A Note on Managerial Delegation in Oligopolistic Competition with Symmetric Costs

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Abstract

This note reexamines the implication of the separation of ownership and management based on a strategic subsidy policy under oligopolistic competition in a third market. We consider multiple firms in both exporting countries and symmetric cost functions. We find that the Brander–Spencer subsidy-equivalent result of Wei[5] is satisfied only with one firm in each exporting country. When the number of firms increases, the owner's equivalent subsidy may be larger or smaller than that *à* la Brander–Spencer subsidy, depending on the number of firms.

1 Introduction

The theory of strategic trade policy developed remarkably in the 1980s. A standard third-market model proposed in Brander and Spencer [1] (hereafter, the BS model) revealed that the rent-shifting effect of the strategic subsidization induces the domestic firm to win a Stackelberg-leader position in quantity competition, thus improving its own welfare. The essence of the BS model is that the governments' subsidization induces the firms to maximize the distorted non-profit objective functions. Similarly, the distorted objective function can be found in a strategic managerial delegation model first examined by Fershtman and Judd [3] and Sklivas [4]. They considered a model (hereafter, the FJS model) where owners offer incentive contracts to their managers, who then compete in quantities in the oligopolistic competition. The model clarified that delegating a manager with non-profit-maximizing objective functions also diverts the firm to act as a Stackelberg leader in the quantity competition.

However, few studies have pointed out the similarity between the BS and FJS models. Das[2] applied an FJS-style delegation in both quantity and price settings to analyze strategic managerial delegation involving international trade policies. While Wei[5] also combined the BS model and the FJS model as in Das[2] and focused on the nature of the equivalent strategic behavior between government trade policy and managerial delegation in duopolistic competition. Wei[5] clarified that the owners' strategic subsidization incentive is strengthened with government intervention and summarized both the owners and governments' strategic subsidy as a total subsidy.

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In this note, we reexamine the owner's subsidization effect hidden in the managerial delegation as in Wei[5], and extend this to the model with the given number of firms located in both exporting countries, that is, the oligopolistic competition. We show that the BS subsidy-equivalent result is satisfied only with one firm in each exporting country. When the number of firms increases, the equivalent owner's subsidy may be larger or smaller than that *à* la Brander–Spencer subsidy, depending on the number of firms. We also show that the owner's strategic subsidization incentive is not always strengthened with government intervention and show how the number of firms affects under oligopolistic competition.

The rest of the paper proceeds as follows. In section 2, we reexamine a three-stage government-owner-manager game with multiple firms in both exporting countries. In section 3, we compare the results with the case without managerial delegation and find that the BS subsidy-equivalent result does not hold with multiple firms. Some concluding remarks are summed up in section 4.

2 Managerial Delegation in the Third-Market Model

Following the framework of the BS model, we consider two exporting countries, labelled M and N. Country M has m firms and country N has n firms located in their respective territories. The firms produce a homogeneous product and compete *à* la Cournot in the third country, which is an importing country. Let $q_{Mi}(i = 1, 2, \cdots, m)$ denote the output produced by firm i in country M and $q_{Nj}(j = 1, 2, \cdots, n)$ denote the output produced by firm j in country N. Then, $Q = \sum_{i=1}^{m} q_{Mi} + \sum_{j=1}^{n} q_{Nj}$ represents the total output. Throughout our paper, we assume the following linear inverse demand function in the third market:

$$p(Q) = a - Q = a - \sum_{i=1}^{m} q_{Mi} - \sum_{j=1}^{n} q_{Nj}.$$

Let c^0_{Mi} (or c^0_{Nj}) denote the marginal production cost of firm i in country M (or firm j in country N). The government of country M (or N) provides a unit production(=export) subsidy s_M (or s_N) to its national firms. The exporting firms' profit functions are given by

$$\begin{aligned} \pi_{Mi} &= [p(Q) - c_{Mi}]q_{Mi} \qquad && (i = 1, 2, \cdots, m) \\ \pi_{Nj} &= [p(Q) - c_{Nj}]q_{Nj} \qquad && (j = 1, 2, \cdots, n), \end{aligned}$$

where $c_{Mi} = c^0_{Mi} - s_M$ and $c_{Nj} = c^0_{Nj} - s_N$ denote the subsidy-inclusive costs.

