European Economic Review 42 (1998) 1443–1467

Implementing results-oriented trade policies: The case of the US–Japanese auto parts dispute

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Received 1 July 1996; accepted 7 July 1997

Abstract

Why would the US threaten punitive tariffs on luxury autos to implement a market share target in auto parts? We show that by making threats to a *linked* market, a market share target may be implemented with fairly weak informational and administrative requirements. Moreover, such policies can be both pro-competitive and advantageous to US firms.

JEL classification: F13

Keywords: Market access; Linked markets; Oligopoly

1. Introduction

On 28 June 1995, just 12 hours before the threat of punitive sanctions on Japanese automobiles was to become effective, an impending trade war between the US and Japan was averted. The threat of punitive tariffs seemed to play a central role in the US bargaining strategy and was specifically mentioned by

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0014-2921/98/$ – see front matter
PII S0014-2921(97)00091-3

President Clinton in explaining how an eventual compromise was reached.[1] The nature of the US threats is somewhat paradoxical in that they did not directly affect the market over which the dispute was centered. The US intended to place prohibitively high tariffs on Japanese luxury automobiles if Japan did not agree to market share targets in its auto parts industry.[2] Thus, the US did not threaten any action directly against the market over which the trade dispute was centered; rather, they threatened a related market which would indirectly impact the auto parts industry in Japan.

An obvious question, then, is whether the threat of punitive tariffs on Japanese auto manufacturers (who purchase auto parts in Japan) is sufficient to implement the market share target. More broadly, if the US wishes to achieve the target (in auto parts) without any help (or hindrance) from the Japanese government, what policy or set of policies should it adopt? This paper addresses these two questions by developing a model which highlights the *linkages* between markets and finds, somewhat surprisingly, that the credible threat of punitive tariffs on automobile producers, who purchase goods in the auto parts market, is sufficient to implement the market share policy. In contrast to other mechanisms which require that governments carefully choose their policies to exactly attain a desired outcome, this policy requires relatively little information on the part of the US government. That is, the government need only make a sufficiently large threat to attain the desired outcome. The advantages of utilizing such a mechanism in practice are obvious.

The role of threats in trade policy is not limited to the recent US–Japanese trade dispute. The US has routinely publicly threatened to revoke China's most favored nation status if it failed to curb intellectual property rights abuses in its markets. The US has also threatened France with a wide range of punitive sanctions if it failed to open its agricultural markets to US goods. The common factor in all of these cases seems to be that the US has been trying to effect some type of voluntary import expansion (VIE) policy in China, Japan, and France by means of threats in linked markets. Notice that the US has always made its threats very public, perhaps as a commitment device, so that they would be credible to the affected nations; however, in all of these cases, the need to actually impose punitive sanctions was averted and the parties came to some agreement.

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[1] See The Economist (1995a, b, c). Specifically, Clinton said, "After 20 months of negotiations, I ordered my trade representative, Ambassador Kantor, to impose sanctions on Japan unless it agreed to open these markets. Today Japan has agreed that it will truly open its auto and auto parts arkets to American companies" (The Economist, 1995d).

[2] Levinsohn (1996) suggests that this policy would extensively reduce the profits of Japanese producers, concluding that the threat of these tariffs led to the negotiated agreement in auto parts. In contrast, we argue that the threat itself could be sufficient to generate *voluntary* compliance with market share targets in auto parts.

In the parlance of international trade, the market share or quantity targets[3] discussed above represent a *results-oriented trade policy*; i.e. a policy whose measure is in terms of market outcomes rather than in the power of the tools used in the implementation. For example, a conventional trade policy might call for an $x\%$ tariff on some good, which might be anticipated to result in an $\alpha\%$ market share for some country in the market for the good. A results-oriented trade policy would specify the market share target only, and leave the implementation to the discretion of the countries entering into the agreement. The details of the implementation, however, can significantly impact the distribution of gains and losses among those affected. The advantages of the use of threats to linked markets are threefold. First, such threats result in self-enforcing agreements; i.e. even without the ability to directly intervene in the market being targeted, effective control may still be exercised. Second, while many market share restrictions tend to act as facilitating practices, our scheme may actually encourage competition. Finally, this scheme does not allow the implementation procedure to be chosen in a way which facilitates Japanese interests at the expense of US firms.

Strategic manipulation by the government whose markets are directly affected by the results-oriented policy has been formally modeled in several applications. Krishna et al. (working paper) consider the case where the affected market is imperfectly competitive. Analogous to the results of Gruenspecht (1988) and Carmichael (1987), Krishna et al. find that the effects of such policies depend crucially upon the timing of the government policy rule. Greaney (1993) also considers an imperfectly competitive market where firms compete variously in price or quantity. She finds the optimal policies depend crucially upon the specification of the firms' strategy space; however, under both her specifications, the implementation of a VIE results in reduced competition among the firms.

In contrast to these papers, which mainly examine how imposition of market share targets might be achieved through tariffs, subsidies and the like which affect the targeted market directly, our scheme considers imposition via threats in a *linked* market. As an illustration, consider the link between the market for auto parts and that for automobiles themselves. We examine the effect of threats to impose tariffs in the *automobile market* on the behavior of firms in the *auto parts market* (who sell to the auto market). We show that the threat of tariffs in the auto market is sufficient to induce the competitors in the auto parts market to adhere to the market share requirement. Two elements are crucial to this result: First, the markets must be linked so that threats in the auto market indirectly affect the auto parts market. Second, the *threats* must be sufficiently

[3] The particular market share policy has been dubbed a voluntary import expansion, or VIE by Bhagwati (1987).

unpleasant and credible[4] that the competitors in the parts market prefer to abide by the target rather than compete in the usual fashion and suffer the tariffs. The threat must be potentially damaging to the firms which would ultimately benefit from the market share target; for example, the US auto parts firms in the dispute with Japan. If the execution of the threatened action actually benefits these firms, then they have incentives to behave strategically and ensure that the share target is not met. Ironically, it is the US firms which act to undermine the market share target when they are the beneficiaries of US government threats.

We consider the following model: Suppose that there are two firms, one from the US, the other from Japan, competing Cournot style in the Japanese auto parts market where the market share target is to be implemented.[5] The demand for these auto parts comes from Japanese auto manufacturers who sell in both Japan and the US. Thus, the US government can threaten to impose tariffs on Japanese auto makers if the market share target is not met. Naturally, the imposition of this tariff reduces the derived demand in the auto parts market thus creating a linkage between the two markets. We find conditions such that the threat of such a tariff leads to the implementation of the VIE as a Nash equilibrium of the game. We contrast the results obtained via credible threats with those achievable through direct intervention via production subsidies as well as with results achievable through a combination of threats and direct intervention. Finally, we examine how the minimal tariff required to implement an α% market share target varies with the number of competing firms.

The paper consists primarily of a graphical analysis of firm best response functions and equilibria induced by the use of credible threats on the part of the government. Due to the discontinuities in firm payoff functions, graphical analysis becomes advantageous in two respects: First, it makes transparent the forces impacting on the optimization decisions of the firm, and second, it makes the characterization of equilibria considerably easier than a purely mathematical treatment. Throughout, the figures used in the paper will reflect a simple linear case; however, the qualitative characteristics of the figures are robust to more general demand specifications.

