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Endogenous Export Subsidies and Welfare Under Domestic Cost Heterogeneity*

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Abstract

We present a model of Cournot rivalry where domestic and foreign firms compete in a third-country market, and where the domestic export subsidy is determined by lobbying. Greater domestic cost heterogeneity (a mean-preserving spread of the marginal costs of the domestic firms) means that the subsidy level, aggregate domestic output, and domestic market share will all be higher. However, the effect of heterogeneity on domestic welfare is ambiguous. From a near-symmetric initial situation, greater domestic cost-heterogeneity reduces domestic welfare if the number of domestic firms exceeds some critical value. However, when starting farther from symmetry, greater heterogeneity may raise welfare. Our results are in contrast with the no-lobbying scenario, where market share is independent of increased heterogeneity, and welfare is monotonically increasing in it.

*The order of authors is purely alphabetical. The views expressed are those of the authors and do not necessarily represent official positions of the Federal Reserve Bank of St. Louis, nor of the Federal Reserve System.

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1. Introduction

While the area of trade policy with oligopolistic industries has been widely researched, the role of lobbying in determining policy in such a setting has received relatively little attention. It is well understood, though, that actual trade policy has more to do with political economy considerations than with the welfare-enhancing rent-shifting motive normally discussed in the literature. In this regard, the literature is lagging behind other the areas of trade theory, where various trade policies have been modeled as the results of political processes, rather than of government maximization of national welfare.[1] The need to close this gap is apparent from Olsonian arguments (Olson, 1965), which would suggest that lobbying should be more prevalent in oligopolistic industries than in more-competitive ones. In such a setting, the gains from lobbying are concentrated in the hands of an especially small group, oligopolists, whereas the losses are borne by an especially large and dispersed group, taxpayers.

The question we consider is the welfare effects of lobbying when domestic firms compete with foreign firms in a third market. We augment the standard Brander and Spencer (1985) setup by allowing the subsidy to increase with domestic-firm lobbying. This follows Moore and Suranovic (1993), who find that the standard case for strategic export subsidies is weakened when rent-seeking costs are considered. The novelty of our model is that domestic firms have heterogeneous marginal costs, allowing us to examine the effect of this cost heterogeneity on the firms' lobbying efforts, and, hence, on the subsidy and welfare. Another model in which trade policy for oligopolies depends on lobbying efforts is Long and Soubeyran (1996). They analyze the relationship between cost heterogeneity and *import tariffs* when tariffs are determined by

[1]Grossman and Helpman (1994) and Levy (1997) are recent examples. See Rodrik (1995) and Magee (1994) for surveys.

domestic-firm lobbying. They find that under certain conditions, an increase in the degree of heterogeneity raises the tariff level when lobbying is non-cooperative. In the cooperative case, the relationship between the tariff level and cost heterogeneity depends on the elasticity of the slope of the demand curve.

The first link between domestic cost heterogeneity and welfare in a third-country export rivalry model is its effects on domestic output and profits. Bergstrom and Varian (1985, p. 715) show that industry output in a constant marginal cost Cournot oligopoly is independent of the distribution of the marginal costs. This implies that in an international oligopoly, a mean-preserving spread of domestic marginal costs will not affect domestic or foreign aggregate output. Nonetheless, as Long and Soubeyran (1997) demonstrate, average domestic profit is increasing in the degree of domestic cost heterogeneity, even though domestic market share is unaffected. This, in turn, means that domestic welfare rises with cost heterogeneity because of improved allocative efficiency in producing the unchanged aggregate domestic output level (recall Bergstrom and Varian, 1985). This effect holds regardless of the number of domestic firms.

