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Contingent Protection, and the International Distribution of Excess Capacity

by

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Queen's University

DISCUSSION PAPER #763

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ABSTRACT

The implications of demand and cost fluctuations, both anticipated and uncertain, for the international distribution of industrial excess capacity are explored. Three partial equilibrium models of excess capacity and contingent protection policies which are correlated with distress on the part of the domestic firms are constructed. It is argued that conventional tariff-equivalent measures of protection are substantial understatements of the long run effects of contingent protection when sunk costs in the form of capacity are large. It is also argued that contingent protection exacerbates the degree of excess capacity on average in the industry, and further that anticipation of the policy 'triggers' for implementation of contingent protection fosters collusive behaviour in the industry.

JEL Classification: 131, 411, 422

Keywords: excess capacity, contingent protection, commercial policy

1. Introduction

This paper is a contribution to the growing literature on contingent protection. It focuses on the manner in which contingent protection impacts on the distribution and level of excess capacity in an international industry. Industries with large sunk costs, such as steel or automobiles, come to mind in the discussion of excess capacity problems. Countries may resort to defensive contingent protection as a policy to shift the burden of excess capacity to trading partners. At the same time the existence of mechanisms for contingent protection affect the level of investment in the form of sunk capacity by both import competing and exporting firms, through the existence of an implied "threat" in the application of the contingent protection. The "capacity" may be in the form of either physical or human capital, or both. In the case of human capital these would be jobs which were necessarily industry-specific over the relevant time horizon.

In industries with large sunk costs it is inevitable that in periods of slack demand, due either to cyclical or structural shifts, that excess capacity will emerge. International trade and the rules of international trade are an important determinant of the distribution of excess capacity across countries. In cyclical downturns, particularly in older basic industries, there is a surprising amount of excess capacity which emerges; far above the average level of reduction in aggregate demand, for example. There is also a wide variation in the experience of individual countries. Table 1 lists the measured level of excess capacity in the steel industry in nine industrial countries at the end of two recessions in 1977 and 1984. For example, in the EC9 region total excess capacity was 31 percent, with a high of 52 percent in Ireland and a low of 23.6 percent in West Germany. Obviously the benefits of exploiting comparative advantage must be balanced

against the cost (or benefits) of possible additional excess capacity caused by trade in a full welfare analysis. More to the point, however, is that mechanisms of protection in periods of slack demand affect the international distribution of excess capacity and hence the net long run costs and benefits of protection.

Table 1

Percentage Excess Capacity in Steel in 11 Industrial Regions

Country	1984 Excess Capacity	1977 Excess Capacity
United States	38.0	28.9
EC9	31.0	37.2
FRG	23.6	42.4
France	34.1	33.6
Italy	35.4	31.7
Netherlands	27.9	40.2
Belgium	27.8	41.2
Luxembourg	37.5	47.2
United Kingdom	37.0	29.1
Ireland	51.9	48.4
Denmark	35.5	38.8

Source: Tarr, 1988, Table 7.1.

In this paper it is argued first, that the level of protection offered under an administrative contingent protection mechanism measured by an ex ante expected rate of tariff equivalent protection, is a substantially biased downward measure of the true level of protection. Second, it is argued that the mechanisms of contingent protection have both anti-competitive effects (raise prices above short run marginal cost) and contribute to the level of excess capacity in the world industry.

Contingent protection is defined as protection offered on particular products in the form of quotas or tariffs, but offered only in particular contingencies, usually defined in the form of 'injury' to the import

competing firms.[1] Two characteristics of contingent protection are focused on: (i) the uncertainty attached to the protection being offered, and (ii) the administrative/legal nature of contingent protection systems which endogenizes to a considerable extent the application of contingent protection. In must countries 'contingent protection' is associated with anti-dumping law or countervail, but it would also include escape clause action in the United States, and a host of other non-tariff measures applied selectively in a wide range of countries including VER's, orderly marketing arrangements, and administration of the GSP.

While the dumping literature[2] is closest in spirit to the models in this paper, they differ in a number of ways. Most notably, this paper focuses on the sunk capacity decision, and its relation to the mechanism of contingent protection. The models used are highly stylized, and focus on those cases where sunk costs are in the form of output capacity. The models focus on segmented markets in the Home and Foreign country with two firms competing, a Home Firm and a Foreign firm, designated H and F.[3] Clearly the implied emphasis is on oligopolistic markets where indivisibilities and sunk costs create sufficient entry barriers to justify an oligopolistic market structure without free entry. Firms are assumed to be expected profit maximizers. Risk aversion and capital market imperfections are abstracted from. Most notably these assumptions eliminate any consideration of 'security of market access' or risk allocation issues in explaining firm behaviour. Secondly the

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[1] 'Contingent' or Administered Protection is discussed in De Grey (1981), Finger et.al (1982) and Harris (1987).

[2] Models attempting to explain dumping include David and McGuiness (1982), Ethier (1982), Blair and Cheng (1984), Bernhardt (1984), Hillman and Katz (1986), and Leidy and Hockman (1988).

[3] Markets are segmented if prices are set independently in each market.

analysis is partial equilibrium for the usual reasons, and with the usual qualifications.