Each exporting firm has one owner and one manager. Each owner designs an incentive contract to compensate its manager, which is expressed as a weighted-average combination of the firm's profits and sales as in the FJS model:[1]

$$O_{Mi} = \lambda_{Mi}\pi_{Mi} + (1 - \lambda_{Mi})p(Q)q_{Mi} = \left[a - \sum_{i=1}^{m} q_{Mi} - \sum_{j=1}^{n} q_{Nj}\right] q_{Mi} - \lambda_{Mi}c_M q_{Mi}$$

$$O_{Nj} = \lambda_{Nj}\pi_{Nj} + (1 - \lambda_{Nj})p(Q)q_{Nj} = \left[a - \sum_{i=1}^{m} q_{Mi} - \sum_{j=1}^{n} q_{Nj}\right] q_{Nj} - \lambda_{Nj}c_N q_{Nj},$$

[1]Note that O_{Mi}, O_{Nj} do not represent a manager's rewards in general. See Wei [5] for details.

where λ_{Mi} (or λ_{Nj}) denotes the contract term of firm i in country M (or firm j in country N) and is the weight on the firm's profit in the contract.

We denote the owners' subsidy (or tax) equivalents by following Wei[5], which are expressed as

$$\sigma_{Mi} := (1-\lambda_{Mi})(c_{Mi}-s_M) \tag{1}$$

$$\sigma_{Nj} := (1-\lambda_{Nj})(c_{Nj}-s_N). \tag{2}$$

Owner's subsidy (or tax) equivalent shows that by manipulating an incentive contract, the owner can divert the manager's objective from pure profit maximization to attain the subsidization (or taxation) objective. (See Wei[5].)

Following Das[2], we explore a three-stage government-owner-manager game. In the first stage, each exporting country's government simultaneously determines the country-specific subsidy rate. In the second stage, each owner delegates a manager and designs its optimal managerial contract. In the third stage, each manager decides the production quantity by competing *à* la Cournot. We solve the game by backward induction.

In the third stage, after observing each country's government subsidy rate and each firm's incentive contract, the managers decide their optimal outputs that satisfy the following first-order conditions (FOCs).

$$0 = \frac{\partial O_{Mi}}{\partial q_{Mi}} = a - Q - q_{Mi} - \lambda_{Mi}c_{Mi} \tag{3}$$

$$0 = \frac{\partial O_{Nj}}{\partial q_{Nj}} = a - Q - q_{Nj} - \lambda_{Nj}c_{Nj}. \tag{4}$$

Summing (3) over m firms in country M and summing (4) over n firms in country N, we obtain the total output as below.

$$Q = \frac{(m+n)a - \sum_{i=1}^{m}\lambda_{Mi}c_{Mi} - \sum_{j=1}^{n}\lambda_{Nj}c_{Nj}}{m+n+1}.$$

Substituting the above Q into (3) and (4), we obtain the equilibrium outputs in the third stage:

$$q_{Mk} = a - Q - \lambda_{Mk}c_{Mk} = \frac{a-(m+n)\lambda_{Mk}c_{Mk} + \sum_{i\neq k}^{m}\lambda_{Mi}c_{Mi} + \sum_{j=1}^{n}\lambda_{Nj}c_{Nj}}{m+n+1}$$

$$q_{Nk} = a - Q - \lambda_{Nk}c_{Nk} = \frac{a-(m+n)\lambda_{Nk}c_{Nk} + \sum_{i=1}^{m}\lambda_{Mi}c_{Mi} + \sum_{j\neq k}^{n}\lambda_{Nj}c_{Nj}}{m+n+1}.$$

Note that an increase in the weight of profit in the managerial contract reduces its own production but expands the other rival firms' production in both domestic and foreign countries. However, the decrease in the own production is much larger than the increase in the other firms' production, and hence, the total production falls.

$$\frac{\partial q_{Mk}}{\lambda_{Mk}} = -\frac{(m+n)c_{Mk}}{m+n+1} < 0$$

$$\frac{\partial q_{Mk}}{\lambda_{Mi}}(i=1,\cdots,k-1,k+1,\cdots,m) = \frac{c_{Mi}}{m+n+1} > 0 \quad , \quad \frac{\partial q_{Mk}}{\lambda_{Nj}}(j=1,\cdots,n) = \frac{c_{Nj}}{m+n+1} > 0$$

$$\frac{\partial Q}{\partial \lambda_{Mi}} = -\frac{c_{Mi}}{m+n+1} < 0 \quad , \quad \frac{\partial Q}{\partial \lambda_{Nj}} = -\frac{c_{Nj}}{m+n+1} < 0.$$

In the second stage, each owner maximizes its profit by choosing λ in the managerial contract. Evaluating the equilibrium outputs above yields the FOCs for profit maximization as below.