The second link between welfare and domestic cost heterogeneity is through domestic lobbying efforts. When lobbying is noncooperative, and the subsidy level is determined by total lobbying expenditure, the domestic export subsidy is a public good for the domestic firms. Therefore, in equilibrium, only the lowest-cost domestic firm will expend lobbying effort.[2] If there are only two domestic firms, greater cost heterogeneity means more lobbying because less of the profit shifted from the foreign firm goes to the high-cost non-contributing firm, i.e. there is less free riding. With more than two domestic firms, it depends on whether the greater cost

[2]Panagariya and Rodrik (1993) have an analogous outcome, although their context is quite different.

heterogeneity affects costs for the dominant, lowest-cost, firm. If it does not, then the output and lobbying efforts of the dominant firm are unrelated to the degree of cost heterogeneity. On the other hand, similar to the two-domestic-firm case, a mean-preserving increase in cost heterogeneity that lowers the marginal cost of the dominant firm will lead to a higher subsidy.

The overall welfare effects of higher cost heterogeneity depend on the balance of the potential gains (allocative efficiency and the shift of profit from the foreign firm) and the potential costs (the government's subsidy outlays and the firms' rent-seeking costs). We find that when there are only two domestic firms, greater cost heterogeneity is welfare-reducing when starting from near-symmetry. Because the firms have very similar costs, for given output levels the effect of the cost dispersion is effectively zero. What tips the balance is that the positive profit-shifting effect is more than offset by the costs of the resulting expansion of the subsidy.[3] However, at the other extreme of near-monopoly, when the domestic firms have very different costs, the welfare gains from profit-shifting and allocative efficiency may dominate. Thus, with two domestic firms, the relationship between cost heterogeneity is (in general) non-monotonic.

The relationship between welfare and cost heterogeneity is more complicated when there are multiple domestic and foreign firms. First, domestic cost heterogeneity may increase without affecting the costs of the dominant domestic firm. If so, then the domestic subsidy and market share are unaffected, and welfare rises because of improved allocative efficiency. On the other hand, if a mean-preserving spread involves a cost reduction for the dominant firm, the effect of greater cost heterogeneity on welfare is ambiguous. If the number of domestic firms is sufficiently

[3]This result is transparent under linear demand. The profit shifting effect (due to a net increase in domestic output) is exactly offset by the negative effect on domestic profits due to a price reduction. The only effects that remain are the increased subsidy payments (on incremental output) and rent-seeking costs.

large, welfare falls starting from a near-symmetric situation because there is little profit to be shifted from the relatively few foreign firms. Also, from near-symmetry, the allocative efficiency effects are small, so there is a greater likelihood of a negative welfare effect from the adverse effects of rent-seeking. Conversely, starting from a high level of heterogeneity and a relatively large number of foreign firms, welfare is likely to rise in response to a mean-preserving spread.

2. The Model and Analysis

First consider the effects of domestic cost heterogeneity in the absence of lobbying. Suppose there are two domestic firms, 1 and 2, and a foreign firm, 3, competing in a third-country market.[4] Let the firms produce outputs q_i at constant marginal costs c_i. Inverse demand is:

$$p = p(Q),\ Q = q_1 + q_2 + q_3. \tag{1}$$

The profit of firm-i is B^i:

$$B^i = (p - c_i)q_i,\ i=1,2,3. \tag{2}$$

The firms' first order conditions are:

$$p - c_i + q_i p' = 0. \tag{3}$$

As Bergstrom and Varian (1985) point out: (i). adding these first order conditions implies that Q is a function of the sum of all marginal costs; and, (ii) $dq_i = (1/p')dc_i$, where the sum of all marginal costs is constant.[5] This implies that:

$$d(q_1 + q_2) = (1/p')d(c_1 + c_2). \tag{3'}$$

Thus, aggregate domestic output (and market share) is a function only of aggregate domestic

[4]Section-3 of the paper extends the analysis to the multi-firm case where there are n domestic and m foreign firms. The important findings of the current section are generally supported, although some interesting new possibilities arise in the multi-firm case.

[5]Throughout the paper we assume that foreign marginal costs are constant. Thus, when we have a domestic mean-preserving spread, it also implies that the sum of all (domestic and foreign) marginal costs is constant.

costs, and is independent of domestic cost heterogeneity.

Domestic welfare W is the sum of the profits of the domestic firms, and, following Long and Soubeyran (1997, page-210), it is clear that W is an increasing function of domestic cost heterogeneity (given a constant mean of domestic costs). We show below that if subsidies are determined endogenously, then the effects of an increase in cost heterogeneity on market share and welfare can be strikingly different from this.