The analysis of contingent protection in either competitive industries, with or without fixed factors, and in contestable industries, raises a number of issues not discussed in this paper. Some of these are discussed in Harris (1987). Clearly the type of industries one has in mind are oligopolistic manufacturing industries, although some resource and service industries are both oligopolistic and characterized by large sunk costs.

2. Investment in Capacity Under Uncertainty

It is convenient first to consider a monopoly model of investment in capacity under uncertainty. Consider a monopolist facing an inverse demand curve $D^s(Q)$, where $s = 1,2$ denotes two alternative states of 'nature'. State 1 will denote the high demand states. Capacity measured in units of output is denoted by k, and output in each state by q^s. Variable costs per unit of output are c, and cost per unit of capacity is r. The monopolist maximizing expected profits chooses k, q^1, q^2 to maximize

$$(1) \quad \pi\left[D^1(q^1) - c\right]q^1 + (1-\pi)\left[D^2(q^2) - c\right]q^2 - rk$$

$$\text{subject to} \quad q^s \leq k, \quad s = 1,2.$$

where π is the probability of the high demand state. The solution to this problem is given by setting marginal revenue in the high demand state, $MR^1(k)$, evaluated at capacity output equal to

$$(2) \quad MR^1(q^1) = c + \frac{r}{\pi}$$

and

$$(3) \quad MR^2(q^2) = c,$$

with $q^1 = k$. Thus capacity is fully utilized in the high demand state, and

in the low demand state output is determined by short run marginal cost. The solution is presumed to be configured as in figure 1, with excess capacity in state 2.

3. Protection Contingent on Market Demand: the Monopoly Exporter

A common application of contingent protection is in those circumstances in which, due to cyclical or structural reasons, the demand for the good in the Home market shrinks causing economic distress in the form of lost jobs or profits to Home firms in that industry.[4] Suppose the mechanism of contingent protection amounts to application of a per unit tariff of t on the Foreign firm in the event that the demand state is low, s = 2, and otherwise no protection is offered (i.e. in the high demand state).

It is useful to begin by abstracting from competition and look at the monopoly exporting firm's problem. In the low demand state the first order condition changes to

$$(4) \quad MR^2(q^2) = c + t,$$

otherwise the condition determining capacity, (2) remains unchanged. Hence in this model, given that protection reduces demand only in the low demand state,

the level of capacity invested in exporting to the Home country by the Foreign monopoly exporter is unaffected by the level of protection given in the low demand state.

This is obviously a contrived situation without import competing firms, but it is useful to think about the impact this type of protection has on the

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[4]It is assumed throughout this paper that protection is correlated with "distress" on part of the Home firm.

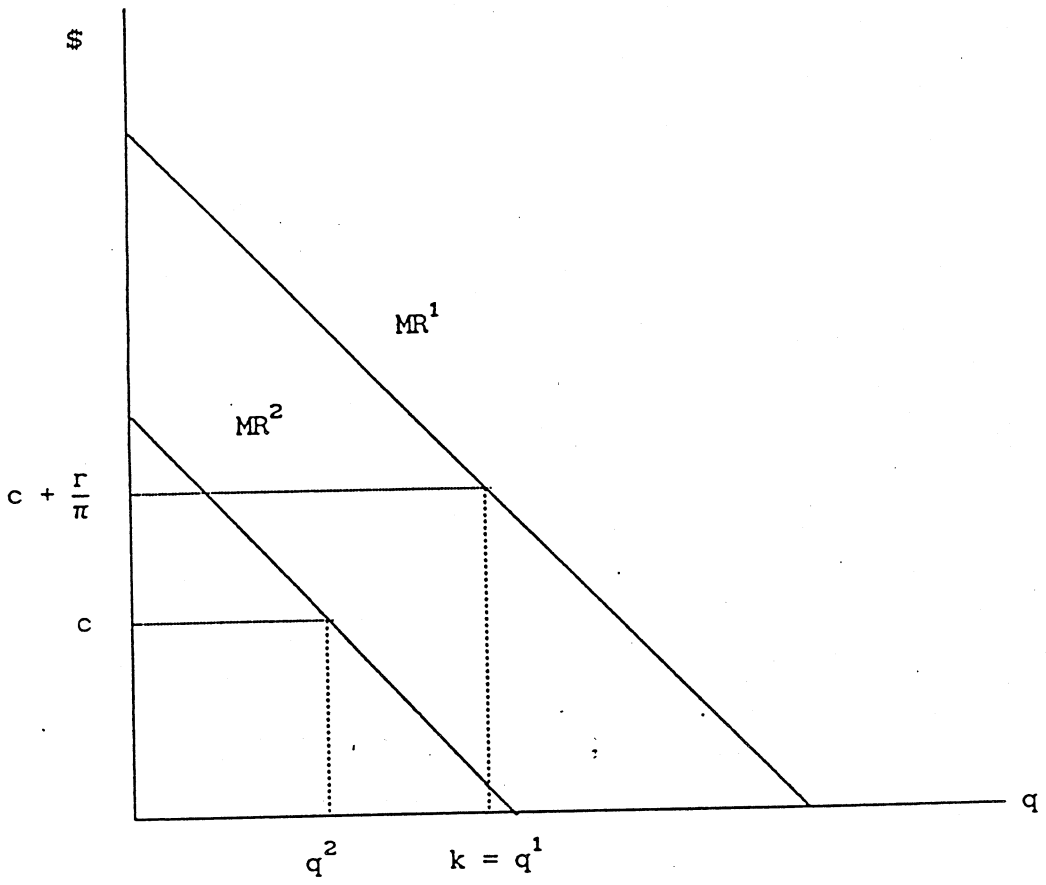

Figure 1

Determining capacity and output with random demand.