$$0 = \frac{\partial \pi_{Mk}}{\partial \lambda_{Mk}} = (a - Q - c_{Mk})\frac{\partial q_{Mk}}{\partial \lambda_{Mk}} - q_{Mk}\frac{\partial Q}{\partial \lambda_{Mk}} \tag{5}$$

$$0 = \frac{\partial \pi_{Nk}}{\partial \lambda_{Nk}} = (a - Q - c_{Nk})\frac{\partial q_{Nk}}{\partial \lambda_{Nk}} - q_{Nk}\frac{\partial Q}{\partial \lambda_{Nk}}. \tag{6}$$

To simplify the analysis, we consider the symmetric cost function inside both countries, that is, $\forall c^0_{Mk}(k = 1, \cdots, m) = c^0_M$ and $\forall c^0_{Nk}(k = 1, \cdots, n) = c^0_N$. Thus, in the equilibrium, we have $\lambda_{Mk} = \lambda_M$ and $\lambda_{Nk} = \lambda_N$. Solving (5)(6) in the symmetric equilibrium, we find

$$\begin{bmatrix} [m(m+n)+(n+1)]c_M & n(m+n-1)c_N \\ m(m+n-1)c_M & [n(m+n)+(m+1)]c_N \end{bmatrix}\begin{bmatrix} \lambda_M \\ \lambda_N \end{bmatrix} = \begin{bmatrix} (m+n+1)(m+n)c_M - (m+n-1)a \\ (m+n+1)(m+n)c_N - (m+n-1)a \end{bmatrix},$$

which yields the equilibrium results as below.

$$\lambda^*_M = \frac{[n(m+n)+(m+1)](m+n)c_M - n(m+n-1)(m+n)c_N - (m+n-1)a}{[(m+n)^2+1]c_M}$$

$$\lambda^*_N = \frac{[m(m+n)+(n+1)](m+n)c_N - m(m+n-1)(m+n)c_M - (m+n-1)a}{[(m+n)^2+1]c_N},$$

where the superscript $*$ represents the equilibrium values in the second stage.

The owner's subsidy equivalent defined in (1)(2) yields the following results.

$$\sigma^*_M = \frac{m+n-1}{(m+n)^2+1}[a - (n^2+mn+1)c_M + n(m+n)c_N], \tag{7}$$

$$\sigma^*_N = \frac{m+n-1}{(m+n)^2+1}[a - (m^2+mn+1)c_N + m(m+n)c_M]. \tag{8}$$

Under international duopolistic competition when $m = 1$ and $n = 1$, Wei[5] indicated the BS subsidy-equivalent result. That is, the optimal owner's subsidy equivalent in the FJS model yields the same value as that *à* la Brander-Spencer government subsidy, namely, $\sigma^*_M = \frac{a-c^0_M+2c^0_N}{5} = s^{BS}_M$ and $\sigma^*_N = \frac{a-3c^0_N+2c^0_M}{5} = s^{BS}_N$.

Differentiating σ^*_M with m and n, we obtain

$$\frac{\partial \sigma^*_M}{\partial m} = \frac{[2-(m+n-1)^2]a - [(n^2+1)(2m+n+1)+m^2(n-1)]c_M + n[(m+n+1)^2-2]c_N}{[(m+n)^2+1]^2}$$

$$\frac{\partial \sigma^*_M}{\partial n} = \frac{[2-(m+n-1)^2]a - \{[(m+n)^2+1]^2 - m[(m+n+1)^2-2]\}c_M}{[(m+n)^2+1]^2} + \frac{\{[(m+n)^2+1][(m+n)^2-m]+2n(m+n-1)\}c_N}{[(m+n)^2+1]^2}.$$

Under total symmetric cost functions when $c^0_M = c^0_N$, $\frac{\partial \sigma^*_M}{\partial m} = \frac{\partial \sigma^*_M}{\partial n} < 0$ holds without government intervention. Increasing the number of firms in either country reduces the individual firm's owner's subsidy equivalent.

Using (σ_M^*, σ_N^*), we can express the equilibrium outputs in the second stage as

$$q_M^* = \frac{m+n}{(m+n)^2+1}[a-(n^2+mn+1)c_M+n(m+n)c_N]$$
$$q_N^* = \frac{m+n}{(m+n)^2+1}[a-(m^2+mn+1)c_N+m(m+n)c_M]$$
$$Q^* = mq_M^*+nq_N^* = \frac{m+n}{(m+n)^2+1}[(m+n)a-mc_M-nc_N].$$

Since each firm's production is positive, we have $\lambda_M^* < 1$ and $\lambda_N^* < 1$. Equivalently, each firm's owner provides a positive subsidy in its managerial contract, that is, $\sigma_M^* > 0$ and $\sigma_N^* > 0$.