We introduce lobbying into the model with a modified version of the Moore and Suranovic (1993) model. Let L_i be the lobbying effort of firm i, w be the exogenously given price of lobbying effort, and F be the level of subsidy in the home country. The foreign nation is assumed to be committed to free trade. The lobbying effort and output levels are chosen simultaneously. The subsidy level is a function of the total amount of lobbying effort by the domestic firms:

$$F = F(L_1+L_2),\ F_N > 0,\ F_O < 0. \tag{4}$$

The profits of the firms when there are domestic lobbying opportunities are:

$$B^i = \{p - c_i + F(.)\}q_i - wL_i,\ i=1,2. \tag{5}$$

$$B^3 = (p-c_3)q_3. \tag{6}$$

2.1 *Non-Cooperative Lobbying*

The first order condition of the foreign firm's profit maximization yields:[6]

$$p-c_3 + q_3 p_N = 0 \Rightarrow q_3 = q_3(q_1+q_2, c_3),\ \partial q_3/\partial(q_1+q_2) = q_{3.} = -(p_N+q_3 p_O)/(2p_N+q_3 p_O) < 0. \tag{7}$$

The first order conditions of the domestic firms are:

$$p - c_i + F + q_i p_N = 0,\ i=1,2. \tag{8}$$

$$q_i F_N - w \# 0,\ i=1,2. \tag{9}$$

[6]We will make the standard assumption that for all firms marginal revenue diminishes in another firm's output level. That is: $p_N + q_i p_O < 0$.

Using (8) and taking the difference of the first order conditions of the two domestic firms, it is easy to see that q_1 exceeds q_2 if 1 is the low-cost firm. If $q_1 F'(N)$ equals w, then $q_2 F'(N)$ must be less than w, meaning that (9) is binding only for the low-cost firm. Therefore, in equilibrium, firm-2, the high-cost firm, will not lobby at all. This outcome is similar to a Panagariya-Rodrik (1993) type free riding equilibrium, where a uniform tariff generates free riding by industries which have lower marginal benefit from protection compared to the industry that lobbies in equilibrium. The similarity between our context and theirs is in the public good aspect of the subsidy, which arises because the subsidy is common to all domestic firms in the industry.

Using (9) and suppressing w:

$$q_1 F'(L_1) = w \;\Rightarrow\; L_1 = L_1(q_1),\; L_{1q} = -F'(q_1 F'') > 0. \tag{10}$$

(7), (8) and (10) are four equations in the three output levels and the level of the lobbying effort L_1. The solution to this system yields the endogenous variables as functions of the marginal costs and w. We will suppress w and c_3 in the rest of the analysis, and focus on the effects of a mean-preserving spread of c_1 and c_2 on the lobbying effort, subsidy level, and domestic welfare.

Using (7), (10), and the first order condition of firm 2 in (8):

$$q_2 = q_2(q_1, c_2);\; q_{21} = \partial q_2/\partial q_1 = -\{(p'(N)+q_2 p''(N))(1+q_3) + F'(N)L_{1q}\}/D_1,\; q_{2c} = \partial q_2/\partial c_2 = 1/D_1 < 0,$$

$$\text{where, } D_1 = p'(N) + (p'(N)+q_2 p''(N))(1+q_3) < 0. \tag{11}$$

Using (7), (11) and the first order condition of firm 1 in (8):

$$q_1 = q_1(c_1,c_2),\; q_{11} = \partial q_1/\partial c_1 = 1/D_2,\; q_{12} = \partial q_1/\partial c_2 = -(p'(N)+q_1 p''(N))(1+q_3)q_{2c}/D_2,\; D_2 = (p'(N)+$$

$$F'(N)L_{1q}) + (p'(N)+q_1 p''(N))(1+q_3)(1+q_{21}). \tag{12}$$

Now consider a mean-preserving spread in the domestic firms' costs ($dc_1 = -dc_2 < 0$):

$$dq_1 = \{1+(p'(N)+q_1 p''(N))(1+q_3)q_{2c}\}q_{11}dc_1 > 0 \text{ if } q_{11}<0 \text{ (i.e., } D_2<0). \tag{13}$$