Foreign exporter. The main impact is reduction in output in low demand states, and an increase in excess capacity. Total sunk costs denoted by S = rk are unaffected. In terms of constructing a permanent tariff equivalent estimate of this type of protection, one approach would be to estimate the increase in expected average costs of the exporter due to the imposition of the contingent protection scheme. Let q_t^2 be the output in the event of contingent tariff t in the low demand state, and if t=0 simply denote output by q^2. Define expected average cost under the two regimes as

$$(5) \quad AC = \pi\left(c + S/q^1\right) + \left(1-\pi\right)\left(c + S/q^2\right)$$

$$(6) \quad AC_t = \pi\left(c + S/q^1\right) + \left(1-\pi\right)\left(c + S/q_t^2\right)$$

A simple measure of the ex ante cost disadvantage imposed on the Foreign firm subject to the protection is given by the ratio of AC_t/AC. The larger sunk costs the more distinct this disadvantage will be. With an isoelastic demand curve, with elasticity = -1, a 50% reduction in output in the low demand state due to protection could be achieved by a contingent tariff equal to approximately 33% on an ad valorem basis imposed in the low demand state. Taking parameter values of S = 2000, π = 2/3, c = 1.00, q^1 = 1000, q^2 = 600, and q_t^2 = 300 gives a cost disadvantage ratio of AC_t/AC = 1.326. This means that foreign costs are 32.6 percent higher than a domestic based firm with the same factor prices would have. This figure, therefore, measures either the extent to which Home costs could rise relative to Foreign, but with Home remaining the least cost supplier in the Home market, or the extent to which Foreign profits would rise by relocating production to the Home country if costs were similar across countries. Note the *expected tariff*, t*, which is a measure proposed in some studies, is given by

(7) $t^* = (1-\pi)0.33 = 0.11.$

This is substantially less than the measure of cost increase used above. Weighting the tariffs by output in the two states is of little help. The problem is that with short run decreasing costs, as a consequence of the fixed factors, the contingent tariffs substantially raise the ex ante costs of the importing firm. This cost increasing effect is quite different than in the usual competitive model where we associate reductions in output with a decrease in costs. This example illustrates the quantitative impact of adjusting tariff equivalent measures of contingent protection schemes in the presence of significant sunk costs.

4. Duopoly

We now introduce the more realistic assumption of competition between a home firm, designated with the subscript H, and a foreign firm F, both competing in the Home market. With 'injury based' tests for administered protection, it is natural to consider protection contingent on low demand states. Injury based on loss of employment or profitability is easily identified and possibly acted upon. For simplicity we assume both firms have identical costs. Firms choose capacity and state dependent outputs in a sequential Nash equilibrium. Hence both firms choose (k_H, k_F) prior to opening the market and then, depending upon the state realized, choose (q_H^s, q_F^s), s=1,2 in a Cournot quantity competition. The details of calculating this type of equilibrium are routine. Solving by backward induction we end up with the following conditions determining capacities, realizing that the capacity constraints for both firms bind, only in state s=1, and hence

$$q_n^1 = k_n^1, \quad n = H,F, \quad \text{so}$$

$$(8) \quad MR_H^1(k_H, k_F) = c + \frac{r}{\pi},$$

with a similar condition for Foreign. The Marginal revenue functions are defined relative to the assumption of Cournot-Nash quantity competition and are given by the usual form: $MR_H(q_H, q_F) = D'(q_F+q_H)q_H + D(q_H+q_F)$.

What is the impact of demand-dependent protection afforded the Home firm? By levying a per unit tariff on t on the Foreign firm in low demand states the ex post state 2 Cournot-Nash equilibrium shifts in the usual way, with the increase in short run marginal costs of F to c+t, while Home's costs remain at c. For given capacities this causes a reduction in F's output and hence an increase in excess capacity, and likewise an increase in the output of H's output, and decrease in excess capacity. Hence

> *the capacity decisions of both firms are unaffected by the level of protection given in the low demand states, but in low demand states the degree of excess capacity of the Home firm is reduced, and the degree of excess capacity in the Foreign firm is increased.*

There are some interesting boundary problems in this model.[5] If the state 2 tariff is sufficiently high, it could actually induce the Home firm to produce at capacity in both periods. This will occur for example if the tariff affords the Home firm a monopoly position in the low demand state, and conditional on this it pays to operate in both states with the same level of

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[5] It would be easy to set the model up so that pricing by F in its own market and in Home would trigger dumping actions. Thus when F's costs are low its price in the Home market is less than in F's own home market, based on differences in demand elasticities, the usual price definition of dumping would be satisfied.

output. Another case would be if the initial situation was such that equilibrium was characterized by no excess capacity in either state, then levying a state 2 tariff may induce excess capacity as an equilibrium outcome.

