Antidumping, Antitrust, and Competition*

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Abstract

This work develops a two-country, two-firm model of imperfect competition to show that antitrust policy may be anticompetitive both at home and abroad. Antidumping has a procompetitive effect abroad. At home antidumping is anticompetitive in a static framework but procompetitive in a repeated game. The anticompetitive effect of antidumping is shown to be enhanced by the presence of a domestic antitrust policy. If trade and antitrust policies are co-ordinated, welfare is found to be more sensitive to antitrust than to antidumping. Hence, antidumping and antitrust are imperfect substitutes.

Abstrakt

Článek pomocí modelu o dvou zemích, dvou firmách a za nedokonalé konkurence ukazuje, že protimonopolní politika může působit protikonkurenčně doma i v zahraničí. Antidumpingová opatření působí prokonkurenčně v zahraničí. Domácí efekt antidumpingové politiky je protikonkurenční v statickém modelu a prokonkurenční v dynamickém. Protikonkurenční efekt je zesílen, pokud je antidumpingová politika aplikována současně s protimonopolní. V případě koordinace obchodní a protimonopolní politiky je blahobyt více citlivý na protimonopolní než na antidumpingovou politiku. Antidumpingová a protimonopolní politika jsou tak nedokonalými substituty.

Key words: antidumping, antitrust, competition policy, trade policy.

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1. Introduction

The purpose of this article is to investigate how antidumping and antitrust policies interact. Antitrust is a term describing a policy which aims at preventing firms from acquiring market power through merger, collusion or any other means that result in a more concentrated industry structure. This characterises US antitrust laws. Competition policy is a term describing the European approach, according to which getting market power is not in itself an offence, as long as a firm does not abuse its dominant position. The use of the term *antitrust* reflects the assumption that the government deals with the market structure itself rather than penalising the abuse of market power. The term *antitrust* used throughout this study indicates that the attention is focused on collusion, be it explicit or tacit.

Antidumping actions have emerged as a means of protecting national industries against alleged predatory pricing behaviour by foreign firms. However, such actions have often been suspected of having anticompetitive effects, and of being used by governments to protect national industries against *fair* international competition. Antidumping, as a policy of protectionism, favours small but influential groups of stakeholders at the expense of large and diffuse groups of consumers that otherwise would benefit from lower prices.

This paper shows that the interaction between antidumping and antitrust policies affects the role of trade policy. A specific intervention by the government may be beneficial in the absence of any other policy. But it may also be possible for two different, individually beneficial, interventions to interfere with one another in an undesirable way. Specifically, trade policy may trigger unexpected behavioural changes in the presence of antitrust.

The remainder of this study is structured as follows: Section 2 looks at how an antitrust constraint changes the behavior of firms in a duopoly model. The same duopoly, one firm being foreign, is studied in Section 3 under an antidumping rule in the absence of any other market intervention. Section 4 synthesises the results of the previous two sections, looking at combined effects of antidumping and antitrust. In Section 5 the firms are assumed to compete in quantities in an infinitely repeated game. This section is aimed at finding an optimal antidumping duty that minimises the stability of the duopoly in the sense that no firm is willing to deviate from collusion. Finally, Section 6 deals with co-ordinated antitrust and antidumping interventions in a welfare-maximising context.

2. Antitrust and some trade considerations

The goal of antitrust regulation and activity is, by definition, to promote competition on the market even if some of the competitors are harmed as a result. The intended effect of a competition policy is to lower prices by increasing competition, to the benefit of the consumer.

The effects of restrictions imposed by antitrust authorities may turn out to be the opposite of the intended ones. In a theoretical model of duopoly, it can be shown that a restriction on market share results in higher prices and implies more collusive behaviour on the part of firms. The idea is similar to the one developed by Krishna (1985) about the effect of quantitative restrictions on international trade.

Assume there are two firms on Market 1 producing differentiated goods and facing demands: $x_1=1-p_1+ap_{21}$, and $x_{21}=1-p_{21}+ap_1$, $0<a<1$. The notation with double subscript is used for consistency with the next sections, where a two-country model is developed. The first digit stands for "Firm 2," whereas the second one stands for "Market 1." The firms compete in prices and have marginal costs c_1 and c_2, respectively. The Bertrand-Nash equilibrium prices are $p_1^{BN}=[2(1+c_1)+a(1+c_2)]/(4-a^2)$, and $p_{21}^{BN}=[2(1+c_2)+a(1+c_1)]/(4-a^2)$.