The second order condition for firm 1 requires that:

$$B^1_{qq}.B^1_{LL}-(B^1_{qL})^2 = (2p\Lambda-q_1p\Omega)q_1F\Omega - (F\Lambda)^2 > 0 \;\Upsilon\; 2p\Lambda-q_1p\Omega + F\Lambda L_{1q} < 0. \qquad (14)$$

A sufficient condition for (14) to be satisfied is $(p\Lambda-F\Lambda L_{1q}) < 0$. This is ensured by diagonal dominance, where the own effect of q_1 on firm 1's marginal profit (i.e., $2p\Lambda-q_1p\Omega+ F\Lambda L_{1q}$, incorporating the effect of q_1 on F) dominates the cross effect from a rise in q_2 (i.e., $p\Lambda-q_1p\Omega$). We will assume that this condition holds which also ensures that D_2 is negative.[7] Thus, (13) implies that a mean-preserving spread must raise output of firm 1. From (10), the lobbying of firm 1 rises, and, as a consequence, the subsidy rises.

Proposition-1

A mean-preserving spread of domestic marginal costs raises the level of lobbying, the export subsidy, and domestic market share.

Proof and Comment

The first part of the proof follows from the discussion above. In addition, note that summing (8) for the two domestic firms and using (7), we get:

$$2p(q_1+q_2+q_3(q_1+q_2)) - (c_1+c_2) + 2F + p\Lambda(.)(q_1+q_2) = 0. \qquad (8\Lambda)$$

Thus, (q_1+q_2) must rise with F in response to a mean-preserving spread. As firm 1's marginal cost falls and that of firm 2 rises, firm 1's output expands. The increase in the output of firm 1 raises its marginal benefit from lobbying. Consequently, lobbying and the subsidy level increase. Firm 2's output contracts due to its cost increase. Without endogenous subsidies, this contraction would exactly offset the expansion of firm 1, and the mean-preserving spread would have no effect on domestic market share. However, due to lobbying and the associated expansion in the

[7]Although the diagonal dominance condition is sufficient, it is not necessary to establish the negativity of D_2 and therefore proposition-1. For example, with linear demand, the second order condition of firm-1's profit maximization implies that D_2 is negative regardless of diagonal dominance.

subsidy, which is also paid to firm 2, the contraction in q_2 is lower. Therefore, overall domestic output rises. Of course, (7) implies that the foreign output must fall, further ensuring a higher domestic market share. Although our contexts are quite different, our proposition supports and complements Long and Soubeyran (1996), who find that increased cost heterogeneity tends to raise the level of lobbying in an import competition model.

2.2 *Welfare Analysis*

This sub-section explores the effect of lobbying and domestic cost heterogeneity on domestic welfare. Welfare is the sum of profits earned by the domestic firms from exporting, net of the costs of the subsidy to taxpayers:

$$W = B^1 + B^2 - F(q_1+q_2) = (p-c_1)q_1 + (p-c_2)q_2 - wL_1(q_1). \tag{15}$$

Totally differentiating and using (7) and (8):

$$dW = \{pN\theta_{13.}(q_1+q_2) + q_2pN - F - wL_{1q}\}dq_1 + \{pN\theta_{13.}(q_1+q_2) + q_1pN - F\}dq_2$$
$$- q_1dc_1 - q_2dc_{2.} \tag{16}$$

It is useful to interpret (16). The term $pN\theta_{13.}(q_1+q_2)$ is the aggregate profit shifting gains (or losses) for the domestic firms from the expansion or contraction of domestic firm i (i=1,2). The term q_ipN measures the loss to firm i when domestic firm j expands. The costs of subsidy expansion to the marginal unit (of q_1 or q_2) are measured by -F, and $-wL_{1q}$ measures the increased resource cost of lobbying due to expansion of firm 1. Finally, q_idc_i (i=1,2) measures the efficiency effects of changes in c_i.