The paper is organized as follows: Section 2 outlines the basic model. Section 3 characterizes the equilibrium outcome under Cournot competition. Section 4 examines how the results are affected by one-sided threats which only adversely affect some of the firms, and weak threats, which do not impose large

[4] While credibility in the sense of subgame perfection is not formally modeled in this analysis, in the auto parts example, there would be little reason not to implement the threatened tariffs. Levinsohn (1996) shows that US firms would not be affected by its imposition, and it is doubtful whether the political "losses" from disaffected Lexus owners would have any impact on Clinton's reelection prospects.

[5] Similar results are obtained if firms compete in prices. See Appendix A of Krishna and Morgan (1996).

penalties when firms do not adhere to the market share target. Section 5 compares the results of Sections 3 and 4 to direct intervention (rather than threats) on the part of both governments. Section 6 examines how the set of equilibria changes with the number and composition of competing firms. Finally, Section 7 draws conclusions. An Appendix outlines the details of calculations for the many firm case.

2. Preliminaries

Consider the interaction between two countries, H and F, and two markets, auto parts, which we denote u for the upstream market, and autos, denoted d for the downstream market. Suppose that the market for autos only exists in H and that an F company is a monopolist in this good. The parts market only exists in F with single firms from each country competing Cournot style in this market. The only demand for the u good comes from autos, which require one unit of u to produce one unit of d.[6] The parts firms are assumed to be identical[7] with constant marginal cost, c, to produce the u good. The auto producer is assumed to be able to costlessly convert a unit of u into a unit of d, and thus has a constant marginal cost equal to the price prevailing in the parts market.

The governments of the two countries agree to a results-oriented trade policy consisting of a market share target for the u good. Let α denote the agreed upon market share target. The H government can make threats such as the imposition of a tariff on the d market if the target is not met. Throughout, we assume that such threats are credible, possibly resulting from a consequent loss of reputation associated with backing down from public pronouncements.[8] The F government engages in no policies whatsoever.

The extensive form of the game is as follows: Initially, the H government publicly announces the policies which it will implement. Trade in the u market then takes places and the agreed to market share target is either met or not. If the target is not met, pre-specified sanctions are imposed by the H government on the market for d. Following this, trade takes place in the d market, and payoffs for all players are determined.[9]

[6] It is immediate that any constant input requirement production technology for transforming the u good into d will work. A one-to-one transformation is assumed for analytical convenience.

[7] The assumption of identical upstream firms is merely for analytical convenience and is not crucial to the results.

[8] We could formalize this by adding a political economy model where the voter's perception of a candidate being "weak on trade" leads to a diminution in electoral prospects.

[9] As usual, the particular policies chosen will be sensitive to the timing of the game as well as the competitive form and the strategy spaces chosen for all of the players. This example is meant to be suggestive of the types of policies likely to be employed in pursuing a results-oriented policy, rather than a fully general prescription of optimal policy implementation.

The firms in the u market face a derived demand curve based on the needs of the d firm in supplying the downstream market. The downstream monopolist will choose output to maximize profits.[10] Clearly, this is obtained by setting marginal revenue equal to the marginal cost of production, which, in this case, is simply the input price of the upstream good. Thus, the derived demand for the upstream good is given by the downstream marginal revenue curve. In the event that a tariff is imposed, the downstream firm again equates his input price to the tariff-adjusted marginal revenue curve. Consequently, this tariff-adjusted marginal revenue curve then becomes the derived demand curve for the upstream firms.

Define u_H to be the quantity supplied by the home upstream firm, and u_F to be the quantity supplied by the foreign upstream firm. Let the inverse derived demand curve facing the u firms be given by

$$p = p(u_H + u_F, 0)$$

if no tariffs are imposed, and

$$p = p(u_H + u_F, \tau)$$

if they are.

For a given $u_H + u_F$, the inverse demand curves have the property that p is decreasing in τ.[11] That is, tariffs naturally reduce the derived demand for the upstream good.

The profits of the u firm associated with country $i = \{H, F\}$ when tariffs are not imposed may then be written as

$$\pi_0^i(u_H, u_F) = (p\,(u_H + u_F, 0) - c)u_i,$$

while when tariffs are imposed, profits are given by

$$\pi_\tau^i(u_H, u_F) = (p\,(u_H + u_F, \tau) - c)u_i.$$

We assume that profit functions are concave. Note that $\pi_0^i(u_H, u_F)$ lies above $\pi_\tau^i(u_H, u_F)$, as depicted in Fig. 1. Finally, holding u_F fixed, the u_H^* which maximizes $\pi_0^H(u_H, u_F)$ is greater than that which maximizes $\pi_\tau^H(u_H, u_F)$; that is, the best response function for H firms with a tariff lies below that without a tariff. Likewise for F firms.

[10] Consistent with the timing assumption made above, we assume that the downstream monopolist takes the price of inputs as given.

[11] This is the crucial requirement, other than the second-order conditions holding, to generate the results in this section and not that the best response function shifts inwards with a tariff. Specifically, this property ensures that profits of the u firms fall with the imposition of a tariff. Provided that this property holds, our qualitiative results will not be affected by either the introduction of additional upstream or downstream firms.

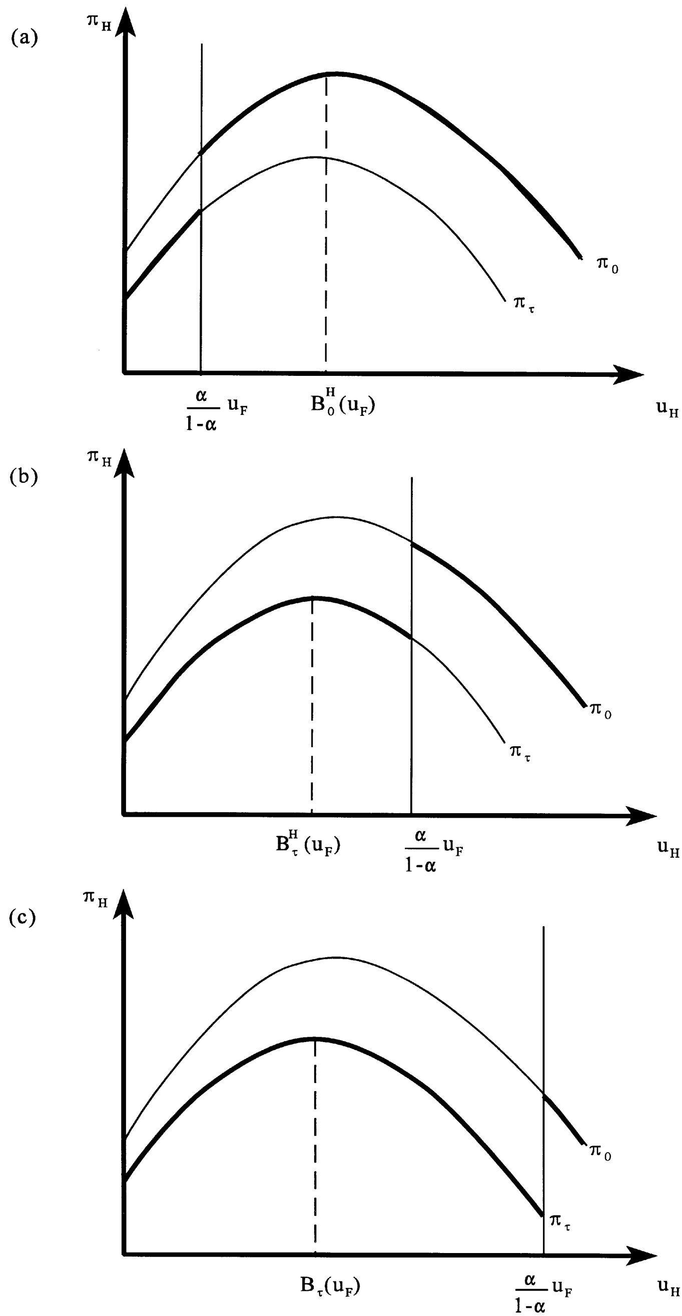

Fig. 1. Home composite profit function.

