Injury Investigations in Antidumping and the Super-Additivity Effect: A Theoretical Explanation

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Abstract: Empirical evidence shows that in injury investigations in antidumping cases conducted by the United States International Trade Commission, the probability of a positive finding is higher when the number of defendant firms is larger, holding constant their total market share. In the paper we offer a theoretical explanation of this finding. We show that the presence of many exporters exacerbates the free-rider problem, which leads every firm to invest less on defense. Thus for the same market share, injury finding is more likely to be positive for many small sellers than a few large sellers. JEL no. F13, L13
Keywords: Antidumping; cumulation; injury investigation

1 Introduction

Successful prosecution in antidumping cases involves two separate steps: establishing injury to the domestic industry from increased imports and determining a positive dumping margin. The latter is typically measured by the excess price charged by the defendant firm in its domestic market over what it charges in the market where dumping is said to have taken place. In the United States, the International Trade Commission (ITC) does the injury investigation while the Department of Commerce (DOC) determines the dumping margin.

In this paper, we offer a theoretical explanation of a surprising empirical finding relating to injury investigations in antidumping cases. In an important paper, Hansen and Prusa (1996) carry out a careful econometric investigation of the determinants of an affirmative finding in the injury in-

Remark: The paper was written while Arvind Panagariya was a Visiting Scholar at the International Monetary Fund. The authors have benefited immensely from comments by Bruce Blonigen, Jim Gordon, Robert Staiger and Tom Prusa on an earlier draft. Please address correspondence to Poonam Gupta, 700 19th St. N.W. Washington, D.C., US 20431, United States; e-mail: pgupta@imf.org

 DOI: 10.1007/s10290-006-0060-1

vestigations conducted by the U.S. ITC. Among other things, they find that the probability of a positive finding is higher when defendants are many and small than when they are few and large. Stated precisely, they find that, holding the market share of defendant firms constant, "cumulation," defined as the practice of aggregating over the exports of several countries, has a positive effect on the probability of an affirmative injury determination. A subsequent paper by Tharakan et al. (1998) confirms this finding for the European Community injury decisions as well.[1]

That cumulation should raise the probability of a positive injury determination is not surprising: adding one more country to the set of countries investigated raises the market share of the accused firms and, ceteris paribus, must make the case for a positive finding stronger. The surprising aspect of the Hansen and Prusa (1996) and Tharakan et al. (1998) studies is the presence of what the former call the "super-additivity" effect: for the *same* market share, cumulation raises the probability of affirmative injury determination.[2] Interestingly, however, neither of these sets of authors provides any explanation—whether heuristic or formal—of this finding.

In this paper, we suggest one possible formal explanation why affirmative injury determination is more likely when defendants are many and small rather than a few and large. We show that the presence of many small exporters exacerbates the free-rider problem that accompanies multiple defendants. Unlike the dumping margin, which must be determined separately for each defendant firm, the injury determination is common to all defendant firms: either all defendants are found guilty of causing injury to the domestic firm or all are acquitted.[3] To the extent that defense may be costly, this fact inevitably gives rise to a free-rider problem. At one extreme, if a single large firm is subject to investigation, it has every incentive to defend itself. At the other extreme, if tens of small firms spread over as many countries are investigated, none may have an incentive to defend, giving the domestic, plaintiff firms a free hand in influencing the outcome.

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[1] The literature on antidumping is growing rapidly. For example, see Anderson (1993), Baldwin and Steagall (1994), Blonigen and Haynes (1999), Ethier (1982), Haaland and Wooton (1998), Liebman (2004), Panagariya and Gupta (1998), Prusa and Skeath (2002), Rosendroff (1996), and Staiger and Wolak (1992, 1994).

[2] As Hansen and Prusa (1996) note, this outcome has encouraged domestic industries to file more cases against countries with smaller market shares.

[3] In informal correspondence, a U.S. ITC official puts the matter as follows: "It is not possible to reach different determinations on imports from countries that have been cumulated. The only way to reach different determinations is not to cumulate."