Define world excess capacity as

$$(9) \quad E = k_H + k_F - (q_H + q_F).$$

In the low demand state E is positive. It is straightforward to show that starting from a symmetric equilibrium, a contingent tariff on the Foreign firm reduces total output, $q_H + q_F$. Hence

A contingent tariff mechanism increases the degree of world excess capacity relative to a no protection symmetric equilibrium.

5. A Two-Country Model

Extending these results to an explicit two-country framework raises issues regarding spillover between countries. A useful simplification is to think of two possible demand states in each country (H,L) and thus *four* possible states of the world, (H,H) (L,L) (H,L) (L,H). Under free trade capacity levels are determined by the (H,H) state – high demand in both countries; in all other states the market is in varying degrees of excess capacity.

For notational simplicity it is convenient to Change notation in this section and to denote the firms by the superscripts 1,2, the markets by subscripts by H and F, and the states of nature by s. Let $\pi(s)$ denote the probability of state s occurring. In addition to simplify matters further, we assume capacity of each firm, k^i, is fixed. Endogenizing the ex ante capacity decision significantly complicates matters without adding a great

deal of insight.[6] Consequently in any state $s \in S$ the two firms play a Cournot-Nash quantity game in each national market subject to an overall capacity constraint. Thus in state s firm i solves

$$\max_{q_H^i(s), q_F^i(s)} \; q_H^i(s)\left\{D_H\left[q_H^1(s) + q_H^2(s),\ s\right] - c\right\} + q_F^i(s)\left\{D_F\left[q_F^1(s) + q_F^2(s),\ s\right] - c\right\}$$

$$\text{subject to} \quad q_H^i(s) + q_F^i(s) \leq k^i.$$

The equilibrium solution may or may not be capacity constrained in all states. Equilibrium requires that each firm i equate marginal revenue across markets, so $MR_H^i(s) - c = MR_F^i(s) - c$. Note that prices are set independently in each of the two markets. We assume firm 1 produces in the Home country and firm 2 produces in the Foreign country. Both have common constant variable marginal costs of production, c. Trade reflects the Brander-Krugman (1983) cross-hauling effect, plus difference in country size, as reflected in the relative position of the inverse demand curves. Note that under firm symmetry and free trade, each firm will have a market share of $\frac{1}{2}$ in each country. Equivalently import shares are exactly $\frac{1}{2}$ in each country. Consider two possible cases. Ex ante symmetric countries with demand perfectly correlated across countries, and demands perfectly negatively correlated.

Positively Correlated Country Demands

In this situation, there are really only two relevant states, high world and country specific demand, and low world and country specific demand. Trade offers no opportunities for stabilizing firm output in this case. The

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[6] Venables (1988) treats the capacity choice problem in detail in a certainty framework.

analysis is an extension of the one country case with excess capacity in low demand states. Both countries impose tariffs in the low demand state, shifting domestic demand towards domestic firms. The net effect is to reduce demand in both countries and hence increase the level of world excess capacity relative to that prevailing under free trade.

Because both firms have excess capacity when state s = {Low}, the sales decision in each of the two markets are unlinked; contraction of output in one market does not spill over into the other market. Thus "dumping" does not occur in equilibrium in the sense of shifting sales to the export market in response to a slump in domestic demand. In this model both the domestic and export market slump at the same time. Contingent protection mechanisms, therefore, cause observed protection to be correlated across countries. The net impact of the protection is to raise prices, decrease output and increase world excess capacity in the common low demand state. It also reduces the export share of each firm in total sales relative to the High demand states. Trade volume is, therefore, negatively correlated with protection as one would expect. In summary:

In a symmetric two country model with positively correlated demands and symmetric contingent protection the effects relative to free trade are

(a) an increase in prices, and a fall in output in low demand states (output destabilizing);

(b) an increase in the level of world excess capacity in low demand states;

(c) a decrease in trade volume in low demand states;

(d) a reduced share of imports in both countries in low demand demand states.

Negatively Correlated Demands

Now consider the case of perfectly negatively correlated demands so world demand under free trade in any period is constant at a common price in both countries. While obviously not realistic as a description of cyclical demand shifts it is a convenient reference case. In the low demand country each firm would reduce output, and in the high demand country each firm would expand output. Given symmetric but negatively correlated demand in both countries it is possible to have a free trade equilibrium with no excess capacity in the world economy in either state. In this case trade serves as a device to reduce the cost of investment in sunk capacity through diversification of sales across countries.

Suppose now that both countries levy a tariff contingent on the low demand state in the home country, (L,H) (high demand state in the foreign country). As the market remains open in the high demand state-country, a firm from a country experiencing low domestic demand necessarily faces high export demand, and vice-versa. Conversely an open (non-protected) home market implies a low demand export market for the national firm. The world contingent tariff system thus has the effect of

(a) increasing the size of the Home market to the Home firm when demand at Home is low;

and

(b) reducing the size of the export market to the Home firm when Home demand is high.