3. Equilibrium analysis

In this section, we derive the best response functions for both the H and F firms in the auto parts market. We then characterize the Nash equilibria of the subgame, given the threat strategy chosen by the US (H) government.

3.1. Home best response function

Given the output choice of the Japanese auto parts firm, the profit function of the US firm is depicted in Fig. 1a–Fig. 1c. The curve denoted π_0 denotes home's profits if the threat is not carried out; whereas, the curve π_τ denotes the profits from different quantity choices, u_H when the threatened tariffs are enacted. The market share target is $u_H/(u_H+u_F)\geq\alpha$. The vertical line at $u_H=(\alpha/(1-\alpha))u_F$ denotes the threshold level of home outputs required for the satisfaction of the market share target. Thus, the bold portions of the two profit functions define the composite profit function facing the H firm.

Let $B_0^H(u_F)$ denote the optimal output choice of the H firm, given the output choice u_F by the F firm in the event no tariffs are imposed. Similarly, let $B_\tau^H(u_F)$ be analogously defined in the event tariffs are imposed. Finally, let $\hat{B}^H(u_F)$ denote the overall best response function of the H firm.[12] There are two cases:

(i) If $B_0^H(u_F)\geq(\alpha/(1-\alpha))u_F$, then $\hat{B}^H(u_F)=B_0^H(u_F)$. This case is depicted in Fig. 1a.

(ii) If $B_0^H(u_F)<(\alpha/(1-\alpha))u_F$, then there are two possibilities. When, $\pi_0^H((\alpha/(1-\alpha))u_F,u_F)$ (weakly) exceeds $\pi_\tau^H(B_\tau^H(u_F),u_F)$, it is optimal to adhere to the market share target; hence $\hat{B}^H(u_F)=(\alpha/(1-\alpha))u_F$. This case is depicted in Fig. 1b.

Alternatively, if

$$\pi_0^H\left(\frac{\alpha}{1-\alpha}u_F,u_F\right)<\pi_\tau^H\left(B_\tau^H(u_F),u_F\right),$$

then $\hat{B}^H(u_F)=B_\tau^H(u_F)$. This case is depicted in Fig. 1c.

Let $u_F^*(\tau)$ implicitly define the u_F which solves[13]

$$\pi_0^H\left(\frac{\alpha}{1-\alpha}u_F,u_F\right)=\pi_\tau^H\left(B_\tau^H(u_F),u_F\right). \tag{1}$$

[12] Throughout the analysis, we will assume that when a firm is indifferent to two strategies, it chooses the strategy which results in the market share target being adhered to.

[13] We are assuming that the solution is unique. In the linear demand case, this holds since

$$\frac{d\pi_0^H}{du_F}<\frac{d\pi_\tau^H}{du_F}<0,$$

under case (ii). Moreover, at $B_0^H(u_F)=(\alpha/(1-\alpha))u_F$, π_0^H lies above π_τ^H; hence the solution (if one exists) is unique. We will assume analogous conditions hold for the F firm.

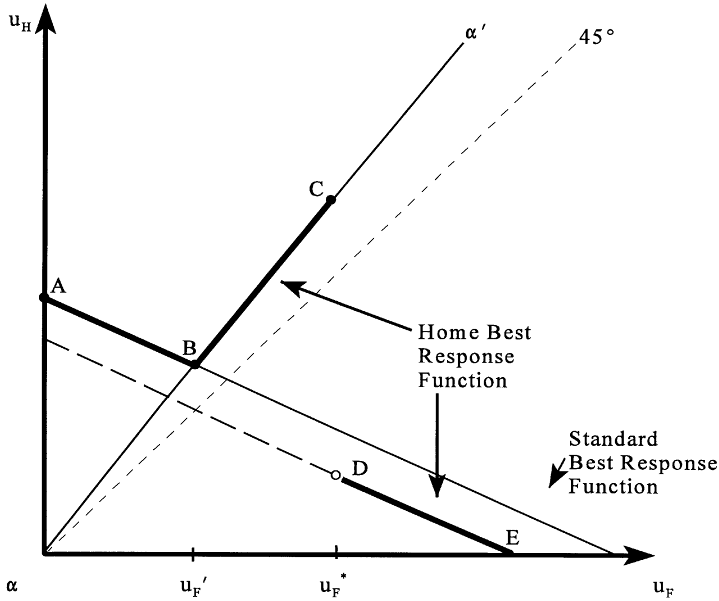

Fig. 2. Home best response function.

Then if $u_F > u_F^*(\tau)$, $\hat{B}^H(u_F) = B_\tau^H(u_F)$, and otherwise $\hat{B}^H(u_F) = (\alpha/(1-\alpha)u_F$ as depicted in Fig. 2.

Home's best response function thus consists of determining for which outputs u_F home's best response is given by Fig. 1a–Fig. 1c, respectively. The best response function for the H firm is as shown in Fig. 2. The ray $\alpha\alpha'$ and the area lying to the northwest of it represent the locus of output pairs (u_F, u_H) which satisfy the market share target. For $u_F \leq u_F'$ in Fig. 2, case (i) applies so that the best response function is given by line segment AB. For $u_F' \leq u_F$ case (ii) applies. For u_F less than u_F^*, the best response is given by line segment BC, and for u_F above u_F^*, the best response is given by line segment DE.

3.2. Foreign best response function

It remains to construct the Japanese auto parts producer's best response function. Since the market share constraint represents a minimum market share for the US firm, the Japanese firm's problem is not symmetric with the US firm's problem.