Our analysis is closely related to the vast body of literature on private provision of a public good. Among the directly relevant contributions are the papers by Rodrik (1986) and Panagariya and Rodrik (1993).[4] Rodrik (1986) offers an argument why welfare-maximizing governments may choose tariffs over production subsidies in the presence of lobbying. Output subsidies can be firm specific whereas tariffs are levied at the level of the industry. Therefore, when lobbying is at the level of the firm, output subsidies are not subject to free-riding by the firms that did not invest in seeking the subsidy but tariffs are. Consequently, tariffs lead to less lobbying and the level of equilibrium tariffs turns out to be smaller than the equilibrium level of subsidies. The end outcome of tariffs can then be welfare superior even though they lead to distortion in consumption. Similarly, Panagariya and Rodrik (1993) demonstrate why, under plausible conditions, the adoption of a uniform tariff rule may lead to a superior outcome. When lobbying for tariffs is at the level of the industry, the uniform-tariff rule creates a free-rider problem since the tariff granted to one industry is granted to all industries. This lowers the incentive for every industry to lobby.

In the present paper, the free-rider problem, leading to the super-additivity effect, arises in the provision of defense by the defendant firms against the injury charge. The defense provided by one firm becomes automatically available to all firms subject to the investigation. This leads every firm to invest less on defense than will be the case in a cooperative solution. Ceteris paribus, the larger the number of firms charged, the more serious the free-rider problem.[5]

To our knowledge, the focus on the free-rider problem on the defendant side of the game for protection is new. Traditionally, the literature has focused on the free-rider problem on the side of petitioners. For instance, in Rodrik (1986) and Panagariya and Rodrik (1993) above, lobbies seeking tariffs or subsidies are effectively petitioners. Likewise, in antidumping cases, we may encounter free riding among petitioners since the domestic producers benefit from antidumping actions regardless of whether or not they contribute to the petition.

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[4] Also see Hillman (1989: chapter 6) and Ursprung (1990).

[5] In our analysis below we assume that firms are identical. In the presence of asymmetry, one or more firms may be large enough to find it profitable to defend themselves irrespective of the number and share of other smaller firms with which they have been cumulated in the antidumping case. Therefore, the free-rider problem may be less serious in the asymmetric case.

Though our objective is limited and specific, we also provide a simple but general framework for the analysis of the injury issue. To-date, the theoretical literature on the injury issue is virtually nonexistent. Therefore, future empiricists as well as trade theorists interested in this issue will find our framework helpful. We begin in Section 2 with some institutional details and evidence on the increased role of cumulation in injury cases in recent years in the United States and European Union. Our formal model is then outlined in Section 3. Our main result is derived in Section 4 and our brief concluding remarks appear in Section 5.

2 Cumulation in Practice

The cumulation amendment was enacted by the U.S. Congress in 1984, which requires the U.S. ITC to cumulate imports when a trade dispute involves imports from multiple sources. The statute states: "The commission *shall* cumulatively assess the volume and effect of imports of the subject merchandise from all countries with respect to which petitions were filed or investigations were self-initiated on the same day, if such imports compete with each other and with domestic like products in the United States market." (USITC 2002: II-39).

Prior to 1984, the U.S. ITC had some discretion with respect to whether or not to cumulate the imports of different defendants in the determination of injury. But the 1984 amendment makes it mandatory to cumulate in cases involving multiple defendants. As Prusa (1998) documents, since the 1984 amendment, cumulation has been applied with much greater frequency. While only 13 percent of the antidumping cases were subject to cumulation between 1980 and 1984, as many as 75 percent became subject to this practice between 1985 and 1994. According to Tharakan et al. (1998), cumulation has also been practiced liberally in the European Communities (EC). During 1980–1987, 91 percent of the multiple-country filings were determined on the basis of the cumulated market share of imports.

Hansen and Prusa (1996) and Tharakan et al. (1998) study the experience of the United States and EC, respectively, and show that holding the share of defendant firms in total sales constant, cumulation increases the probability of an affirmative injury determination. According to an example considered in Hansen and Prusa (1996), when 40 percent of imports are under investigation and a single country is involved, the probability of an

affirmative injury finding is 0.60. But when the petition is filed against two countries with a cumulated market share of 40 percent, divided equally between them, the probability rises to 0.72. This change represents a 20 percent increase in the probability of affirmative action. Extending the example to five countries, holding constant the market share of imports, the probability rises to 0.78 or by 30 percent. Tharakan et al. (1998) provide similar examples using the estimates for the EC. The probability of an affirmative finding rises from 0.92 for two countries to 0.98 for three countries, holding constant the market share of imports under investigation. Thus, cumulation has played a significant role in yielding a positive injury determination. Why has this been so? This key question is the subject matter for the rest of this paper.