The peculiar characteristics of the world market induced by contingent protection is that the total market size facing each firm is now random, and *negatively correlated* with the state of Home demand. 'Bad times' nationally

mean 'good times' abroad plus protection in the home market. Furthermore the market size facing each firm is negatively correlated. Note that in a symmetric free trade equilibrium, which is capacity constrained, import *shares* are constant across states. However, the volume of imports into a specific country is higher in the period in which demand is high in the national market. What will the impact be on the allocation of output as in this case markets are 'linked' provided capacity constraints bind? Given the capacity constraints bind total would supply across both markets is constant in any state. The effect of the tariff is to reduce exports by both firms, but in aggregate to shift supply to the non-protected "high" demand state market.

The domestic firm from the low demand state country reduces exports as it is more profitable to sell into the home market. The firm located in the high demand state country is thus given a greater share of its home market at the same time it is given reduced access to the export market. The tariff, therefore, tends to stabilize prices relative to the free trade situation, but increases output variance in each country.

For a sufficiently high tariff it is possible to get equilibrium with excess capacity on the part of the firm facing the tariff barrier in the foreign market. In this case the firm with excess capacity sets marginal revenue to variable cost in both markets and its output decisions are now unlinked across markets. Excess capacity is observed in the firm in the country whose market remains open and where demand is high. If contingent tariffs rise sufficiently high, then imports to low demand state markets will cease altogether. This would occur, for example, if tariff plus marginal cost exceeds the "choke price" in the protected market. One-way trade will occur, however, as firms from the country in a "slump" export to the "boom"

countries. Firms from "boom" countries, however, paradoxically may carry excess capacity as a result of their inability to export. In such an equilibrium the contingent protection scheme is the source of the excess capacity, and its burden falls on the producers in "boom" countries, and consumers in "slump" countries.

6. Cost Dependent Contingent Protection

A good deal of contingent protection is triggered by shifts in the costs of foreign firms. For example, exchange rate shifts may induce anti-dumping actions based on 'full cost' definitions of dumping, or possibly unanticipated subsidies given firms may trigger countervail action. To focus on this type of contingent protection scheme, we focus on the one-country market and imagine a situation in which the short-run marginal costs of the Foreign firm are uncertain (measured in Home currency), and denoted by c^1 and c^2, with state 2 denoting the low cost state. H's marginal variable costs, c, are constant with $c \geq c^1$, $c^1 \geq c^2$. Demand uncertainty is not present in this model, so that the Home demand curve is the same in both states. Solving the duopoly model under these conditions with the same sunk capacity decision yields the condition that the capacity of the Foreign firm is determined by the condition that marginal revenue equals long run expected marginal cost *in the low cost state*. This happens, obviously, because output is highest for the Foreign firm, given Home's costs are constant, when Foreign's costs are low. Thus the condition determining capacity and output of Foreign is given by

$$(11) \quad MR_F\left(k_F, q_H^2\right) = c^2 + \frac{r}{(1-\pi)} \qquad MR_F\left(q_F, k_H\right) = c^1.$$

In this equilibrium the Home firm will be in a situation of excess capacity when Foreign has low costs, since its output will be lower in this state than

in the high cost state. Hence, in summarizing the cross-country distribution of excess capacity we have that

with pure cost uncertainty on the part of Foreign, excess capacity between Home and Foreign will be negatively correlated.

Consider now the impact of a cost dependent contingent protection scheme with a per unit tariff levied on Foreign when Foreign costs are low. Clearly equation (11) determining Foreign capacity changes in a straightforward way. Provided Foreign remains the low cost firm inclusive of the tariff, $c^2+t < c$, and remains low cost inclusive of the tariff, relative to state 1, so $c^2+t < c^1$, (11) adjusted for the tariff in state 2 will determine Foreign's capacity decision. In this case

contingent protection which is imposed in the Home market when Foreign costs are low directly reduces the ex ante level of capacity for export by Foreign to the Home market.

A sufficiently clever cost contingent tariff scheme could eliminate entirely any excess capacity in this model by eliminating cost - inclusive-of-tariff differences between firms. It is also noteworthy that contingent protection may have no impact on the level of ex ante capacity investment by the Home firm. This would occur if Home were constrained in the high cost state, and Foreign were unconstrained in the high cost state. A small contingent tariff would not affect the marginal revenue curve of the Home firm in the low cost state and hence the capacity choice of the Home firm.

7. Summary: Uncertainty Driven Contingent Protection

With shifting uncertain demand and costs and large sunk capacity, the cost of excess capacity is shared between countries, and the distribution of these costs is affected by contingent protection policy. On welfare grounds,

given the capacity decision, in low demand states there is no particular reason to protect the Home market other than to shift profits toward the Home firm. This profit shifting motive can be strong in the face of elastic domestic supply. From the political economy point of view the demand for protection, given the sunk costs, is driven by the Home firm and workers will be losing money. By shifting demand towards the Home firm and away from Foreign these losses can be reduced or even eliminated. The losers are Home consumers and the Foreign firm. *Ex ante, it is even possible the contingent protection will induce Home to invest in additional capacity.* This will occur if contingent protection is sufficiently protective to make Home's capacity level bind in periods in which contingent protection is offered. This seems admittedly a rather unlikely case.