Fig. 3a–Fig. 3c reflect three cases for the foreign firm's optimization problem. All curves are identical to those of the home firm described in Fig. 1a–Fig. 1c; however, the market share constraint, $u_F = ((1-\alpha)/\alpha)u_H$ now binds in the opposite direction. That is, if the foreign firm's output lies to the left of

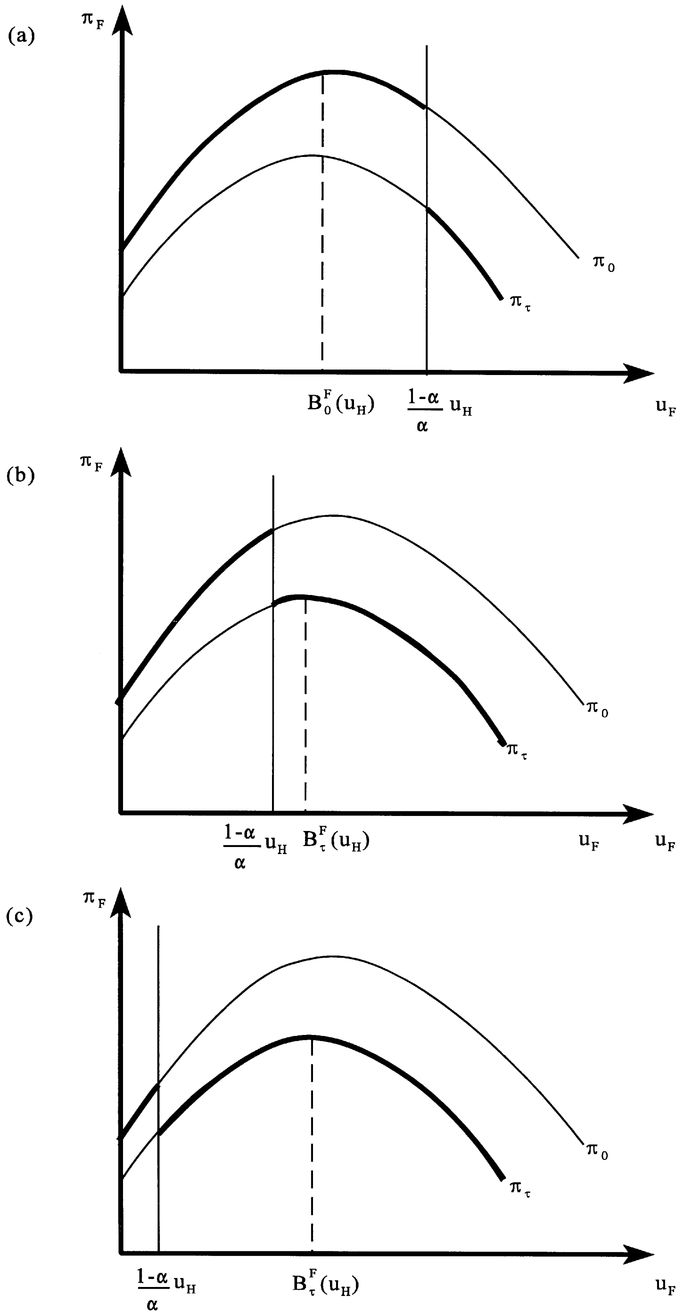

Fig. 3. Foreign composite profit function.

$((1-\alpha)\alpha)u_H$, then the market share constraint is satisfied, whereas outputs to the right violate the constraint. As in Fig. 1a–Fig. 1c, the curve denoted π_0 denotes F firm's profits if the threat is not carried out, whereas, the curve π_τ denotes the profits from different quantity choices, u_F, when the threatened tariffs are enacted.

Let $B_0^F(u_H)$ denote the optimal output choice of the F firm, given the output choice u_H by the H firm in the event no tariffs are imposed. Similarly, let $B_\tau^F(u_H)$ be analogously defined in the event tariffs are imposed. Finally, let $\hat{B}^F(u_H)$ denote the overall best response function of the F firm. There are two cases:

(i) If $B_0^F(u_H) \leq ((1-\alpha)/\alpha)u_H$, then $\hat{B}^F(u_H) = B_0^F(u_H)$. This case is depicted in Fig. 3a.

(ii) If $B_0^F(u_H) > ((1-\alpha)/\alpha)u_H$, then there are two possibilities. When, $\pi_0^F(((1-\alpha)/\alpha)u_H, u_H)$ (weakly) exceeds $\pi_\tau^F(B_\tau^F(u_H),u_H)$, it is optimal to adhere to the market share target; hence $\hat{B}^F(u_H) = ((1-\alpha)/\alpha)u_H$. This case is depicted in Fig. 3b.

Alternatively, if

$$\pi_0^F\left(\frac{1-\alpha}{\alpha}\,u_H, u_H\right) < \pi_\tau^F(B_\tau^F(u_H), u_H),$$

then it is optimal for F to choose $\hat{B}^F(u_H) = B_\tau^F(u_H)$. This case is depicted in Fig. 3c.

Let $u_H^*(\tau)$ implicitly define the u_H which solves

$$\pi_0^F\left(\frac{1-\alpha}{\alpha}\,u_H, u_H\right) = \pi_\tau^F(B_\tau^F(u_H), u_H), \tag{2}$$

then if $u_H < u_H^*(\tau)$, $\hat{B}^F(u_H) = B_\tau^F(u_H)$, and otherwise $\hat{B}^F(u_H) = ((1-\alpha)/\alpha)u_H$ as depicted in Fig. 4.

The foreign best response function thus consists of determining for which outputs u_H its best response is given by Fig. 3a–Fig. 3c, respectively. The best response function for the F firm is as shown in Fig. 4. The ray $\alpha\alpha'$ and the area lying to the northwest of it represent the locus of output pairs (u_F, u_H) which satisfy the market share target. For $u_H > u'_H$ in Fig. 4, case (i) applies so that the best response function is given by line segment AB. For $u_H \leq u'_H$ case (ii) applies. For u_H greater than u_H^*, the best response is given by line segment BC, and for u_H below u_H^*, the best response is given by line segment DE.

3.3. Nash equilibria

Fig. 5 depicts the combination of the H and F best response functions.[14] Notice that there is a continuum of Nash equilibria along line segment EF.

[14] Fig. 5 depicts the case in which the market share target is binding and the threat is sufficiently severe to rule out equilibria in which the market share target is not met. The case in which the market share target is binding but the threats are not severe is depicted in Fig. 6 discussed below. For the case in which the market share target is not binding, the introduction of the threat does not affect the equilibrium.

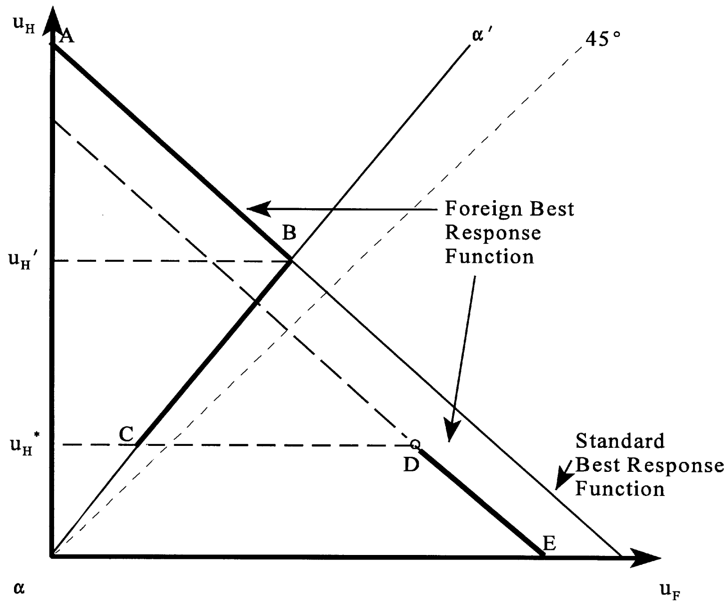

Fig. 4. Foreign best response function.

