hypothesis that, with other factors controlled for, a quantity restriction on imports, by itself, hastens the declining process of a declining industry in the face of import competition.

5. Integration of an identical industry across countries

The model is now applied to the issue of integration of or multilateral trade liberalization across similar countries. Consider a given homogeneous-product industry in two countries. The number of firms in the industry in each country is same, equal to m; moreover, m is given (i.e. no entry and exit). The demand function is the same ($z = a - p$) and each firm's marginal cost is the same, equal to c. Thus the industry across the two countries is identical. As usual, integration is modelled by a movement from autarky to free trade. The assumptions of symmetry, product homogeneity and no entry-exit rule out sources of gains from trade such as comparative advantage, product variety and scale economies. As shown by Markusen (1981), there are still gains from trade because the total output in the "world economy" (two countries together) is greater. Each country is able to consume more and benefits from trade.

The new element here is that a change in the degree of oligopolistic competition will motivate owners to offer a different managerial incentive. The questions are:

how do the incentives change (with free trade) and how are the gains from a movement from autarky to free trade affected?

5.1. Autarky equilibrium

Consider the industry in equilibrium in either country. The inverse demand function is written as $p=a-(x_1+\cdots+x_m)$. In stage II firm i in the Cournot–Nash equilibrium maximizes $\pi_i=(a-x_1\cdots-x_i\cdots-x_m-\alpha_i c_i)x_i$ with respect to x_i. The stage II solutions are:

$$x_i=\frac{a-m\alpha_i c+c\sum_{j\neq i}^{m}\alpha_j}{m+1};\quad p=\frac{a+c\sum_{i=1}^{m}\alpha_i}{m+1}. \tag{8}$$

$$\pi_i=\frac{a+c\sum_{i=1}^{m}\alpha_i-(m+1)c}{m+1}\cdot\frac{a-m\alpha_i c+c\sum_{j\neq i}^{m}\alpha_j}{m+1}. \tag{9}$$

At the Nash equilibrium in the incentive space (stage I) $\partial\pi_i/\partial\alpha_i=0$, i.e.,

$$-m\left[a+c\sum_{i=1}^{m}\alpha_i-(m+1)c\right]+a-m\alpha_i c+c\sum_{j\neq i}^{m}\alpha_j=0. \tag{10}$$

All α's being equal at the equilibrium, the above equation reduces to $-(m-1)a+m(m+1)c-m^2c\alpha-c\alpha=0$, yielding

$$\alpha_A=\frac{-(m-1)a+m(m+1)c}{(m^2+1)c}, \tag{11}$$

where "A" denotes autarky. Substituting this into (8)

$$X_A^I\equiv mx=\frac{m^2(a-c)}{m^2+1}, \tag{12}$$

X_A^I being the total quantity produced and consumed in each country at the incentive equilibrium.

5.2. Free trade

In free trade the two markets are integrated. There are $2m$ firms. The world market demand function is now $z=2a-2p$, implying $p=a-(x_1+\cdots+x_{2m})/2$. In stage II firm i maximizes $[a-(x_1+\cdots+x_i+\cdots x_{2m})/2-\alpha_i c]x_i$ with respect to x_i. The first-order condition is:

$$a-\frac{x_1+\cdots+x_i+\cdots+x_{2m}}{2}-\alpha_i c-\frac{x_i}{2}=0. \tag{13}$$

Aggregating over all $(2m)$ firms

$$2ma - mQ_w - c\sum_{i=1}^{2m}\alpha_i - \frac{Q_w}{2} = 0 \Rightarrow Q_w = \frac{4ma - 2c\sum_{i=1}^{2m}\alpha_i}{2m+1}, \tag{14}$$

where Q_w is the total output of the industry in the two countries combined (the world economy). The equilibrium output of firm i, market price and profits in stage II are equal to

$$x_i = \frac{2}{2m+1}\left[a - 2m\alpha_i c + c\sum_{j\neq i}^{2m}\alpha_j\right]; \quad p = \frac{a + c\sum_{i=1}^{2m}\alpha_i}{2m+1}, \tag{15}$$

$$\pi_i = \frac{2}{2m+1}\left[\frac{a + c\sum_{i=1}^{2m}\alpha_i}{2m+1} - c\right]\left[a - 2m\alpha_i c + c\sum_{j\neq i}^{2m}\alpha_j\right]. \tag{16}$$

In stage I, the firm owners choose α_i noncooperatively. $\partial\pi_i/\partial\alpha_i = 0$ yields

$$-2m\left[a + c\sum_{i=1}^{2m}\alpha_i - (2m+1)c\right] + a - 2m\alpha_i c + c\sum_{j\neq i}^{2m}\alpha_j - 0. \tag{17}$$

Invoking symmetry, the above equation solves α_w—the relative profit incentive in the integrated world economy. This leads to the solution of other variables in the system. In particular

$$\alpha_w = \frac{-(2m-1)a + (4m^2+4m-1)c}{2m(2m+1)c}, \tag{18}$$

$$X_w^1 = \frac{(4m^2+4m-1)(a-c)}{(2m+1)^2}. \tag{19}$$

Comparing (18) with (11).