3 The Model

We work with a model in which there are three types of firms: firms from the country in which dumping takes place, exporting firms subject to the antidumping action, and other exporting firms. The product under consideration is homogeneous and the firms are assumed to engage in Cournot competition.[6] We do not model the decision of domestic firms to bring the antidumping petition. Nor do we formalize the process by which the firms charged with dumping are chosen. Our focus is on the choices made by defendant firms in the injury investigation.

Throughout, we use lower case letters to denote firm-level variables. Variables associated with domestic firms are distinguished by a tilde ($\sim$) and those associated with foreign firms not subject to the antidumping action by an asterisk ($*$). Since our focus is on the exporting firms subject to antidumping, we represent their variables by lower case letters without tilde, asterisk or any other scripts. Unless otherwise stated, all market-level variables relate to the domestic economy and we denote them by upper case letters without sub- or superscripts. To keep the analysis simple, we work with linear demand and linear production costs. Our central result can arise under more general demand and cost functions, however.

[6] We could also employ a Bertrand competition framework as, for example, in Prusa (1992) to derive our main result but this would require a demand specification that admits product differentiation.

Let us then write the inverse market demand in the country where dumping takes place and is called the home or domestic economy as

$$P = A - BX\,, \tag{1}$$

where P denotes the market price and X the total market demand. Parameters A and B are positive by assumption. The equality of demand and supply implies

$$X = \sum_{i=1}^{\tilde{n}} \tilde{q}_i + \sum_{j=1}^{n} q_j + \sum_{r=1}^{n^*} q_r^*\,, \tag{2}$$

where $\tilde{q}_i$ denotes the sales by ith domestic firm, q_j that by jth exporting firm subject to antidumping and q_r^* by rth exporting firm not subject to antidumping. Similarly, $\tilde{n}$, n, and n^* represent the total number of firms in the three groups.

For expositional simplicity, we shall assume that in the case of foreign firms, there is one firm per country. Therefore, the exporting country is synonymous with the exporting firm and cumulation across countries is equivalent to cumulation across firms. Moreover, an increase in the number of targeted countries is equivalent to an increase in the targeted number of firms. Strictly speaking, the analysis applies at the firm level. Therefore, we will refer to exporting entities as "firms" rather than "countries." An outline of the possible extension to the more general case, which allows for multiple firms from one or more foreign countries and therefore distinguishes between cumulation across countries and firms, is provided at the end of the next section.

The profit maximization problem of a domestic firm, say firm h, may be written:

$$\underset{\tilde{q}_h}{\text{Max}}\ \psi = \left[A - B\left\{\sum_{i=1}^{\tilde{n}} \tilde{q}_i + \sum_{j=1}^{n} q_j + \sum_{r=1}^{n^*} q_r^*\right\} - \tilde{c}_h\right]\tilde{q}_h\,, \tag{3}$$

where c_h is the constant average and marginal cost of production of domestic firm h. By assumption, firms act as Cournot players and therefore choose their optimal quantities taking the sales quantities of all other firms as given. Therefore, the optimal quantity of domestic firm h can be written

$$\tilde{q}_h = \frac{\left[A - B\left\{\sum_{i=1}^{\tilde{n}} \tilde{q}_i + \sum_{j=1}^{n} q_j + \sum_{r=1}^{n^*} q_r^*\right\}\right] - \tilde{c}_h}{B}\,. \tag{4}$$

Analogously, the solution to the profit maximization problem of an exporting firm not subject to antidumping, say firm g, is

$$q_g^* = \frac{\left[A - B\left\{\sum_{i=1}^{\tilde{n}} \tilde{q}_i + \sum_{j=1}^{n} q_j + \sum_{r=1}^{n^*} q_r^*\right\}\right] - c_g^*}{B}. \tag{5}$$