Denote Firm 1's reaction function, $p_1(p_{21})=(1+c_1)/2+ap_{21}/2$, by R_1, and Firm 2's reaction function, $p_{21}(p_1)=(1+c_2)/2+ap_1/2$, by R_2. The two reaction functions are illustrated in Figure 1 as lines R_1 and R_2. They intersect at point BN, the Bertrand-Nash equilibrium point. Inside the region situated between lines D_1 and D_{21}, the quantities demanded are positive.

Suppose there is an active antitrust policy which restricts the maximum market share to any one firm. Let us denote the maximum allowed market share by S. The restriction to Firm 1 is $x_1/(x_1+x_{21})\leq S$, or translated in prices, $p_1\geq A(S)+p_{21}B(S)$, where $A(S)=(1-2S)/[1-S(1-a)]$ and $B(S)=[a+S(1-a)]/[1-S(1-a)]$. This restriction is illustrated in Figure 1 as line K_1. Given p_{21}, Firm 1 is not permitted to reach any point below line K_1 since it would violate the restriction on market share. Analogously, Firm 2 cannot reach points above line K_2, which embodies the restriction on Firm 2's market share $x_2/(x_1+x_{21})\leq S$. Therefore, the imposition of a maximum market share restricts the possible area to the one situated between lines K_1 and K_2. One can prove by straightforward calculation that the slopes of lines K_1 and K_2 take values between the slopes of R_1 and R_2.

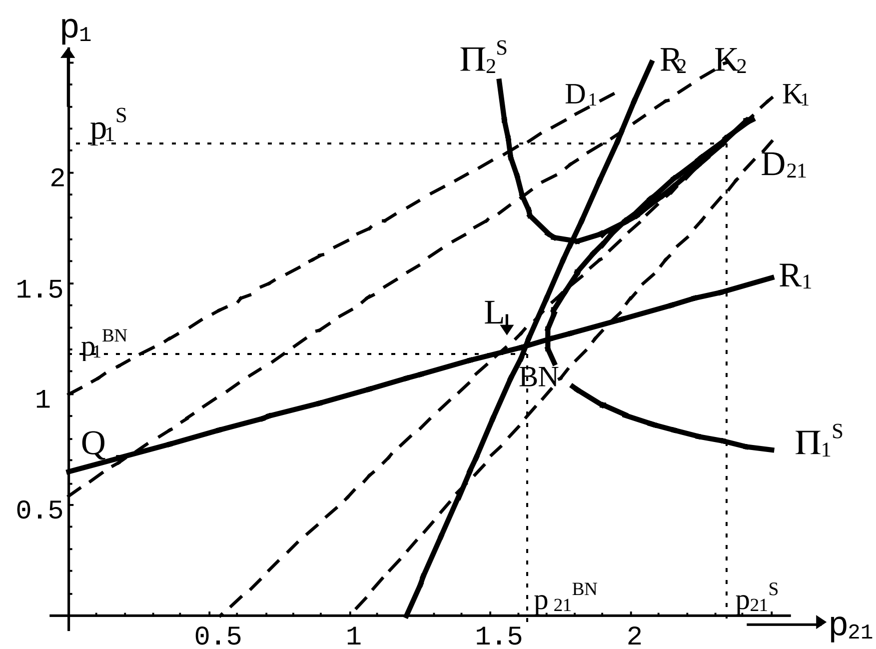

Figure 1. The reaction functions in the presence of a market share constraint for the parameter values: $S=3/4$, $a=0.7$, $c_1=0.3$, $c_2=1.4$.

Suppose Firm 2 has a higher marginal cost than Firm 1, such that the restriction on market share is binding to Firm 1. This situation is shown by Figure 1. Firm 1's reaction function is the two-segment line QLK_1. Since the constraint is binding to Firm 1, Firm 2 has the opportunity of setting p_{21} in such a way as to maximise its profits, given $p_1= A(S)+p_{21}B(S)$. This is a situation of price leadership, which is always possible since K_1 is steeper than R_1 and flatter than R_2.[1] Firm 2's maximisation problem is $\underset{p_{21}}{\text{Max}}\,\{p_{21}(1-p_{21}+ap_1) : p_1=A(S)+p_{21}B(S)\}$, with the solution denoted by p_{21}^S, where Π_2^S is tangent to K_1. In the example illustrated by Figure 1, the profits to the two firms, Π_1^S and Π_2^S, are higher than the Bertrand-Nash profits. For some other values of the parameters Firm 1 might have lower profits, but deriving all the possibilities is not within the scope of this analysis.