Proposition 7. The relative profit incentive is greater in free trade than in autarky.

Integration of the industry across the two countries implies, from any particular firm's viewpoint, (a) an increase in the number of rivals and (b) an expansion of the market size. As shown in Fershtman and Judd (Proposition 4), an increase in the number of firms, market size remaining unchanged, leads to an increase in α. It is because a larger number of firms tends to reduce the oligopolistic interdependence between any two firms. An increase in the market size, on the other hand, tends to lower α (see (2)). Proposition 8 holds that effect (a) outweighs effect (b).

If we compare (19) to (12), the total quantity produced and consumed in each country is greater in free trade than in autarky. Hence each country gains from integration. But how does the magnitude of gains from integration compare with that in the simple profit-maximization case?

Proposition 8. The gains from integration (free trade) is less than in the simple profit-maximization case.

The reason is that the firms become less sales-oriented in free trade. Hence the positive effect of free trade on quantity is less than if firms were simple profit-maximizers. This implies less welfare gains.

Formally, welfare (of either country) is given by

$$W=\int_0^X (a-z)\,\mathrm{d}z - pX + (p-c)X = aX - \frac{X^2}{2} - cX \equiv W(X).$$

$\mathrm{d}W/\mathrm{d}X = a - X - c - p - c > 0$ and $\mathrm{d}^2W/\mathrm{d}X^2 = -1 < 0$. Thus welfare is an increasing and a concave function of total quantity. Denote $W_i = W(X_i)$. Concavity implies that $W_4 - W_3 < W_2 - W_1$ if $X_3 > X_1$ and $X_4 - X_3 < X_2 - X_1$. Interpret X_3 as X_A^I and X_1 as X_A, where X_A is the quantity in autarky in the simple profit-maximization case. Putting α_i and α_j equal to 1 in (8)

$$X_A = \frac{m(a-c)}{m+1}. \tag{20}$$

Comparing this with (12) it is evident that $X_A^I > X_A$. Next, interpret $X_4 = X_W^I$ and $X_2 = X_W$, where X_W is the total output in each country in free trade in the simple profit-maximization case. Putting $\alpha_i = 1$ in (14) and dividing it by 2,

$$X_W = \frac{4m(a-c)}{2m+1}. \tag{21}$$

It remains to show that $X_W^I - X_A^I < X_W - X_A$. We already have the expression for each of these and it is easy to verify that this inequality holds.

6. Concluding remarks

In today's world of global competition among firms, the firm behavior is critical in determining international competitiveness of a sector or industry. Traditional trade theory treats the firm as a simple profit-maximizing entity, whereas a modern corporation in which ownership and management are separated and managers are delegated the quantity and pricing fixing decisions and act as agents of the owners, may very well deviate from profit-maximization. This paper investigates the

ramifications of this deviation for trade policy in the context of managerial incentives offered by owners in an oligopoly market.

Treating the simple profit-maximization case as the bench-mark case, we find that the scale of policy intervention in an (oligopolistic) export market is reduced. The scale of policy intervention in an import-competing industry may be reduced or enhanced depending on whether firms compete in quantity or price. A quantity restriction on imports acts as a collusive mechanism even when firms compete in quantity. Moreover, such a restriction leads, paradoxically, to a decrease in output by the import-competing domestic firm. Lastly, managerial incentives may reduce the size of gains from multilateral trade liberalization among similar countries.

While linear demand and cost functions have been assumed throughout, the insights obtained seem general and robust. But a formal analysis having general demand and cost functions (as in Eaton and Grossman (1986)) seems quite formidable because of the three-stage-game nature of the model. However, as long as these functions are continuous and differentiable, all the results formally hold if their curvatures are sufficiently small.

Moreover, as correctly observed by a referee, a general point emerging from the analysis is that deviations from profit-maximization is not the only case pertaining to intrafirm decision which may have implications for strategic trade policy. Any other form of incentive scheme—whether to managers or workers—which is set strategically (vis-a-vis those offered by other firms) will have a bearing on optimal trade policy.

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