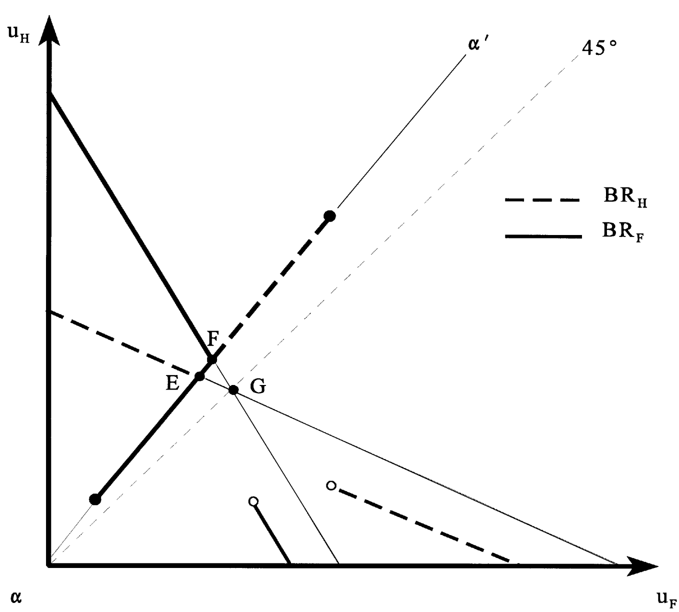

Fig. 5. Equilibrium under threats to linked markets.

Point E represents the joint profit maximizing equilibrium choice of outputs from EF. Thus, in the presence of side payments, it seems reasonable to choose point E.

In equilibrium, the threat by the H government is never carried out and the market share requirements are "voluntarily" satisfied by both firms. Comparing point E to point G, the Cournot solution in the absence of market share restrictions, shows that the total sales of auto parts fall. In addition, the H firms increases its profits as a result of the VIE since both price and H's output rise. In contrast, the F firm's profits decline as can be seen by drawing the relevant isoprofit contour.

The intuition for the nature of the equilibria is as follows: On the one hand, firms face a discrete reduction in profits by violating the market share target causing them to remain exactly on the market share line over some interval, thus permitting a continuum of equilibria to arise. On the other hand, adhering to the market share target can become too onerous, in which case firms will ignore the market share target and accept the imposition of the threatened action.

To see these two forces concretely, consider the situation facing the H firm. In the absence of the market share constraint, it will always be optimal for the H firm to reduce its output when faced with output increases by the F firm. However, the threatened tariffs induce the H firm to choose the opposite action; i.e. H must *increase* output in the face of F firm increases in order to ensure adherence to the target. Eventually, the benefits of adherence are more than offset by its costs, at which point the H firm switches to its standard best response in the presence of tariffs.

4. When threats fail

One may wonder about the limits to the effectiveness of the above policies. In particular, under what conditions are such policies likely to work in a way consistent with adherence to the market share target? We identify two potentially relevant circumstances under which the use of threats can *fail*. First, the execution of the threatened action may actually be desirable for one of the parties; we will refer to these as *one-sided threats*. Naturally, this will create incentives for one of the parties to ensure that the market share target is not met. Second, the threats may not be sufficiently severe to ensure that the market share target is met, and hence, in equilibrium, the threat will be carried out. These are termed *weak threats*.

One-sided threats are likely to be the case when Japanese and US downstream goods are close substitutes and US upstream firms stand to gain from downstream output expansion when tariffs are imposed. This could occur if there are both Japanese and US downstream firms all of whom have a strong home bias in the purchase of inputs. Then, if the introduction of tariffs leads to significant market share gains on the part of downstream US firms, US input suppliers would have positive incentives to see that upstream market share target (in Japan) was not met. This would eliminate all pure strategy equilibria where the market share target is met. In such cases, either there is a pure strategy equilibrium where the market share target is not met, or there is no pure strategy equilibrium (see Krishna and Morgan (1996) for details).

In contrast to circumstances in which both firms are hurt by the imposition of a tariff (in which case the market share target was exactly met), here, there are no regions in which the H and F firms find it mutually desirable to see that the market share target is satisfied. There are no pure strategy equilibria exactly on the market share line, since, in this case, H firms will always wish to "just miss" the target. Obviously, there are no pure strategy equilibria where the market share target is more than met, since this would involve an intersection of the no-tariff best response functions in the non-binding region. This leaves only cases in which tariffs will be imposed; hence, the only possible pure strategy equilibrium occurs at the intersection of the best response functions in the presence of a tariff.

This result is similar to Reitzes and Grawe (1994), who model the effects of the imposition of a market share quota on imports. In a Cournot market in which a market share quota is imposed at free trade levels, home firms choose to "hide behind the quota" by sometimes producing less than the free trade level of output. If foreign firms continue to produce at free trade levels, they are faced with the additional costs of violating the quota. Thus, the market share quota acts as a one-sided threat.

We now consider the case of weak threats. If threats made by the H government have little effect on the derived demand (and hence the profits) of the auto parts firms, the downward shift of the best response functions due to the imposition of the tariffs is small. This results in a case like that depicted in Fig. 6.

In Fig. 6 the two best response functions have no intersection along the market share target ray, $\alpha\alpha'$, instead, they intersect at point Z, the usual Nash equilibrium given the imposition of the tariff. Since there is little movement in the best response functions, there will be little difference between Z and the equilibrium in the absence of tariffs. Notice that this results in both firms producing smaller quantities than in the unconstrained case. Of interest is the fact that a small threat does not manage to achieve the desired market share outcome.

5. Direct implementation

Suppose now that the H government attempts to implement the VIE directly through production taxes/subsidies rather than through threats. As Krishna et al. show, the timing of the moves in this game is crucial; however, we shall

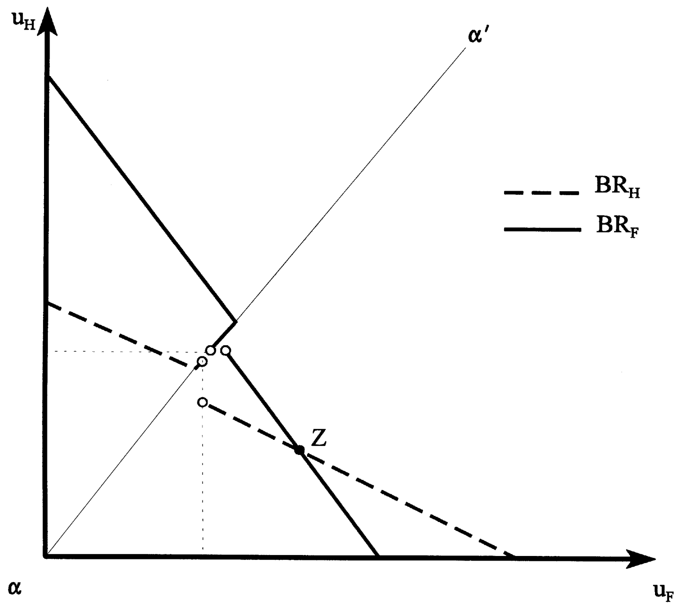

Fig. 6. Equilibrium under weak threats.

assume that the government moves first, followed by the firms. Provided that the H government was perfectly informed about all aspects of costs and demand, implementation involves choosing taxes/subsidies in such a way that the best response functions shift to a point where they exactly intersect along the $\alpha\alpha'$ line. This analysis closely parallels Greaney (1993).