Differentiating q_M^* with m and n, we obtain

$$\frac{\partial q_M^*}{\partial m} = \frac{[1-(m+n)^2]a+(m^2-n^2-1)c_M+2n(m+n)c_N}{[(m+n)^2+1]^2}$$
$$\frac{\partial q_M^*}{\partial n} = \frac{[1-(m+n)^2]a-[(m+n)^4+2n(m+n)+1]c_M+[(m+n)^4+(m+n)(m+3n)]c_N}{[(m+n)^2+1]^2}.$$

Under total symmetric cost functions when $c_M^0 = c_N^0$, $\frac{\partial q_M^*}{\partial m} = \frac{\partial q_M^*}{\partial n} < 0$ holds without government intervention. Increasing the number of firms in either country reduces the individual firm's output. However, total output increases with the increasing number of firms, that is, $\frac{\partial Q^*}{\partial m} > 0$ and $\frac{\partial Q^*}{\partial n} > 0$.

Each country's welfare function is expressed by the product surplus minus the subsidy payment over the firms.

$$W_M = \sum_{i=1}^{m}(\pi_{Mi} - s_M q_{Mi}) = \sum_{i=1}^{m}(p-c_{Mi}^0)q_{Mi} = m(p-c_M^0)q_M$$
$$W_N = \sum_{j=1}^{n}(\pi_{Nj} - s_N q_{Nj}) = \sum_{j=1}^{n}(p-c_{Nj}^0)q_{Nj} = n(p-c_N^0)q_N.$$

Evaluating at the equilibrium output in the second stage, the FOC for welfare maximization yields

$$0 = \frac{\partial W_M}{\partial s_M} = \sum_{i=1}^{m}\left[(p-c_{Mi}^0)\frac{\partial q_{Mi}^*}{\partial s_M} - q_{Mi}\frac{\partial Q^*}{\partial s_M}\right]$$
$$0 = \frac{\partial W_N}{\partial s_N} = \sum_{j=1}^{n}\left[(p-c_{Nj}^0)\frac{\partial q_{Nj}^*}{\partial s_N} - q_{Nj}\frac{\partial Q^*}{\partial s_N}\right].$$

Solving for both countries in the symmetric equilibrium, we obtain

$$\begin{bmatrix} 2m(m+n)(n^2+mn+1) & n(m+n)(n^2-m^2+1) \\ m(m+n)(m^2-n^2+1) & 2n(m+n)(m^2+mn+1) \end{bmatrix}\begin{bmatrix} s_M \\ s_N \end{bmatrix} =$$
$$\begin{bmatrix} (n^2-m^2+1)a+(m^2-n^2-1)(n^2+mn+1)c_M^0+n(m+n)(n^2-m^2+1)c_N^0 \\ (m^2-n^2+1)a+(n^2-m^2-1)(m^2+mn+1)c_N^0+m(m+n)(m^2-n^2+1)c_M^0 \end{bmatrix}$$

with the solution

$$s_M^e = \frac{(n^2 - m^2 + 1)[a - (m^2 + mn + 2)c_M^0 + (m^2 + mn + 1)c_N^0]}{m(m+n)[(n+m)^2 + 3]} \tag{9}$$

$$s_N^e = \frac{(m^2 - n^2 + 1)[a - (n^2 + mn + 2)c_N^0 + (n^2 + mn + 1)c_M^0]}{n(m+n)[(n+m)^2 + 3]}, \tag{10}$$

where the superscript e represents the first-stage equilibrium with government intervention. We find that the exporting governments do not always have positive subsidization incentives. (9) and (10) show that when $m \geq n + 1$, $s_M^e < 0$ and $s_N^e > 0$ hold under total symmetric costs. That is, when the number of domestic firms is larger than the number of foreign firms, the domestic government has an incentive to tax the firms to reduce the domestic competition, while the foreign government has an incentive to subsidize the firms.