Using (11) to solve for dq_2, and substituting for it in (16), we obtain:

$$dW = [\{pN\theta_{13.}(q_1 + q_2) + q_2pN - F - wL_{1q}\} + q_{21}\{pN\theta_{13.}(q_1 + q_2) + q_1pN - F\}]dq_1$$
$$+ \{pN\theta_{13.}(q_1 + q_2) + q_1pN - F\}q_{2c}dc_2 - q_1dc_1 - q_2dc_2. \tag{17}$$

In a near symmetric situation (i.e., $c_2 \approx c_1$, $q_2 \approx q_1 = \bar{q}$), and using a mean-preserving spread ($dc_2 =$

$-dc_1 > 0$), it can be shown that $dW/dc_2 < 0$, if demand is linear or strictly convex. If demand is strictly concave, dW/dc_2 can still be shown to be negative as long as the foreign firm's market share is less than half.[8] Inspection of the firms' first order conditions reveals that this must be the case if the foreign marginal cost is not too small relative to domestic marginal costs. For tractability we analyze the non-symmetric case using linear demand. Using (13) to substitute for dq_1 and using a mean-preserving spread, we obtain from (17):

$$dW = 2[\{(L_{1q}/pN)(wpN - FFN)/(2pN + FNL_{1q})\} + (q_1 - q_2)]dc_2. \tag{18}$$

Using (8):

$$q_1 - q_2 = (c_1 - c_2)/pN \tag{19}$$

(18) and (19) imply that:

$$dW = 2[\{(L_{1q}/pN)(wpN - FFN)/(2pN + FNL_{1q})\} + \{(c_1 - c_2)/pN\}]dc_2. \tag{20}$$

We already know that in the near-symmetric case dW/dc_2 must be negative (this is captured here by the first term of (20), which is strictly negative). Expression (20) suggests that if the cost difference between the two domestic firms is large, then the second term may dominate the first, and the welfare effect may be positive.

<u>Proposition-2</u>

For near-symmetry between the domestic firms, a mean-preserving spread must reduce welfare. For large cost asymmetry, the effect of the mean-preserving spread on welfare is ambiguous.

<u>Proof and Comment</u>

The discussion following (17) establishes the near-symmetric result. Expression (20) and Figure-1 at the end of the paper establishes the second part of the proposition.[9] This result is an

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[8]Proof of the negativity of the welfare effect dW/dc_2 is available from authors on request.

[9]To establish the second part of proposition-2 it is necessary to provide a counterexample where W rises with cost heterogeneity. Figure-1 provides such a numerical example (solved with

interesting complement to the existing literature on the effects of cost heterogeneity on domestic welfare. At the beginning of section-2 we argued that in the absence of lobbying, domestic welfare is an increasing function of domestic cost heterogeneity. Here we find a contrasting result which we explain below. If the firms are near-symmetric and demand is linear, then, as c_2 rises and c_1 falls, the aggregate profit- shifting gain from the expansion of firm-1 are exactly offset by the negative effect of price reduction on firm-2 (i.e., $pN_{q3.}(q_1+q_2)$ 6 $-pN_{qi}$). Also, the efficiency enhancement of firm 1 (i.e., q_1dc_1) is offset by the efficiency reduction of firm 2. Therefore, in the limit, (16) reduces to:

$$dW = -Fd(q_1+q_2) - wL_{1q}dq_1. \qquad (16N)$$

Using proposition-1, we know that (q_1+q_2) as well as q_1 must rise with a mean-preserving spread. The first term in (16N) captures the subsidy costs of domestic output expansion not justified by any net gains in aggregate domestic profit. The second term is the resource cost of increased lobbying by firm 1, which can now internalize more of the gains from lobbying. Consider at the other extreme the case of near monopoly (domestic) where q_2 tends to zero. In this case (16) reduces to:

$$dW = q_1pN_{q3.}d(q_1 + q_2) + q_1pN_{q1}dq_2 - q_1dc_1 - Fd(q_1 + q_2) - wL_{1q}dq_1. \qquad (16O)$$