The model provides several interesting insights. If the two firms have marginal costs that are not very different (S determines how close the marginal costs should be), no constraint is binding and the Bertrand-Nash equilibrium is obtained. If one of the firms has a much higher marginal cost than the other one, it will be able to increase its profit due to the restriction on market share. Suppose one of the firms, say Firm 2, is a foreign firm. Any trade policy that affects Firm 2's marginal cost, for instance a tariff, might change the strategic interaction between the firms in the presence of an antitrust policy in the way described above. If the foreign firm is initially a low-cost firm relative to the domestic one, imposing a tariff may bring the equilibrium point inside the "competitive zone," that is, between lines K_1 and K_2. This would be a pro-competitive trade policy. On the contrary, if the firms have close marginal costs, a tariff would deepen the difference in marginal costs. This may have an anticompetitive effect, since it may change the character of the interaction between the two firms from a Bertrand competition to a price leadership.

3. Antidumping

3.1 The literature on antidumping and prices

A body of literature on the influence of antidumping laws on pricing already exists. Wares (1977) shows that when the domestic market is perfectly competitive, antidumping makes the foreign firm export less and sell more in its own (foreign) market. Webb (1992) finds that antidumping may have the same effect when firms compete in quantities. Anderson, Schmitt, and Thisse (1995) use a duopoly model to prove that enforcing antidumping raises prices in the domestic market and lowers

[1] It can easily be proved that this is true for any S and any *a*.

prices abroad. Staiger and Wolak (1989) use a model of stochastic demand and an infinitely repeated game to show that, in states of low demand, the threat of the domestic firm filing an antidumping suit leads to a higher potential for collusion on the domestic market. Gruenspecht (1988) develops a two-period model of dynamic competition between a foreign and a domestic firm where costs in Period 2 depend on output produced in Period 1. Both firms may find optimal setting prices below the marginal costs in Period 1 and produce more in order to reduce second period costs. Antidumping prevents the foreign firm from doing so, thus changing the pay-off structure of the game. Hartigan (1994) comes back to a purely anticompetitive type of dumping, the predatory one. Nevertheless, the assessment as to whether a foreign firm dumps is still dependent on the price the foreign firm charges on the foreign market. The author finds that antidumping laws enhance or inhibit the signal the foreign firm sends to the domestic firm about its costs. This signal is sent by the price the foreign firm charges on the domestic market.

3.2 The effect of antidumping on the Bertrand duopoly

This section looks at the effect of an antidumping provision on equilibrium prices in a Bertrand duopoly model in the absence of any other trade or competition policy. It is shown that antidumping reduces the market power of the monopoly in the foreign country but increases prices on the domestic market. Section 4 will combine the results of this section and of Section 2 in order to assess the combined effects of antitrust and antidumping on prices.

The term "dumping" is understood here as "selling abroad at a lower price than in the producer's (i.e., the exporter's) home country." Nevertheless, the model developed in this section considers that the government may allow for a margin of dumping on grounds of efficiency or other reasons. A partial antidumping duty is modelled by D, the antidumping ratio, as will be explained below. In the current practice of antidumping, this definition tends to be replaced by "selling abroad at a price lower than a 'fair' value."

A foreign producer may sell abroad more cheaply than at home for various reasons. Let us denote by “1” the home market, that is, the market where the government wants to implement antitrust and antidumping policies. Notation “2” stands for the foreign market. First, if the foreign producer has a dominant position in its home market (Market 2) while the importing market (Market 1) is more competitive, the exporter gets profits by discriminating on prices. This is possible only when arbitrage between the two countries cannot take place. Then, if Market 1 is a new one for the exporter, lower prices may be, for instance, promotional or aimed at achieving economies of scale. One last reason for dumping, from the point of view of the firm involved, would be to drive local competitors out of business (predatory dumping). In the model developed below, dumping is the result of a difference in price elasticities of demand between two markets, which permits price discrimination.