Using the above results, the equilibrium outputs are

$$q_M^e = \frac{(n^2 + mn + 1)[a - (m^2 + mn + 2)c_M^0 + (m^2 + mn + 1)c_N^0]}{m[(m+n)^2 + 3]}$$

$$q_N^e = \frac{(m^2 + mn + 1)[a - (n^2 + mn + 2)c_N^0 + (n^2 + mn + 1)c_M^0]}{n[(m+n)^2 + 3]}$$

$$Q^e = mq_M^e + nq_N^e = \frac{[(m+n)^2 + 2]a - (n^2 + mn + 1)c_M^0 - (m^2 + mn + 1)c_N^0}{(m+n)^2 + 3}.$$

Under total symmetric equilibrium when $c_M^0 = c_N^0 = c^0$, we can rewrite the above equations as below.

$$q_M^e = \frac{n^2 + mn + 1}{m[(m+n)^2 + 3]}(a - c^0) \quad , \quad q_N^e = \frac{m^2 + mn + 1}{n[(m+n)^2 + 3]}(a - c^0)$$

$$Q^e = \frac{[(m+n)^2 + 2](a - c^0)}{(m+n)^2 + 3}.$$

Differentiating the above equations with m and n, we find

$$\frac{\partial q_M^e}{\partial m} < 0 \quad , \quad \frac{\partial q_M^e}{\partial n} > 0 \quad , \quad \frac{\partial q_N^e}{\partial m} > 0 \quad , \quad \frac{\partial q_N^e}{\partial n} < 0 \quad . \quad \frac{\partial Q^e}{\partial m} > 0 \quad , \quad \frac{\partial Q^e}{\partial n} > 0.$$

With government intervention, an increase in the number of firms has the same effect for the domestic production and total production as the case without government intervention. However, the effect for the foreign production is different, that is, an increase in the number of domestic firms increases the foreign firms' production with government intervention, while it reduces the foreign production without government intervention.

3 Without Managerial Delegation

Next, we compare the results in the previous section with the case without managerial delegation, the BS model. Setting $\lambda_{Mi} = \lambda_{Nj} = 0$, firm owners maximize their own profits and do not hire managers. Under profit maximization, we obtain the FOCs as below.

$$\frac{\partial \pi_{Mi}}{\partial q_{Mi}} = a - Q - c_{Mi} - q_{Mi} \tag{11}$$

$$\frac{\partial \pi_{Nj}}{\partial q_{Nj}} = a - Q - c_{Nj} - q_{Nj}. \tag{12}$$

Summing (11) over m firms in country M and summing (12) over n firms in country N, we can write the total output as

$$Q = \frac{(m+n)a - \sum_{i=1}^{m} c_{Mi} - \sum_{j=1}^{n} c_{Nj}}{m+n+1}.$$

Substituting the above Q into (11) and (12) yields the equilibrium outputs as below.

$$q_{Mk}^{**} = a - Q - c_{Mk} = \frac{a + \sum_{i \neq k}^{m} c_{Mi} + \sum_{j=1}^{n} c_{Nj} - (m+n)c_{Mk}}{m+n+1}$$

$$q_{Nk}^{**} = a - Q - c_{Nk} = \frac{a + \sum_{j \neq k}^{n} c_{Nj} + \sum_{i=1}^{n} c_{Mi} - (m+n)c_{Nk}}{m+n+1},$$

where the superscript $**$ represents the second-stage equilibrium without managerial delegation.

In the symmetric equilibrium, we can rewrite

$$q_M^{**} = \frac{a - (n+1)c_M + nc_N}{m+n+1} \quad , \quad q_N^{**} = \frac{a - (m+1)c_N + mc_M}{m+n+1}.$$

Comparing the second-stage equilibrium outputs with the delegation case in the previous section, we obtain

$$(q_M^{**} - q_M^{*}) \propto (1 - m - n)a + [n(m+n)^3 + m - 1]c_M + n[1 - (m+n)^3]c_N.$$

When $c_M^0 = c_N^0$, we find that $q_M^{**} < q_M^{*}$. Firms tend to expand the outputs under managerial delegation due to owners' equivalent subsidization. Further, we obtain $Q^{**} < Q^{*}$ and $p^{**} > p^{*}$.