Equations (4) and (5) are the best response functions of domestic firm h and foreign firm g not subject to antidumping, respectively. Note that in view of (1) and (2), the term in square brackets in (4) and (5) equals P. Therefore, imposing symmetry across firms within each group and dropping subscripts h and g in (4) and (5), respectively, we can rewrite them as

$$\tilde{q} = \frac{P - \tilde{c}}{B} \quad \text{and} \tag{4'}$$

$$q^* = \frac{P - q^*}{B}. \tag{5'}$$

Because P is endogenous and remains to be determined, these equations do not represent final solutions for q and q^*. Furthermore, (5) has been derived under the assumption that the group of exporting firms not subject to antidumping action is known before production decisions are made. Within the model, this property can be rationalized by assuming that the profit-maximizing price of each of these firms in its home market is lower than the price in the market where dumping takes place. Under this assumption, the firm knows beforehand that it will not be subject to a dumping investigation.

The firms charged with dumping also know beforehand that they will be charged. Again, this can be rationalized by assuming that the profit-maximizing price of each of these firms in its domestic market is higher than that in the market where dumping takes place. In addition, we assume that the presence of the dumping margin necessarily leads to antidumping and hence injury investigation.[7] While the injury investigation is, thus, necessarily undertaken, there is uncertainty with respect to the final outcome and hence eventual prosecution. Under the current national laws, which must conform to the GATT Article VI and the WTO Agreement on Antidumping, no antidumping duties can be levied without a positive determination of injury to the domestic industry.

[7] Implicitly, we model exporting firms as discriminating monopolists. A more sophisticated formalization would follow Brander and Krugman (1983).

We assume that the probability of a positive injury determination varies directly with the combined market share of the firms charged with dumping.[8] As is generally true in practice, this means that either all firms are found guilty or all are acquitted. We further assume that the firms can invest resources to defend themselves against the injury charge. By assumption, the probability of a positive finding varies inversely with the *total* amount of resources so invested by the defending firms. Thus, the probability of a positive finding is written,

$$\rho = \rho\left(\frac{\sum_{j=1}^{n} q_j}{X}, \sum_{j=1}^{n} e_j\right), \tag{6}$$

where e_j is the expenditure on defense incurred by firm j. Based on the assumptions just outlined, $\rho_1(.) > 0$ and $\rho_2(.) < 0$, where $\rho_1(.)$ and $\rho_2(.)$ represent the partial derivatives of $\rho(.)$ with respect to first and second arguments, respectively. In addition, we impose the plausible restrictions $\rho_{11} < 0$ and $\rho_{22} > 0$. The former restriction says that the increase in the import share increases the probability of affirmative action at a diminishing rate. The latter restriction says that the marginal reduction in the probability of affirmative action attributable to the expenditure on defense declines as we increase the expenditure.

We assume that if the finding of injury is positive, each firm is subject to a fine equal to the difference between the price in the firm's home market, p_k, and that in the market subject to dumping, P. For simplicity, we assume that the former is determined solely by the firm's home market variables and thus can be treated as a parameter for purposes of the present problem. Alternatively, as Bruce Blonigen has suggested to us, we could think of p_k as the constructed cost measure of the "fair value" of the exporting firm's product, which is exogenous. The Department of Commerce uses the constructed cost method in a significant number of cases. Either way, we can represent the antidumping duty by $p_k - P$ where p_k is specified exogenously. Assuming the firms are risk neutral and there-

[8] To determine injury in the United States, the law directs the U.S. ITC to consider the volume of imports of the subject merchandize, the effects of imports of that merchandize on prices in the United Sates for domestic like products, and the impact of imports of such merchandize on domestic producers of domestic like products in the context of production operations within the United States.

fore maximize expected profits, we can write the objective function of firm k as

$$\begin{aligned}\underset{q_k,e_k}{\text{Max}}\,\zeta = \rho(.)\Bigg[A - B\Bigg\{\sum_{i=1}^{\tilde{n}}\tilde{q}_i + \sum_{j=1}^{n} q_j + \sum_{r=1}^{n^*} q_r^*\Bigg\} \\ - c_k - (p_k - P)\Bigg]q_k - e_k \\ + [1-\rho(.)]\Bigg[A - B\Bigg\{\sum_{i=1}^{\tilde{n}}\tilde{q}_i + \sum_{j=1}^{n} q_j + \sum_{r=1}^{n^*} q_r^*\Bigg\} - c_k)\Bigg]q_k\,.\end{aligned} \tag{7}$$