The foreign firm (Firm 2) is dumping in the domestic market (Market 1) if the price it charges in the domestic market, p_{21}, is lower than the price it charges in the foreign market, p_{22}. Suppose the foreign firm is a monopolist in the foreign market (in Market 2). The domestic firm charges price p_1 and it does not sell abroad. On the domestic market, the unconstrained reaction functions are $p_1(p_{21})=(1+c_1+ap_{21})/2$ and $p_{21}(p_1)=(1+c_2+ap_1)/2$, and the Bertrand-Nash equilibrium prices are $p_1^{BN}=[2(1+c_1)+a(1+c_2)]/(4-a^2)$ and $p_{21}^{BN}=[2(1+c_2)+a(1+c_1)]/(4-a^2)$.

Suppose the monopoly (Firm 2 in Market 2) faces a demand $x_{22}=M-p_{22}$, where M is a measure of market size. The monopoly price is $p_{22}^M=(M+c_2)/2$, the quantity $x_{22}^M=(M-c_2)/2$, and the profit $\Pi_{22}^M=(x_{22}^M)^2$. Define $d=p_{21}/p_{22}$. The foreign firm is liable for dumping if $d<D$, where D is exogenous. Let us call d the (actual) dumping ratio and D the antidumping ratio. The foreign firm faces the antidumping constraint $p_{21}\leq Dp_{22}$. Without the constraint, Firm 2 would choose d corresponding to the Nash equilibrium on the domestic market, $d^{BN}=p_{21}^{BN}/p_{22}^M=[2/(M+c_2)][2(1+c_2)+a(1+c_1)]/(4-a^2)$. Firm 2 is dumping on Market 1 if $d^{BN}<1$. Throughout the next discussion, it will be assumed that M is always sufficiently great for Firm 2 to dump on Market 1.

Note that the antidumping constraint, $d \leq D$, is binding only if $D > d^{BN}$, since d^{BN} reflects the price Firm 2 would optimally set in Market 1. As Figure 2 illustrates, Firm 2 cannot be obliged by the antidumping authority to set a price lower than p_{21}^{BN}. The arrows in Figure 2 indicate the regions where the constraint $d \leq D$ is not binding and the direction in which Firm 2 would change d. Firm 1's reaction function is not affected by the antidumping constraint. It is, as before, $p_1(p_{21})=(1-c_1+ap_{21})/2$.

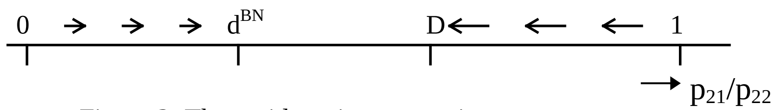

Figure 2. The antidumping constraint

Firm 2 solves the problem:

$$\underset{p_{21},\, p_{22}}{\mathrm{Max}}\ p\{(p_{21} - c_2)(1 - p_{21} + ap_1) + (p_{22} - c_2)(M - p_{22}) : p_{21} = Dp_{22}\},$$

equivalent to:

$$\underset{p_{21}}{\mathrm{Max}}\ \{ (p_{21} - c_2)(1 - p_{21} + ap_1) + (\frac{p_{21}}{D} - c_2)(M - \frac{p_{21}}{D})\}.$$

The solution to this maximisation problem is Firm 2's reaction function on Market 1 in the presence of the antidumping constraint, $p_{21}^D(p_1)=A(D)+B(D)p_1$, where $A(D)= (1+c_2+M/D+c_2/D)/[2(1+1/D^2)]$, and $B(D)= a/[2(1+1/D^2)]$. Figure 3 illustrates the

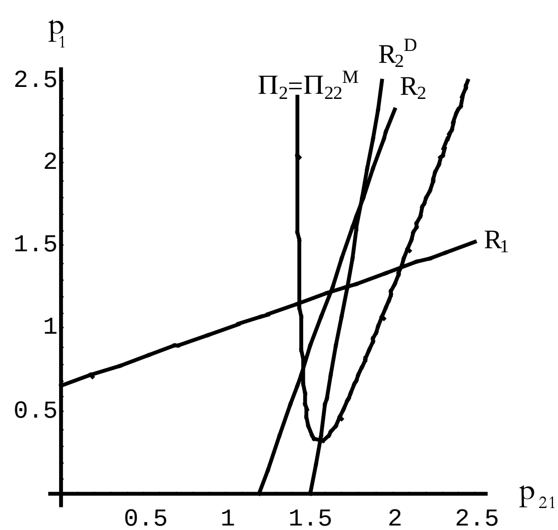

Figure 3: Change in Firm 2's reaction curve under antidumping for a=0.7, c_1=0.3, c_2=1.4, D=1.