The government optimal subsidy rates are determined by the following FOCs.

$$0 = \frac{\partial W_M}{\partial s_M} = \sum_{i=1}^{m} (p - c_{Mi}^0) \frac{\partial q_{Mi}^{**}}{\partial s_M} - \sum_{i=1}^{m} q_{Mi} \frac{\partial Q^{**}}{\partial s_M},$$

$$0 = \frac{\partial W_N}{\partial s_N} = \sum_{j=1}^{n} (p - c_{Nj}^0) \frac{\partial q_{Nj}^{**}}{\partial s_N} - \sum_{j=1}^{n} q_{Nj} \frac{\partial Q^{**}}{\partial s_N},$$

where the symmetric equilibrium yields

$$\begin{bmatrix} 2m(n+1) & n(n+1-m) \\ m(m+1-n) & 2n(m+1) \end{bmatrix} \begin{bmatrix} s_M \\ s_N \end{bmatrix} = \begin{bmatrix} (n+1-m)[a-(n+1)c_M^0+nc_N^0] \\ (m+1-n)[a-(m+1)c_N^0+mc_M^0]. \end{bmatrix}.$$

Solving for the optimal subsidy rates, we obtain

$$s_M^E = \frac{(n+1-m)[a-(m+2)c_M^0+(m+1)c_N^0}{m(3+m+n)} > 0 \tag{13}$$

$$s_N^E = \frac{(m+1-n)[a-(n+2)c_N^0+(n+1)c_M^0}{n(3+m+n)} > 0, \tag{14}$$

where the superscript E represents the first-stage equilibrium values without managerial delegation. The BS subsidy-equivalent result holds in the duopolistic competition when $m = n = 1$, that is, $s_M^E = \sigma_M^*$, $s_N^E = \sigma_N^*$ as in Wei [5]. The owners' managerial delegation plays the same role as the governments' strategic subsidies in the BS model. However, when $m > 1$ and $n > 1$, the equilibrium values are different and the difference is dependent on the number of firms. Comparing (13) with (7), we have the following result under symmetric costs.

$$s_M^E - \sigma_M^* = \frac{1+2m-2m^3+n+n^2+n^3-m^2(1+3n)}{m(3+m+n)(1+m^2+2mn+n^2)}(a-c^0),$$

which can be either positive or negative, depending on the numerator. Defining $f(m,n) := 1 + 2m - 2m^3 + n + n^2 + n^3 - m^2(1+3n)$, we find that

$$\frac{\partial f(m,n)}{\partial m} = 2(1-3m^2) - 2m(1+3n) < 0$$

$$\frac{\partial f(m,n)}{\partial n} = 1 + 2n + 3n^2 - 3m^2 < 0 \qquad \text{if} \quad m > n.$$

An increase in m causes $f(m,n)$ to decrease. However, an increase in n reduces $f(m,n)$ only when $m > n$. Starting from $m = n = 1$, we find that if the number of domestic firms is larger than that of foreign firms, the equivalent owner's subsidy is always larger than *à* la Brander-Spencer subsidy, that is, $\sigma_k^* > s_k^E$ ($k = M, N$). The increase in the number of either country's firms makes this difference larger. However, if the number of foreign firms is large enough, the equivalent owner's subsidy may become smaller than that *à* la Brander-Spencer subsidy.

Further, the equilibrium outputs yield

$$q_M^E = \frac{(n+1)[a-(m+2)c_M^0+(m+1)c_N^0]}{m(3+m+n)} \quad , \quad q_N^E = \frac{(m+1)[a-(n+2)c_N^0+(n+1)c_M^0]}{m(3+m+n)}$$

$$Q^E = \frac{(m+n+2)a-(n+1)c_M^0-(m+1)c_N^0}{3+m+n}.$$

When $c_M^0 = c_N^0$, we find the same results: $\frac{\partial q_M^E}{\partial m} < 0$, $\frac{\partial q_M^E}{\partial n} > 0$, $\frac{\partial q_N^E}{\partial n} < 0$, $\frac{\partial q_N^E}{\partial m} > 0$, $\frac{\partial Q^E}{\partial m} > 0$, $\frac{\partial Q^E}{\partial n} > 0$, as in the previous section. With government intervention, the effects of the number of firms on the production are the same irrespective of whether the owners hire managers.

4 Conclusions

This note extends Wei[5] with multiple firms in both exporting countries and reexamines the implication of the separation of ownership and management with strategic trade policies in a third market. We consider the symmetric cost functions and focus on the effects of the number of firms in both exporting countries. We find that the BS subsidy-equivalent result indicated by Wei[5] is satisfied only with one firm in each exporting country. When the number of firms increases, the equivalent owner's subsidy maybe be larger or smaller than that *à* la Brander-Spencer subsidy dependent on the number of firms.

This note does not consider the strategic relationship between the individual and total production. The conjectural variation adds more strategic relationship and complicates the analysis. Further, this note does not consider the asymmetric cost functions. The symmetric assumption simplifies the analysis but has few implications on the cost difference. These are challenges for future research.

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