The profit-shifting gain of firm 1 from the net expansion in domestic output (first term), the gain in profits of firm 1 as firm 2 contracts (second term), and the efficiency gains for firm 1 (third term) all raise domestic welfare. The negative effects on firm 2 are all scaled be a near-zero output and disappear in (16O). The subsidy expansion effects remain as in (16N) and are unambiguously negative. The final welfare effect in this extreme asymmetric case is ambiguous in

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the help of GAMS) for the case of linear demand. It shows that starting from a symmetric situation a mean-preserving spread of domestic costs reduces W up to a certain critical level of cost asymmetry. Beyond that level W rises with increasing heterogeneity.

general, and depends on the relative magnitudes of these contrasting effects.

3. Several Domestic and Foreign Firms

Now assume that there are m foreign and n domestic firms. Let the aggregate output of the foreign firms be q^*, and that of the domestic firms be q. Summing the first order conditions [see (7) above] of the m foreign firms we obtain:

$$mp(q + q^*) - \Sigma c_i^* + p\Phi(.)q^* = 0 \Rightarrow q^* = q^*(q, \Sigma c_i^*); dq^*/dq = q^*\Phi \tag{21}$$

Summing the first order conditions of the n domestic firms, and using (9) and (10):

$$n\{p(.) + F(L_1(q_1))\} - \Sigma c_i + p\Phi(.)q = 0. \tag{22}$$

Using (8), (9) and (10):[10]

$$p(q+q^*) - c_1 + F(L_1(q_1))\} + q_1p\Phi = 0 \Rightarrow q_1 = q_1(q + q^*, c_1). \tag{23}$$

Using (21), (22) and (23):

$$q = q(\Sigma c_i, \Sigma c_i^*, c_1). \tag{24}$$

<u>Case-1</u>: *A Mean-Preserving Spread in Domestic Cost with c_1 Remaining Constant.*

Expression (24) clearly shows that a mean-preserving spread cannot affect q (and in turn q^*) unless a change in c_1 is involved. Therefore, from (23) we can infer that q_1 cannot change. Using (10) we may then infer that L_1 must remain constant as well. Therefore, in contrast to proposition-1, cost heterogeneity has no effect on the endogenous subsidy. Domestic welfare and the marginal welfare effects are, respectively:

$$W = \Sigma (p - c_i)q_i - wL_1(q_1) \Rightarrow dW = \Sigma \{(p - c_i)dq_i - q_idc_i\}. \tag{25}$$

Expression (25) can be reduced to:

$$dW = - (2/p\Phi)\Sigma c_idc_i \Rightarrow dW/d(Var.c_i) = -(n/p\Phi)>0, \text{ where } Var.c_i = \Sigma (c_i-\bar{c})^2/n. \tag{26}$$

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[10]Firm-1 is assumed to be the domestic firm with the minimum cost. Thus, the same type of free riding equilibrium as in section-2 obtains in the present context.

Thus, a mean-preserving spread cannot reduce W.

<u>Case-2</u>: *A Mean-Preserving Spread in Domestic Cost with c_1 Involved in the Spread.*

Let $\tilde{q}$ be the aggregate domestic output excluding the dominant firm. From (21) and (22) we can see that $\tilde{q}$ is implicitly defined as a function of q_1 by the following relationship:[11]

$$np(q_1 + \tilde{q} + q^*(q_1+\tilde{q})) - \Sigma c_i + nF'(L_1(q_1)) + (q_1 + \tilde{q})p'(.) = 0 \;\Rightarrow\; \tilde{q} = \tilde{q}(q_1). \tag{27a}$$

$$d\tilde{q}/dq_1 = \tilde{q}' = - \{p' + nF''L_{1q} + (1+q^{*\prime})(np' + qp'')\}/\{p' + (1+q^{*\prime})(np' + qp'')\}. \tag{27b}$$

Using the function $\tilde{q}(q_1)$ in the first order condition of firm-1 we have:

$$p[q_1 + \tilde{q}(q_1) + q^*(q_1 + \tilde{q}(q_1))] - c_1 + F'(L_1(q_1)) + q_1p'(.] = 0. \tag{28a}$$