What can be learned from the models in sections 4-6, is that contingent protection schemes can have permanent or temporary effects, depending upon how they are designed and the type of industry to which they apply. In the case of industries with large sunk costs to capacity, if the principal contingency which triggers the protection is an adverse demand shift in the Home market, then this is less likely to have permanent effects on the level of import capacity in the industry. Alternatively, if the trigger mechanism is principally cost based tests, with protection being triggered by unusually low costs of imports, then anticipation of this mechanism by all parties will cause a permanent reduction in the level of imports.

One simple policy conclusion to be drawn from this analysis is in balancing domestic interests versus the social costs of restricting imports. Domestic distress is usually thought to be a temporary state to which contingent protection policies are applied. Inadvertent use of tests for contingent protection which have permanent effects on the level of imports,

substantially raise the permanent social cost of such policies, while retaining only temporary benefits.

8. Manipulable Trigger Mechanisms in Declining Industries

In this section I consider some complications which arise when the imposition of the protection through some type of trigger mechanism is subject to manipulation by both the perceived beneficiaries of the policy and those firms who are the target of the mechanism. Almost any type of contingent protection scheme, due to the administrative nature of the process under which these policies are run, is subject to this type of consideration. The model used to illustrate this will be of an extreme form, in the sense that the worst aspects of these policies will emerge as equilibrium outcomes.

The market structure is one of two firms competing in a declining industry. Thus, unlike the previous sections, the fall in demand is *intertemporal* and anticipated, rather than merely *uncertain* demand. The situation, therefore, is one in which the domestic industry is declining for structural reasons due to a long term fully anticipated fall in demand. There is a significant period of life remaining in the industry, however, and decisions as to the appropriate level of long term capacity must be made. The U.S. steel industry in the late 1970s or early 1980s would be an example. In the case of steel, demand was expected to fall, import competition was stiff, but remaining plant lives were forecast to be in the order of ten years.[7]

The model will use import market shares as the appropriate trigger.[8] In

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[7]See Tarr (1988) for a useful summary of the steel crisis in the U.S. during this period.

[8]Market share and investment in capacity in industrial organization models has a long history. See Brander and Harris (1983) for a discussion in the

both dumping and countervail cases in Canada and the United States, for example, the share of imports, or the change in this share, is often the most important piece of evidence used in attempting to demonstrate injury. Unlike the cost or demand based schemes referred to earlier, it is usually (barring arguments about market definition) easy to establish what these shares are. We imagine a case in which the actual import share, m, is measured relative to some target value M. The policy is to levy a tariff on imports if the share of imports exceeds the known target level M. To keep matters particularly simple, imagine that non-compliance induces such a high penalty tariff that importing firms strive to meet the announced target. To facilitate this assumption we use an intertemporal certainty model, with the target M announced in the first period, with compliance expected *and attained* in the second period.

To endogenize the process, imagine that the target itself is based on past market experience. Thus M is set at the level of import shares which obtained in the past. For our purposes we are interested in how such a procedure affects the intertemporal equilibrium. Hence, in period 1 firms choose outputs and capacities rationally anticipating the outcome of the administrative contingent protection scheme in the future, period 2. The declining industry assumption implies that period 2 is a low demand state relative to period 1, so that the imposition of protection is justified on the grounds of economic distress of the domestic firms. The administration of this protection uses the market share test.

We solve this game as a sequential Cournot-Nash game. In period 2 both firms have installed capacities (k_F, k_H), and a market share of imports

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context of preemptive investment.

standard, M, has been established based on past experience. The two firms solve

$$(12)\ \text{(Home)} \qquad \max_{q_H^2} D^2\left(q_F^2 + q_H^2\right)q_H - cq_H^2 \quad \text{subject to i) } q_H^2 \le k_H$$

$$(13)\ \text{(Foreign)} \qquad \max_{q_F^2} D^2\left(q_F^2 + q_H^2\right)q_F - cq_F^2 \quad \text{subject to ii) } q_F^2 \le k_F$$

$$q_F^2/\left(q_F^2 + q_H^2\right) \le M$$

If Home takes q_F^2 as given then Home ignores the constraint on Foreign induced by the import share trigger mechanism. In practice, given demand is sufficiently low, the market share constraint will always bind on Foreign. In these circumstances it seems more reasonable to assume Home effectively recognizes that Foreign must set

$$(14)\quad q_F^2 = \lambda q_H^2 \quad \text{with} \quad \lambda = M/(1-M).$$

Recognizing the binding nature of (14) turns Home into a Stackleberg leader maximizing against the 'reaction rule' (14) of Foreign.[9] In figure 2 this period 2 equilibrium is illustrated for $M < \frac{1}{2}$ at point E. It is also assumed that both Home and Foreign are not capacity constrained in this period. Under the symmetry assumptions on costs and demand, in the absence of the import share trigger scheme, the free trade equilibrium would be at point CN, with both market shares equal to $\frac{1}{2}$.

Let $\Pi^F(M)$ and $\Pi^H(M)$ denote F and H profits in the second period equilibrium as they depend upon the parameter M. Given conventional Cournot stability conditions, Π^F is increasing in M and Π^H is decreasing in M.

In period 1 firms choose capacities and outputs knowing that market

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[9]The constraint embodied in (14) is similar in spirit to the price leadership role forced on the domestic firms in the VER literature. See Krishna (1989) and Harris (1985).