In Fig. 7, we see that by introducing a production subsidy for the H firm, the H government shifts out the firm's best response function (BR_H) to BR'_H where it intersects both with the F firm's best response function (BR_F) as well as with the market share constraint ($\alpha\alpha'$). Alternatively, by introducing a tax on the F firm, we can likewise attain the market share constraint. Furthermore, combinations of the two policies make all points on EF attainable. Notice that EF in Fig. 7 is identical to EF in Fig. 5.

It seems unreasonable to suppose that the US would be able to tax the Japanese firms directly; thus, only point F in Fig. 7 would in practice be attainable through direct intervention. We earlier argued that point F resulted in lower industry profits than point E; hence, direct intervention results in lower industry profits as well as requiring considerable information for the home government to implement. For these reasons, we argue that the H government is better off relying on threats rather than direct intervention to implement the VIE.

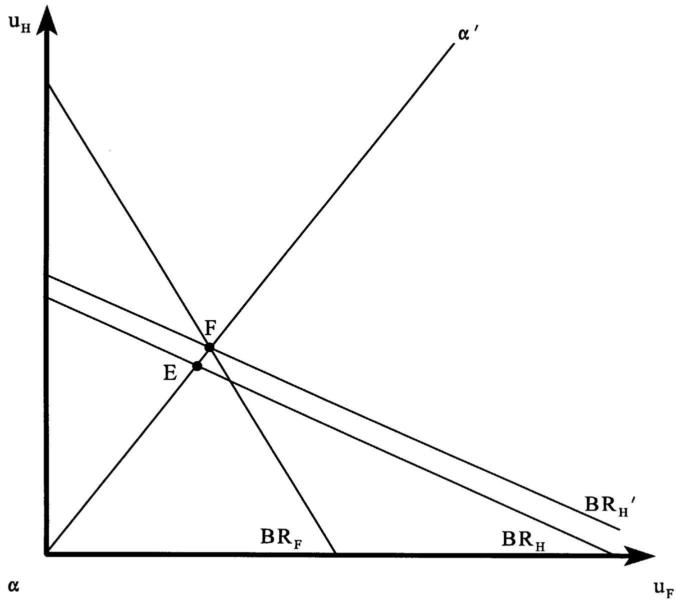

Fig. 7. Equilibrium under direct intervention.

5.1. Combining threats with direct intervention

Suppose now that we allow the H government to offer both direct incentives as well as threats as a means of achieving the market share target in the most favorable manner.

In Fig. 8, point Z corresponds to the highest attainable profits by the home auto parts firm consistent with meeting the market share target, while (due to symmetry) M corresponds to the monopoly output, which maximizes industry profits.[15] It seems natural to ask whether M or Z is implementable as a Nash equilibrium. Clearly, we cannot implement either point using threats or direct intervention (not involving taxes/subsidies on F firms) alone; however, when threats and direct intervention are combined, both, M and Z are attainable.

If the H government places a quantity tax on the home firm, then its best response function is shifted back to BR'_H. Thus, if a large enough threat is made, by our usual arguments along the lines of Fig. 5, line segment FZ represents the locus of Nash equilibrium outputs. Similarly, choosing a tax which shifts the home best response function such that it intersects with point M likewise yields

[15] In Fig. 8, we have drawn Z such that it lies above M; however, in general Z may lie above or below M. Regardless, the Z may be implemented by a combination of direct policies and threats.

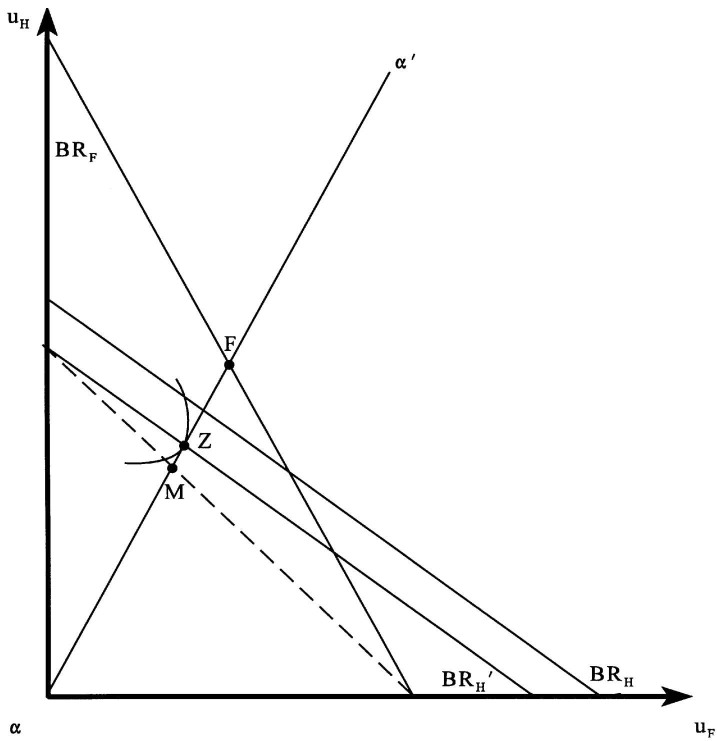

Fig. 8. Equilibrium combining threats with direct actions.

FM as the locus of Nash equilibrium outputs. Thus, a combination of threats and direct actions can be more effective than either policy alone.

The particulars of the direct intervention portion of this policy are surprising. In the case of direct intervention alone, we required a *subsidy* on the home firm; however, when both types of policies are used in combination, a *tax* on the home firm is required.[16]

6. $N \times M$ firm case

In this section, we extend the model to allow for N home firms and M foreign firms, all of whom are identical, to compete in a market subject to a market

[16] This reversal of policies relative to standard results is similar to Spencer and Jones (1991) in examining vertical foreclosure.

Table 1
Changing market shares with complete symmetry

	t	X	Y	Output	Benchmark	π_X/π^*	π_Y/π^*
$N = M = 1$							
$\alpha = 0.51$	0.0003	3.4	3.27	6.67	6.67	1.02	0.98
$\alpha = 0.6$	0.0338	4.0	2.68	6.69	6.67	1.20	0.80
$\alpha = 0.7$	0.1411	4.7	2.03	6.76	6.67	1.38	0.59
$\alpha = 0.8$	0.3448	5.5	1.38	6.90	6.67	1.54	0.39
$\alpha = 0.9$	0.7143	6.4	0.71	7.14	6.67	1.65	0.18
$N = M = 4$							
$\alpha = 0.51$	0.0001	1.1	1.09	8.89	8.89	1.02	0.98
$\alpha = 0.6$	0.0112	1.3	0.89	8.90	8.89	1.19	0.79
$\alpha = 0.7$	0.0466	1.6	0.67	8.93	8.89	1.35	0.58
$\alpha = 0.8$	0.1124	1.8	0.45	8.99	8.89	1.47	0.37
$\alpha = 0.9$	0.2273	2.0	0.23	9.09	8.89	1.51	0.17
$N = M = 8$							
$\alpha = 0.51$	0.0001	0.6	0.58	9.41	9.41	1.02	0.98
$\alpha = 0.6$	0.0059	0.7	0.47	9.42	9.41	1.18	0.79
$\alpha = 0.7$	0.0246	0.8	0.35	9.44	9.41	1.34	0.57
$\alpha = 0.8$	0.0592	0.9	0.24	9.47	9.41	1.45	0.36
$\alpha = 0.9$	0.1191	1.1	0.12	9.52	9.41	1.49	0.17

t = Minimum tariff required to implement market share target.
X = Per firm output for home country.
Y = Per firm output for foreign country.
Output = Industry output under market share requirements.
Benchmark = Industry output in the absence of market share requirements.
π_X/π^* = Ratio of home firm profits under market share requirements to benchmark.
π_Y/π^* = Ratio of foreign firm profits under market share requirements to benchmark.

share target. To retain tractability, we restrict attention to the linear demand case. Of particular interest is the minimum threat required to implement the desired market share target as the number of firms changes.