Using the implicit function theorem on this expression we obtain (28b).

$$\partial q_1/\partial c_1(\text{mean-preserving}) = 1/\{p' + F''L_{1q} + (p' + q_1p'')(1+\tilde{q}')(1+q^{*\prime})\} < 0. \tag{28b}$$

Since c_1 is the minimum among the marginal costs of the domestic firms, in the two domestic firm case this necessarily implies that a mean-preserving spread must reduce c_1. In the multi-firm case, we will still assume that a mean-preserving spread (including c_1) involves a reduction in c_1.[12] Thus, (28b) shows that q_1 must rise and from (10) we infer that lobbying and the endogenous subsidy rises as well. Using (21) and (22) it is easy to see that the rise in the subsidy must raise q, and reduce q^*. Thus, proposition-1 extends to the present context. Using the first equality in (25) above and simplifying:

$$dW = -F'dq + qdp - 2\Sigma q_idc_i + qdF' + d(q+q^*)\Sigma q_i(p' + q_ip'') - wdL_1. \tag{29}$$

Consider an initial situation of near-symmetry where $q_i \approx \hat{q}$ (for all i). Expression (29) reduces to:

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[11]We suppress Σc_i in the functional form for $\tilde{q}(.)$ because we are considering a mean-preserving spread.

[12]The implications for the cases where c_1 may rise or remain constant may be similarly derived.

$$dW/dF = -F\mu + \hat{q}[pN\mu\{n(1+q^*N) - 1\} - 1]; \qquad (30)$$

where, $\mu = dq/dF = (-n)/\{pN + (1+q^*N)(npN + qpO)\} > 0$. Since we have already established that F rises with a mean-preserving spread, a sufficient condition for welfare reduction is: $\{n(1+q^*N) - 1\}$ $ 0. This condition is equivalent to:

$$n \$ (m + 1) + \varepsilon^* R, \text{ where } R = QPO/PN \text{ and } \varepsilon^* = q^*/Q = \text{foreign market share.} \qquad (31)$$

Proposition-3

If the mean-preserving spread does not change the cost of the dominant firm, domestic lobbying, subsidy, and market share are not affected by it, and welfare must rise. If the spread reduces the cost of the dominant firm, domestic lobbying, subsidy, and domestic market share rise. Welfare falls starting from a near-symmetric situation for a sufficiently large number of domestic firms. Welfare may rise if the initial asymmetry is high.

Proof and Comment

The proof is in the discussion under cases 1 and 2 above. Recall that in case-1, the mean-preserving spread does not involve the dominant domestic firm (firm 1). Here our results are similar to Bergstrom-Varian (1985) and Long-Soubeyran (1997) in spite of the presence of lobbying. A mean-preserving spread does not affect aggregate output [recall (21) and (24)] and therefore does not affect the marginal benefit (for a given q_1) of the dominant firm. With an unchanged marginal cost, marginal profit of the dominant firm is unaffected at the initial equilibrium. Hence, firm 1's output does not change, implying that lobbying effort and the subsidy are unchanged. These in turn lead to an unchanged domestic market share and higher domestic welfare (as in Long-Soubeyran, 1997). On the other hand, this case contrasts with our proposition-1 and our case-2, as well as Long and Soubeyran (1996), where greater heterogeneity leads to a rise in the lobbying effort.

In case-2, the fall in the marginal cost of firm-1 will tend to raise its output and thus lobbying and the subsidy. This subsidy expansion encourages the other domestic firms to increase output. Thus, aggregate output rises, in contrast to Bergstrom-Varian (1985) or Long-Soubeyran (1997). Indeed, for near-symmetry between the domestic firms, a mean-preserving spread must reduce welfare if the number of domestic firms is sufficiently large. This is interesting because it contrasts with the welfare effect that one would expect because of better allocative efficiency. For near-symmetry, allocative efficiency effects are small, and what matters are the profit shifting effects and the lobbying-expansion costs. The larger the number of domestic firms the greater is the negative terms-of-trade effects of each domestic firm's expansion on the others. In contrast, a large number of foreign firms accentuates the profit shifting gains from domestic expansion, and raises the possibility of a welfare gain. Therefore, a sufficiently high number of domestic firms ensures a welfare reduction.