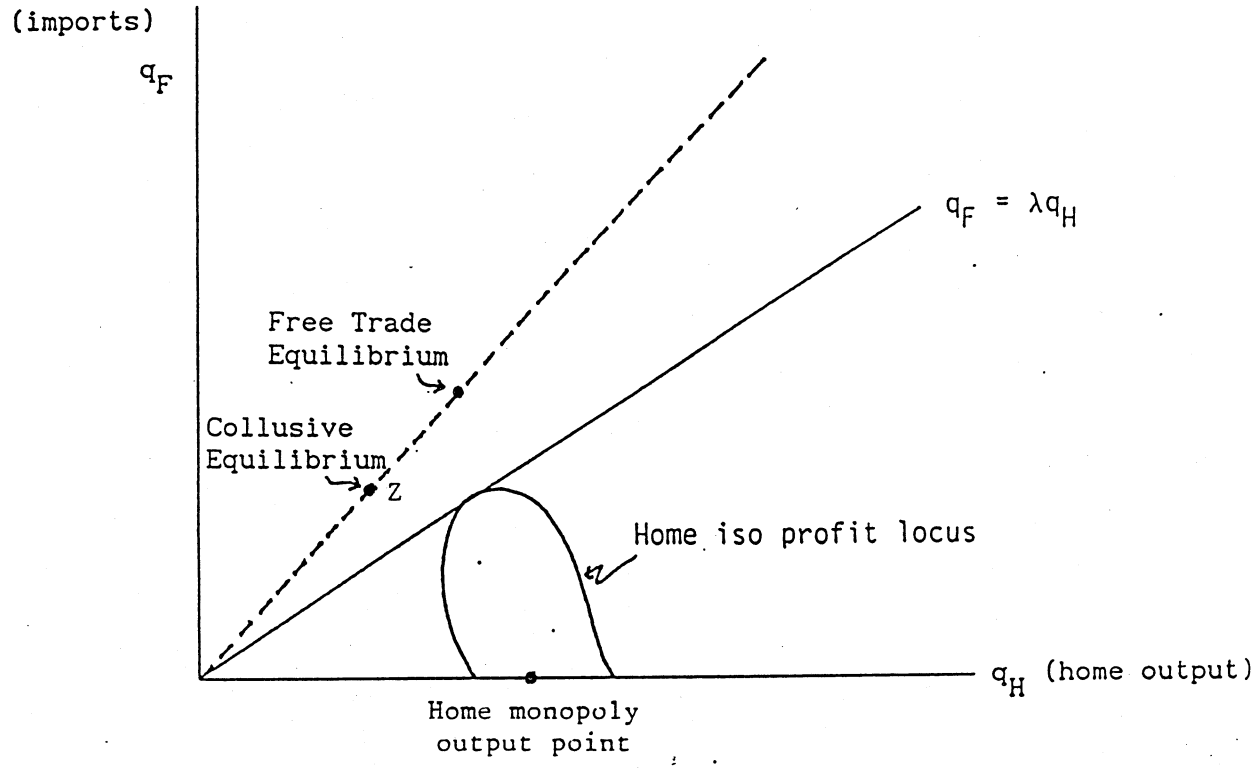

Figure 2

Period 2 Equilibrium with Trigger Coefficient $\lambda < 1/2$

shares determined in the first period will be binding in the second period, due to the fully anticipated trigger mechanism. Firms maximize discounted profits with discount rate δ. Thus the firms solve

$$(15) \quad \max_{q_H, k_H} \left[D^1(q_H + q_F) - c\right]q_H - rk_H + \delta\Pi^H\left(\frac{q_F}{q_F+q_H}\right) \quad \text{subject to } q_H \leq k_H.$$

$$(16) \quad \max_{q_F, k_F} \left[D^1(q_H + q_F) - c\right]q_F - rk_F + \delta\Pi^F\left(\frac{q_F}{q_F+q_H}\right) \quad \text{subject to } q_F \leq k_F.$$

In the absence of the contingent protection mechanism, given assumptions on demand, discounted profits in the second period would be independent of output and capacity decisions in the first period. In this case the condition determining symmetric equilibrium output and capacity in period 1 is given by

$$(17) \quad MR_i^1(k,k) = c + r, \quad i = H,F.$$

With the anticipated trigger mechanism the conditions are

$$(18) \quad MR_H^1(k_H, k_F) = c + r + \frac{M}{Q}\Pi^{H'}(M)$$

$$(19) \quad MR_F^1(k_F, k_H) = c + r - \frac{(1-M)}{Q}\Pi^{F'}(M)$$

with $Q = k_H + k_F$ and M defined as $k_F/(k_F + k_H)$.

There are two basic propositions about the nature of equilibrium in this model.

Equilibrium capacity by both firms is greater in the presence of the import share trigger mechanism than without the scheme.

The proof follows simply from comparing equations (19) and (18) with the usual conditions, (17).

Since $\Pi^{H'}$ is negative, marginal revenue in the trigger mechanism

equilibrium must be lower than its absence, evaluated at capacity outputs. Similarly as $\Pi^{F'}$ is positive for F. Hence, the presence of the trigger mechanism causes firms to invest more in capacity with the trigger mechanism than without it. Since output equals capacity in the first period, this also implies first period output is higher, and price lower than in the absence of the trigger mechanism. What is happening is that both firms are using capacity in the first period as a means of fighting for legitimate market share in the second period. The joint effect of this is to raise outputs and capacities beyond what they would be otherwise.