Since the details of the procedure for making this calculation are cumbersome and unenlightening, we do not present them here.[17] The basic idea is best understood by considering the duopoly case. In this case, it is clear that the minimum threat implementing the market share target is one such that the home and foreign best responses just "touch" at a point between EF in Fig. 5. Notice that this requires that both the home and foreign firms be indifferent between adhering to the market share target and accepting the imposition of the tariffs. For the home firm, this involves solving Eq. (1) to obtain $u_F^*(\tau)$ and,

[17] Details are available from the authors upon request.

Table 2
Changing market shares with asymmetries

	t	X	Y	Output	Benchmark	π_X/π^*	π_Y/π^*
$\alpha = 0.75$							
$N = 2$, $M = 2$	0.1358	3.0	1.01	8.11	8.00	1.44	0.48
$N = 3$, $M = 2$	0.0454	2.1	1.06	8.46	8.33	1.17	0.59
$N = 4$, $M = 2$	0.0137	1.6	1.08	8.66	8.57	1.07	0.71
$N = 5$, $M = 2$	0.0025	1.3	1.10	8.79	8.75	1.02	0.85
$N = 1$, $M = 2$	0.4786	5.5	0.91	7.29	7.50	2.37	0.40
$N = 1$, $M = 3$	0.6250	5.6	0.63	7.50	8.00	3.52	0.39
$N = 1$, $M = 4$	0.7235	5.7	0.48	7.63	8.33	4.88	0.41
$N = 1$, $M = 5$	0.7956	5.8	0.39	7.71	8.57	6.49	0.43
$\alpha = 0.88$							
$N = 2$, $M = 1$	0.2001	3.5	0.96	7.97	7.50	1.14	0.31
$N = 3$, $M = 1$	0.0796	2.5	1.00	8.35	8.00	1.01	0.41
$N = 4$, $M = 1$	0.0322	1.9	1.03	8.57	8.33	0.97	0.53
$N = 5$, $M = 1$	0.0117	1.5	1.05	8.72	8.57	0.96	0.66
$N = 1$, $M = 2$	0.8898	6.5	0.44	7.41	7.50	2.70	0.18
$N = 1$, $M = 3$	1.029	6.6	0.30	7.55	8.00	4.07	0.18
$N = 1$, $M = 4$	1.118	6.7	0.23	7.64	8.33	5.71	0.19
$N = 1$, $M = 5$	1.181	6.8	0.18	7.70	8.57	7.64	0.21

t = Minimum tariff required to implement market share target.
X = Per firm output for home country.
Y = Per firm output for foreign country.
Output = Industry output under market share requirements.
Benchmark = Industry output in the absence of market share requirements.
π_X/π_* = Ratio of home firm profits under market share requirements to benchmark.
π_Y/π_* = Ratio of foreign firm profits under market share requirements to benchmark.

implicitly, $u_H(u_F^*)$ along the $\alpha\alpha'$ line. In Fig. 2, this is given by point C. Likewise, the foreign firm solves Eq. (2) to obtain $u_H^*(\tau)$ and $u_F(u_H)$ along the $\alpha\alpha'$ line; this is given by point C in Fig. 4. The minimum τ, then, is such that the points C given in Figs. 2 and 4 coincide. Analogously, in the $N \times M$ case, restricting attention to symmetric equilibria enables us to follow an identical procedure.

While it is difficult to say anything in general about the properties of the solutions to this system of equations, we can examine numerical results from some simple cases. The system of equations is given by Eqs. (A.1), (A.2) and (A.3), in the appendix. We impose symmetric outputs on the home and foreign firms and consider a linear inverse demand curve of the form: $P = 10 - Q$. This reduces to a 3×3 system. The results of numerical exercises are summarized in Tables 1 and 2.

In the symmetric case, summarized in Table 1, increasing the market share target requires higher minimum threats for implementation. As expected, lower threats are needed as the number of firms increases for a given market share target. As the market share target increases, output for foreign firms falls while output for home firms rises. Industry output also rises. Moreover, industry output is larger than in the absence of market share requirements (benchmark) – a pro-competitive result! Finally, relative to the benchmark, home firm profits always increase and foreign firm profits always decrease.

In the asymmetric case, summarized in Table 2, holding fixed the total number of firms, we see that smaller threats are needed as the percentage of home firms increases. Also, industry output is increasing in the percentage of home firms. Perhaps more surprising is that industry output relative to the benchmark depends upon the composition of firms. Table 2 shows that in the event that foreign firms constitute the majority, industry output is less than the benchmark – an anti-competitive outcome. In the opposite case, industry output exceeds the benchmark – a pro-competitive result. This suggests that having a large proportion of foreign firms (domestic firms) would make the market share requirement, when implemented with the minimal tariff, anti-competitive (pro-competitive). In contrast to the symmetric case, it is possible for both home and foreign firms to gain and to lose relative to the benchmark. In Table 2, with a large proportion of home firms (i.e., $N = 4$ or $N = 5$, $M = 1$, $\alpha = 0.88$), both lose. With a large proportion of foreign firms (i.e., $N = 1$, $M = 15$, $\alpha = 0.1$), both gain.[18]

7. Conclusion

We have shown that a credible threat in a linked market can be an informationally efficient way of implementing a VIE. Moreover, the resultant equilibrium can increase industry profits and, perhaps more importantly, the profits of all firms when the proportion of foreign firms is large. On the other hand, when the proportion of foreign firms is not too large, industry output increases leading to pro-competitive results from the imposition of market share requirements. In some cases this can even reduce the profits of *both* firms.

If the threats affect the H and F firms differently, or if they are not very severe, then the resulting equilibria can change dramatically. In the former case, the H firm has incentives to slightly underproduce such that the market share target is "just" missed.[19] In the latter case, the equilibrium involves both firms accepting the tariffs and playing the Nash equilibrium associated with the derived demand curves in the presence of the tariff. Since the costs of absorbing the tariff are not too large, firms are less willing to adjust their behavior to conform with

[18] This case is not given in Table 2.

[19] See Krishna and Morgan (1996) for details.

the market share target. In the case of direct intervention, we find that the use of threat rather than direct intervention is preferred by the country whose imports the VIE is intended to expand. Moreover, a combination of threats and direct intervention appears to be superior to either policy alone.