change in Firm 2's reaction function under the antidumping constraint. To draw Figure 3, M is considered equal to 1.5 times the value that would solve the equation $d^{BN}=1$ to make sure that M is sufficiently great for Firm 2 to dump in Market 1. The curves R_2 and R_1 are the unconstrained reaction functions, and the curve R_2^D is Firm 2's reaction function under antidumping. In Figure 3 one can also see a parabola indicating the profit Firm 2 would get by selling only as a monopolist on Market 2. All the equilibrium points inside the parabola correspond to higher profits since Firm 2 earns more by selling both at home and abroad than by selling only domestically.

There are several points one can note with respect to the constrained equilibrium. First, antidumping does not involve Firm 1's reaction function. Consequently, the nature of the strategic interaction between the two firms is not changed although the equilibrium set of prices is.

Then, it can be easily shown that both A(D) and B(D) depend positively on D for a market size, M, which is not higher than $2+c_2$. Therefore, a change in D has two effects on Firm 2's reaction function. First, an increase in D shifts the curve toward higher prices. Second, an increase in D also tilts the curve toward higher prices. The two effects are cumulative, and the overall effect is an increase in the equilibrium prices with respect to the unconstrained equilibrium prices.

In Figure 3, the curve R_2^D is steeper than R_2 because, for $D=d^{BN}$, R_2^D does not coincide with R_2. The mere introduction of the antidumping constraint makes R_2^D differ from R_2, but a subsequent increase in D has the effects outlined above.

Lastly, one can derive a relation between prices p_{22} and p_1: $p_{22}(p_1)=p_{21}^D(p_1)/D= A(D)/D+p_1B(D)/D$. The existence of a relation between p_{22} and p_1 indicates that antidumping has a procompetitive effect on the foreign market as long as Firm 2 keeps selling in both markets. Firm 2 becomes a "constrained" monopoly in Market 2, charging less than the monopoly price.

4. Antidumping and antitrust

In the previous section it was shown that the equilibrium price in Market 1 goes up when D goes up. Since Firm 1's reaction function does not change with D, an increase in D moves the equilibrium point upward, along Firm 1's reaction curve. Suppose there is a market share constraint, S. Suppose, also, that the two firms are in a Bertrand-Nash equilibrium before an antidumping provision is enforced; that is, neither of them is bound by the market share restriction. The market share constraint obliges the firms to keep prices between lines K_1 and K_2 (see Figure 1).

When Firm 2 is obliged to increase price p_{21} because of the introduction of an antidumping constraint, Firm 1 may find itself bound by the market share constraint. Therefore, the foreign firm finds itself in a leading position, being able to further increase price and profit in Market 1, as shown in Section 2. The new (higher) price in Market 1 permits Firm 2 to raise the price in the foreign market as well in order to maintain the same value of the dumping ratio d=D.

The first conclusion of this analysis is that the foreign firm may do better in Market 1 when antidumping is enforced in the presence of an antitrust provision. Another conclusion is that a domestic competition policy is anticompetitive both at home and abroad since it raises prices in both markets. One still has to keep in mind that the existence of the antidumping provision promotes competition abroad by establishing a link between the two markets, undermining the monopoly in Market 2.

5. Antidumping and the stability of tacit collusion

This section addresses two questions. First, it investigates the effect of an antidumping provision on the firms' incentive to collude in a repeated game. Second, it determines an optimal antidumping ratio, that is, the antidumping margin that maximises domestic welfare. Under the assumptions of a model of a repeated Cournot game, it turns out that enforcing an antidumping provision *lowers* the probability of collusion on the home market. An optimal antidumping ratio is shown to be lower than 1.