The next proposition is slightly more surprising. The equilibrium market share in the first period M^*, determines the λ^* governing the second period equilibrium. One might expect that, given the Stackleberg leadership position of the Home firm in the second period, this would induce an import share which was less than the free trade share of $\frac{1}{2}$. This turns out *not* to be the case. In fact,

> *the equilibrium market share of both firms in both periods market share triggered protection is equal to the free trade market shares of $\frac{1}{2}$.*

Even more dramatic, however, is the fact that

> *the trigger mechanism induces perfect collusion in the second period in the sense that the monopoly price and output are sustained as equilibrium outcomes.*

This result is fairly stark. It implies that the trigger strategy mechanism based on import share has no effect on equilibrium market shares either in the first or second period, a perfectly collusive outcome is induced in the second period, and excess capacity in the second period

increases due to both higher levels of capacity investment, and reduced outputs relative to the situation with no contingent protection.

The proof of these propositions starts by noting with $\lambda=1$, or $M=\frac{1}{2}$, the second period equilibrium, E, occurs at the symmetric monopoly outcome, Z, in figure 2. That is, both firms set market marginal revenue to marginal cost, c. Given the reaction function of Foreign, Home has a conjectural variation on output of 1, which induces the monopoly collusive outcome. We wish now to establish that (18) and (19) are satisfied at $M=\frac{1}{2}$.

It can be seen that a sufficient and necessary condition for $M=\frac{1}{2}$ and $k_H = k_F$ to satisfy these equations is for

$$(20) \quad \Pi^{F'}(\tfrac{1}{2}) = -\Pi^{H'}(\tfrac{1}{2}).$$

Consider the function $F(M) = \Pi^F(M) + \Pi^H(M)$. Since $M=\frac{1}{2}$ sustains the monopoly joint profit maximizing outcome, with monopoly profits Π^*, and Π^* yields profits greater than any feasible allocation of outputs in the second period, it must be the case that

$$(21) \quad F(M) \leq \Pi^* \quad \text{and} \quad F(\tfrac{1}{2}) = \Pi^*, \quad \text{for all } M \quad 0 \leq M \leq 1.$$

Therefore $F'(\frac{1}{2}) = 0$, which implies that $\Pi^{F'}(\frac{1}{2}) = -\Pi^{H'}(\frac{1}{2})$, which yields (20). Thus a solution of the model is equal market shares in both periods. As to the possibility of alternative solutions, these cannot be ruled out but are unlikely in the case of linear demand.

An interesting implication of the equilibrium is that profits have been shifted intertemporally relative to free trade allocations. Profits of both firms are higher in the second period, exclusive of sunk costs, but profits are lower in the first period, and sunk costs are higher. As equilibrium profits in the second period are independent of δ, the discount factor, it is possible that for sufficiently high δ the increased profits of the second

period dominate the losses in the first period, and the overall effect of the contingent protection mechanism is to raise the present value of profits of both firms. Clearly for δ close to 0, the model equilibrium approaches the conventional first period equilibrium, but leaves the second period equilibrium intact. Thus

> *the collusive effect of the trigger mechanism is independent of the discount rate, but the degree excess capacity effect is increasing in the discount rate.*

Sunk capacity becomes an indirect mechanism for increasing market share. As future profits weigh more importantly in the cash flow stream, the firm will incur greater current cost in the form of additional capacity in an attempt to capture future profits.

9. Conclusion

This paper is a contribution to the growing body of literature on contingent protection. Some models of the causes and consequences of contingent or administrative protection for industrial excess capacity in periods of "slump" have been examined. Three equilibrium models of industrial excess capacity were examined. One model focuses on uncertain demand across states of nature and another with uncertain foreign costs across states of nature. It was shown that a contingent tariff scheme will affect both the level and international distribution of excess capacity within the industry. Demand driven contingent protection while raising the level of excess capacity in a "slump", is less likely to have permanent effects on the level of import capacity to the industry. Alternatively, cost driven contingent protection will tend to permanently reduce the level of imports. The results in a two-country model of demand driven contingent

protection suggest that, in the case of correlated international demand shifts, the results will tend to be similar to that in the one-country models.

The last model considered the issue of fully anticipated contingent protection within a declining industry. The contingent protection mechanism allowed for the importing firm to avoid triggering protection, by maintaining a level of imports below the 'trigger level'. It was demonstrated that the level of capacity in the industry was critically dependent on anticipation of the 'mechanism' of protection, and that the implied threat of the mechanism produced in a stylized model perfect collusion, and levels of excess capacity beyond that expected in a free trade equilibrium within the declining industry.

The paper suggests that the variety of administrative contingent protection mechanisms which countries have increasingly resorted to, may well make matters worse for those industries where they were expressly designed to help – industries with large sunk costs in the form of physical and human capital. The policies can be destabilizing in the sense of exacerbating output fluctuations. The important open question is whether there exist other forms of safeguards which can provide temporary relief, yet are not subject to the same problems as contingent protection schemes.

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