We would not advocate the use of threats in related markets as a means of implementing *all* market share targets. The paper tries to delineate the circumstances likely to be qualitatively important to the outcome of such policies. Specifically, the relative size of home and foreign representation in the market, the restrictiveness of the market share requirements, the impact of the threat on derived demand, and the extent of home bias in downstream markets are all important factors. Nonetheless, successful implementation usually results in US firm profits rising even when industry output rises.[20] That is, threats can be simultaneously pro-competitive and advantageous to US firms.

Acknowledgements

The authors thank Eric Bond and Elhanan Helpman for their helpful comments, an anonymous referee for useful comments on an earlier draft of the paper, and Ataman Ozyildirim for his able research assistance. Research support from the National Science Foundation, grant SBR-9320825, is gratefully acknowledged by the first author.

Appendix A: The $N \times M$ case

Suppose that there are N home firms and M foreign firms competing Cournot style in a market subject to a market share target. Suppose also that the home government can make a "threat" which, if implemented, shifts back the linear demand curve which these firms face by an amount t.

We consider the simple case where inverse demand is given by

$$P = A - Q.$$

Home firms simultaneously choose quantities $x_i, i = 1, \ldots, N$. Likewise, foreign firms choose quantities $y_j, j = 1, \ldots, M$ of outputs to supply the market.

The market share target requires that the overall market share for home firms must be α% of the market. Thus, for the market share target to be met requires

$$\frac{\sum_{i=1}^{N} x_i}{\sum_{i=1}^{N} x_i + \sum_{j=1}^{M} y_j} \geq \alpha.$$

[20] These conditions only hold in cases in which the proportion of US firms is not too small.

Our task is to find the minimum amount t such that adherence to the market share target is a Nash equilibrium for the firms.

Given the actions of all other firms, if the kth home firm adheres to the market share target, then k's choice satisfies

$$\alpha = \frac{x_k + \sum_{i \neq k} x_i}{x_k + \sum_{i \neq k} x_i + \sum_{j=1}^{M} y_j},$$

or, equivalently,

$$x_k = \frac{1}{1-\alpha}\left[\alpha\left(\sum_{i \neq k} x_i + \sum_{j=1}^{M} y_j\right) - \sum_{i \neq k} x_i\right].$$

If k chooses to violate the market share target, then the quantity strategy x_k chosen is simply the conventional Cournot best response:

$$x_k = \frac{A - t - \left(\sum_{i \neq k} x_i + \sum_{j=1}^{M} y_j\right)}{2}.$$

Similarly, the lth foreign firm's choice y_l must satisfy

$$\alpha = \frac{\sum_{i=1}^{N} x_i}{\sum_{i=1}^{N} x_i + \sum_{j \neq l} y_j + y_l},$$

or, equivalently,

$$y_l = -\frac{1}{\alpha}\left[\alpha\left(\sum_{i=1}^{N} x_i + \sum_{j \neq l} y_j\right) - \sum_{i=1}^{N} x_i\right].$$

And violating the market share constraint yields

$$y_l = \frac{A - t - \left(\sum_{i=1}^{N} x_i + \sum_{j \neq l} y_j\right)}{2}.$$

Thus, it is natural to compare indirect profits of employing these two strategies to see the locus at which k (l) is indifferent.

Define $\pi^C(x, y)$ as the profits associated with conforming to the market share target given the quantity vector $x_{-k} = \sum_{i \neq k} x_i$, $y = \sum_{j=1}^{M} y_j$. Then

$$\pi^C(x_{-k}, y) = \left(A - \left(x_{-k} + y + \frac{1}{1-\alpha}\left[\alpha(x_{-k} + y) - x_{-k}\right]\right)\right) \times \left(\frac{1}{1-\alpha}\left[\alpha(x_{-k} + y) - x_{-k}\right]\right).$$

Let $\pi^D(x, y)$ be the profits from violating the market share target given the quantity vector x, y. Note

$$\pi^D(x_{-k}, y) = \left(A - t - \left(x_{-k} + y + \frac{A - t - (x_{-k} + y)}{2}\right)\right) \times \left(\frac{A - t - (x_{-k} + y)}{2}\right).$$

Thus, we seek the locus, x, y such that $\pi^C(x_{-k}, y) = \pi^D(x_{-k}, y) = \pi$ or

$$\begin{aligned}\pi &= \left(A - \left(x_{-k} + y + \frac{1}{1-\alpha}[\alpha(x_{-k} + u) - x_{-k}]\right)\right) \times \left(\frac{1}{1-\alpha}[\alpha(x_{-k} + y) - x_{-k}]\right) \\ &= \left(A - t - \left(x_{-k} + y + \frac{A - t - (x_{-k} + y)}{2}\right)\right) \times \left(\frac{A - t - (x_{-k}k + y)}{2}\right). \end{aligned} \tag{A.1}$$

Similarly, for the foreign firms, we define quantity vectors $x = \sum_{i=1}^{N} x_i$, $y_{-l} = \sum_{j \neq l} y_j$. Thus,

$$\pi^C(x, y_{-l}) = -\left(A - \left(x + y_{-l} - \frac{1}{\alpha}[\alpha(x + y_{-l}) - x]\right)\right) \times \left(\frac{1}{\alpha}[\alpha(x + y_{-l}) - x]\right)$$

are the profits of l when it conforms and

$$\pi^D(x, y_{-l}) = \left(A - t - \left(x + y_{-l} + \frac{A - t - (x + y_{-l})}{2}\right)\right) \times \left(\frac{A - t - (x + y_{-l})}{2}\right)$$

are l's profits when it deviates. Finding the locus of indifference yields

$$\begin{aligned}\pi &= -\left(A - \left(x + y_{-l} - \frac{1}{\alpha}[\alpha(x + y_{-l}) - x]\right)\right)\left(\frac{1}{\alpha}[\alpha(x + y_{-l}) - x]\right) \\ &= \left(A - t - \left(x + y_{-l} + \frac{A - t - (x + y_{-l})}{2}\right)\right) \times \left(\frac{A - t - (x + y_{-l})}{2}\right). \end{aligned} \tag{A.2}$$

Thus, to find the $N + M + 1$ unknowns for x_i, y_j, and t requires that we solve the following system of simultaneous equations.

For $k = 1, \dots, N$:

$$\left(A - \left(x_{-k} + y + \frac{1}{1-\alpha}\left[\alpha(x_{-k} + y) - x_{-k}\right]\right)\right)$$
$$\times\left(\frac{1}{1-\alpha}\left[\alpha(x_{-k} + y) - x_{-k}\right]\right)$$
$$= \left(A - t - \left(x_{-k} + y + \frac{A - t - (x_{-k} + y)}{2}\right)\right)$$
$$\times\left(\frac{A - t - (x_{-k} + y)}{2}\right).$$

For $l = 1, \dots, M$:

$$-\left(A - \left(x + y_{-l} - \frac{1}{\alpha}\left[\alpha(x + y_{-l}) - x\right]\right)\right)\left(\frac{1}{\alpha}\left[\alpha(x + y_{-l}) - x\right]\right)$$
$$= \left(A - t - \left(x + y_{-l} + \frac{A - t - (x + y_{-l})}{2}\right)\right)\left(\frac{A - t - (x + y_{-l})}{2}\right),$$

and

$$\alpha = \frac{\sum_{i=1}^{N} x_i}{\sum_{i=1}^{N} x_i + \sum_{j=1}^{M} y_j}. \tag{A.3}$$

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