The set-up of the model is the same as in the previous sections. Suppose there are two firms situated in two countries. The firms produce a homogenous good. Firm 1 is situated in Country 1 (the "home country"). It produces quantity x_1 and sells only on the home market. Firm 2, the "foreign" firm, is situated in Country 2, the "foreign" country. It produces quantity x_{21} for export to the market in Country 1, and quantity x_{22}, for sale on the market in Country 2. The two markets are segmented. Firm 2 is a monopolist in its own market. Country 1 has a trade authority that can impose a provision on the foreign firm that the price charged in Market 1, p_{21}, be not less than Dp_{22}, where D, the antidumping ratio, is a parameter to be chosen by the trade authority. The trade authority is the first mover and chooses D; then, the firms compete in quantities in the product market. The demand functions are identical in the two countries, namely: $p_i=1–Q_i$, $i=1,2$, where p_i is price and Q_i is the total quantity sold in market i.

The incentive to deviate from a presumed tacit collusion is assessed in a standard way, that is, by calculating the critical interest rate, r^{cr}, in the framework of a repeated game with trigger strategies. A firm deviates from the tacit collusion if the gain from deviating for one period is higher than the loss from playing Cournot forever. That is, $\Pi^d–\Pi^j>(\Pi^j–\Pi^c)/r$, where superscripts d, j, c, stand for deviation, joint decision, and Cournot, respectively, and r is the relevant interest rate.

Define the critical interest rate as $r^{cr}=(\Pi^j–\Pi^c)/(\Pi^d–\Pi^j)$, which is the rate which makes the firm indifferent between colluding and deviating when it knows the punishment strategy. For any $r>r^{cr}$ the tacit collusion is not sustainable since the gain from deviating in one period exceeds the loss from producing the Cournot equilibrium quantities forever. The higher the critical interest rate, the lower the probability of deviating, and hence, the less competitive the industry. Figure 4 shows the regions where the industry is either competitive or collusive. Thus, any action that makes r^{cr} higher is anticompetitive since it decreases the probability that $r> r^{cr}$.

$r < r^{cr}$ r^{cr} $r > r^{cr}$

collusion | *competition*

Figure 4. Possible values of the actual interest rate relative to its critical value

When an antidumping provision is imposed on Firm 2, it forces the firm to link the quantity decisions on the two markets. This implies that the critical interest rate faced by Firm 1 (r_1^{cr}) may differ from the critical rate faced by Firm 2 (r_2^{cr}). In that case the *industry* critical interest rate is the lowest value between the two different critical interest rates specific to the two firms, because the necessary condition for collusion is that *both* firms participate.

Without the antidumping constraint, the outcome of the Cournot game, with linear demand $p=1-x_1-x_{21}$, and with zero marginal costs is: $x_1^c=1/3$, $x_{21}^c=1/3$, $\Pi^c=1/9$. The tacit collusion outcome is the result of joint profit maximisation: $x_1^j= x_{21}^j=1/4$, $\Pi^j=1/8$. When one firm deviates, the outcome is found by maximising that firm's profit, given that the other firm keeps producing the target output. The profit to the deviating firm is $\Pi^d=9/64$.

The critical discount rate for the unconstrained Cournot problem is:

$$r_1^u = r_2^u = \frac{1/8 - 1/9}{9/64 - 1/8} = \frac{8}{9}, \qquad (1)$$

where r_i^u represents the critical discount rate of firm i, (i=1,2) in the unconstrained case. As long as there is no antidumping action, we assume the two markets are completely separate so that the only relevant market for such analysis is Market 1. The industry critical interest rate is $r^{cr} = r^u = 8/9$.

How does r^{cr} change when antidumping is enforced? To answer this question we need to recalculate profits in three situations: (1) Cournot in the presence of antidumping, (2) joint profit maximisation and antidumping, and (3) deviation from collusion and antidumping.

(1) In the "Cournot and Antidumping" case, the firms play a Cournot game in the home market, where Firm 2 faces the constraint $p_1=Dp_2$. Taking into account the demand function, the constraint on prices translates into a constraint on quantities sold by Firm 2: $1-x_{22}=(1-x_1-x_{21})/D$; hence, $x_{22}=(D-1+x_1+x_{21})/D$.