This can be somewhat simplified to

$$\begin{aligned}\underset{q_k,e_k}{\text{Max}}\,\zeta &= \Bigg[A - B\Bigg\{\sum_{i=1}^{\tilde{n}}\tilde{q}_i + \sum_{j=1}^{n} q_j + \sum_{r=1}^{n^*} q_r^*\Bigg\} - c_k\Bigg]q_k \\ &\quad + \rho(.)[P - p_k]q_k - e_k \\ &= [1+\rho(.)]\Bigg[A - B\Bigg\{\sum_{i=1}^{\tilde{n}}\tilde{q}_i + \sum_{j=1}^{n} q_j + \sum_{r=1}^{n^*} q_r^*\Bigg\}\Bigg]q_k \\ &\quad - [c_k + \rho(.)p_k]q_k - e_k\,,\end{aligned} \tag{7'}$$

where we make use of (1) and (2) to replace P in terms of the $\tilde{q}_i$, q_j and q_r^* in the second equality. Maximizing (7') with respect to q_k, replacing the term in square brackets in the second equality back by P, defining $\beta = \sum q_j/X$ and rearranging, we obtain

$$q_k = \frac{(P - c_k) - \Bigg[\rho(\beta, \sum e_j) + \dfrac{\rho_1(\beta, \sum e_j)}{n}\beta(1-\beta)\Bigg](p_k - P)}{B\big[1 + \rho(\beta, \sum e_j)\big]}\,. \tag{8}$$

Again, imposing symmetry, we can rewrite this equation as

$$q = \frac{(P - c) - \Bigg[\rho(\beta, ne) + \dfrac{\rho_1(\beta, ne)}{n}\beta(1-\beta)\Bigg](p - P)}{B\big[1 + \rho(\beta, ne)\big]}\,, \tag{8'}$$

where $\sum e_j = ne$ by symmetry. Observe the similarity between (8') on the one hand and (4') and (5') on the other. The extra term in the numerator in (8') results from the extra cost expected by the firms in the form of antidumping duties.

Finally, maximizing (7) with respect to e_k and imposing symmetry, we obtain

$$\zeta_e = -\rho_2(\beta, ne)q(p - P) - 1 = 0\,. \tag{9}$$

According to (9), the marginal revenue from increased effort by the firm to counter the dumping charge is equated to the marginal cost. The first term in this equation is the reduction in the fine attributable to a unit increase in the effort to combat the dumping charge while the second term is the cost of a unit increase in this effort.

Given our symmetry assumptions, we can rewrite equation (2) as

$$X = \tilde{n}\tilde{q} + nq + n^*q^*\,. \tag{2'}$$

Equations (1), (2'), (4'), (5'), (6), (8'), and (9) give us seven equations in seven variables: P, X, $\tilde{q}$, q, q^*, e and ρ. Thus, the model is fully specified and can be used to study the effects of the changes in costs, the number of firms, and other parameters on the endogenous variables.

4 The Super-Additivity Effect

According to the super-additivity effect, the probability of a positive finding rises with just cumulation. That is to say, for the same market share, the ex post probability of a positive finding is higher for many small sellers than a few large sellers.

Because the share of the firms subject to the dumping charge, β, is endogenous in our model, we cannot address the question at hand by changing n alone. In general, as n changes, β will also change. Therefore, we must assume that in the background, there is at least one another parameter that changes by just the right amount to hold β fixed. For instance, if the rise in n leads to a rise in β, we may raise c by just the right amount to restore β to its original value. Under this scenario, we are comparing two industries that are ex post identical in all respects except the number of firms subject to antidumping investigation.

At first blush, the proposed comparative statics exercise may seem rather complex. Our task is greatly simplified by two features of the model, however. First, as we demonstrate immediately below, the constancy of market share of one set of firms implies constancy of price and hence total demand. This feature is independent of the linearity of demand and cost functions.

Second, the impact of a change in n on the total expenditure on defense at constant β can be derived directly from (9).