Finally, notice that the term $\sum q_i dc_i$ approaches zero at a near-symmetric situation (because $\sum q_i dc_i \approx \bar{q} \sum dc_i = 0$). However, this term can be significantly negative (because the cost reductions will be weighted by high output levels) if we start from a very asymmetric situation. This will help in making the welfare effect in (29) positive. Thus, proposition-2 is modified but generally supported in the multi-firm case.

4. Conclusion

This paper considers the effects of cost heterogeneity on export market rivalry, lobbying and welfare. The findings complement the previous contributions by showing that the market share and welfare effects of cost heterogeneity can be remarkably different under lobbying. Also, the initial degree of cost asymmetry is shown to be critical in driving the welfare results.

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Figure 1

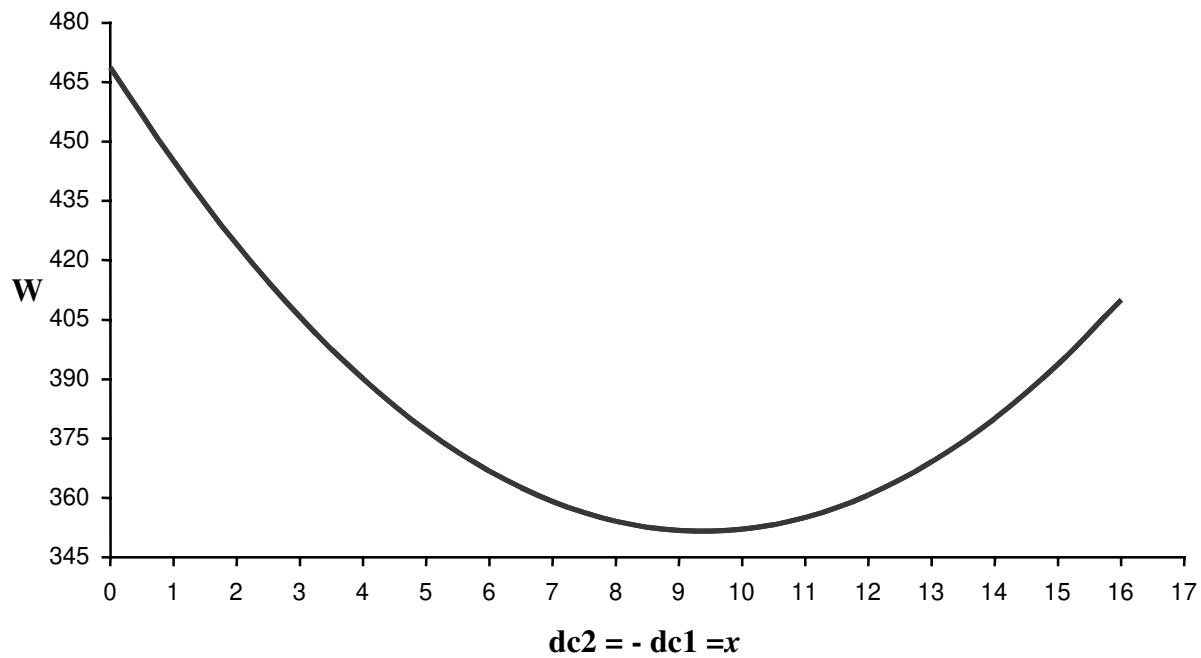

Figure 1 represents the welfare effect of a mean preserving spread for the following functions and parameter configurations:

Demand function: $p = 100 - Q$

Lobbying function: $\sigma = (L_1)^{0.5}$

Lobbying cost: $w = 1.0$

The vertical axis: W = Welfare

The horizontal axis: The origin 0 represents the symmetric case $c_1 = c_2 = c_3 = 25$. Any other point x along the horizontal axis represents the mean preserving change $c_1 = 25 - x$, $c_2 = 25 + x$, and $c_3 = 25$.