To proceed with the first of these points, let us use a circumflex (ˆ) over a variable to denote the proportionate change in that variable. The constancy of market share implies

$$\hat{n} + \hat{q} = \hat{X}\,. \tag{10}$$

Differentiating (2') totally, we have

$$\hat{X} = \tilde{\beta}\hat{\tilde{q}} + \beta(\hat{n} + \hat{q}) + \beta^*\hat{q}^*\,, \tag{11}$$

where $\tilde{\beta}$, β, and β^* are the relevant market shares of the three types of firms and sum to unity. Differentiating (1), (4) and (5), respectively, we can obtain

$$\frac{dP}{A - P} = -\hat{X}\,, \tag{12}$$

$$\hat{\tilde{q}} = \frac{dP}{P - \tilde{c}}\,, \tag{13}$$

$$\hat{q}^* = \frac{dP}{P - c^*}\,. \tag{14}$$

Substituting from (10), (13), and (14) into (11), we have

$$(1 - \beta)\hat{X} = \tilde{\beta}\frac{dP}{P - \tilde{c}} + \beta^*\frac{dP}{P - c^*}\,. \tag{15}$$

From (12) and (15), it is immediate that $dP = 0$ and hence $dX = 0$. A fixed market share of a set of firms requires a fixed price and demand as well. Furthermore, given $dX = 0$, equation (10) leads to $\hat{n} = -\hat{q}$.

The super-additivity effect can now be readily gleaned from (9). Differentiating it totally, recognizing that $\mathrm{d}\beta = dP = 0$, we obtain

$$\rho_{22}qE\hat{E} + \rho_2 q\hat{q} = 0\,. \tag{16}$$

Here $E \equiv e \times n$ denotes the total expenditure on defense by the firms subject to the injury investigation. Substituting $\hat{n} = -\hat{q}$, we immediately obtain

$$\hat{E} = \frac{\rho_2}{\rho_{22}E}\hat{n}\,. \tag{16'}$$

Remembering $\rho_2 < 0$ and $\rho_{22} > 0$, we see that E and n are negatively related. That is to say, an increase in the number of firms is associated with a decrease in the total effort on the part of the defending firms and, hence, an increase in the probability of affirmative finding, just as the empirical evidence shows.

The analysis up to this point assumes one firm per country. If we assume many firms per country, this analysis still holds provided the defense against antidumping takes place at the level of the firm. More substantive modification must be made, however, if the defense takes place at the level of the country either because the firms within a country coordinate their efforts or because the national government assumes charge of defending its firms.

In this case, the natural way to model the defense against antidumping is through a two-stage game. In the first stage, each country must choose the expenditure on defense against antidumping in a simultaneous-move game and in the second, firms must choose sales, again in a simultaneous-move game, taking the expenditures as given. The solution must be recursive: we must first solve for optimal sales of firms taking expenditures on defense against antidumping as given and second optimize on the choice of expenditures taking into account the sales decisions of firms. The formal exercise is beyond the scope of this paper but it may be hypothesized that as long as the final success depends on the *total* expenditures on defense against antidumping, the free-rider problem we have identified will remain so that more resources will be expended for a given market share when this share is represented by one rather than two or more countries.

5 Concluding Remarks

In this paper, we have provided a theoretical explanation of the interesting finding of Hansen and Prusa (1996) and Tharakan et al. (1998) that cumulation across many small exporters by itself leads to increased probability of an affirmative determination in injury investigations. For the same import-penetration ratio, the verdict against many small sellers is more likely to be positive than a few large sellers.

In the process of establishing our theoretical result, we have also provided the first formal model of injury investigations in antidumping cases. A key feature of this model, missing from the existing models of antidumping, is the presence of third countries. In our future work, we plan to exploit this

feature to study the effects of antidumping on "third-country" exporters who are not subject to antidumping.

We conclude by noting an alternative explanation of the super-additivity effect suggested by Robert Staiger. According to him, this effect may also arise if the probability of a positive finding rises with the dumping margin. Ceteris paribus, the larger the number of firms exporting to the country in which dumping takes place the more intense competition is and hence the lower the price there is. As long as this does not impact the price charged by the exporting firms in their domestic markets, we will observe a larger dumping margin and hence larger probability of positive finding on injury.

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