Firm 1's problem is to maximise $\Pi_1=(1-x_1-x_{21})x_1$, by choosing x_1. The solution is the reaction function: $x_1(x_{21})=(1-x_{21})/2$. Firm 2 has two possible options: either to sell only on the foreign market, getting the monopoly profit, $\Pi^M{}_2=1/4$, or to sell both on Market 1 and on Market 2. The decision depends on the total profit $\Pi_2=\Pi_{21}+\Pi_{22}$ earned in this last case. Therefore, Firm 2's problem is to maximise $\Pi_2=(1-x_{22})x_{22}+(1-x_1-x_{21})x_{21}$, subject to the constraint $x_{22}=(D-1+x_1+x_{21})/D$, given x_1. The reaction function to Firm 2's problem is: $x_{21}(x_1)=(1+2/D^2-1/D-x_1(1+2/D^2))/\ (2+2/D^2)$. Solving the system of equations given by the two reaction functions, one obtains the solution: $x_1{}^{cd}=D(D+1)/(3D^2+2)$, $x_{21}{}^{cd}=(D^2-2D+2)/(3D^2+2)$, where the superscript "cd" stands for "Cournot and Antidumping." The corresponding profits are $\Pi_2{}^{cd}$ and $\Pi_1{}^{cd}$ as functions of D. Firm 2 is willing to be present on Market 2 as long as $\Pi_2{}^{cd}$ is greater than $\Pi_{22}{}^M=1/4$, which is Firm 2's monopoly profit on Market 2. The difference between $\Pi_2{}^{cd}$ and $\Pi_{22}{}^M$ is equal to $D(8-4D+8D^2-5D^3)/[4(2+3D^2)^2]$. In Figure 5 this expression is illustrated by curve P. The expression is positive for any relevant value of D, that is, any value between $d^{BN}=2/3$ and 1. This implies that Firm 2 is always selling on both markets.

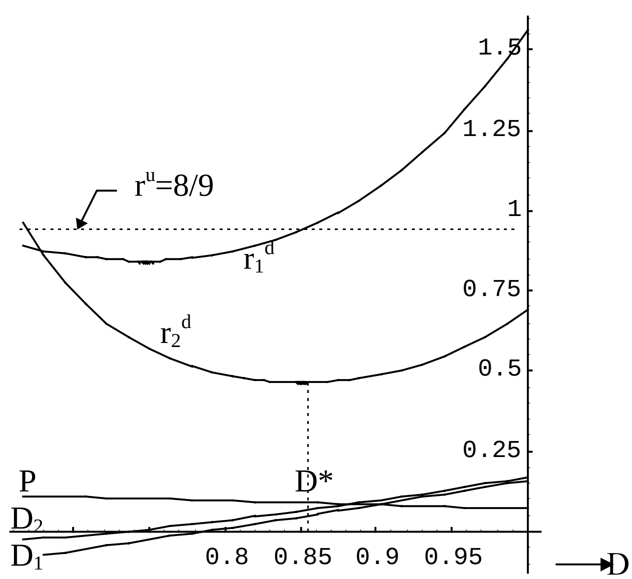

Figure 5. Critical interest rates as functions of the antidumping ratio

(2) In the "Joint and Antidumping" case, joint profit maximisation on Market 1 results in *monopoly* total quantity, total profit, and price: $(x_1+x_{21})^{jd}=1/2$, $\Pi^{jd}=(\Pi_1+\Pi_{21})^{jd}=1/4$, $p_1^{jd}=1/2$, where superscript "jd" stands for "Joint and Antidumping." Firm 2 sells at home at a price equal to p_1^{jd} the monopoly quantity and captures profit $\Pi_{22}^{jd}=1/4$, so that the total profit to Firm 2 from collusion is $\Pi_2^{jd}=\Pi_{21}^{jd}+\Pi_{22}^{jd}$. Since the gains from collusion with respect to the Cournot game are different for each firm, an assumption is needed about the distribution of the total profit on Market 1. Assume that each of the two firms chooses its production such that the total profit is distributed between them according to the Nash bargaining solution.

Suppose Firm 1 gets a fraction α of the total profit on Market 1, and that the gains from collusion with respect to the Cournot game are divided equally between the two firms. Fraction α is then the solution to the equation $\alpha\Pi^{jd}-\Pi_1^{cd}=(1-\alpha)\Pi^{jd}-\Pi_2^{cd}+\Pi_{22}^{jd}$, with $\Pi^{jd}=1/4$, and $\Pi_{22}^{jd}=1/4$. The solution to this equation is $\alpha=1+2(\Pi_1^{cd}-\Pi_2^{cd})$. The profits to each firm under antidumping and tacit collusion are: $\Pi_1^{jd}=\alpha\Pi^{jd}$, and $\Pi_2^{jd}=(1-\alpha)\Pi^{jd}+\Pi_{22}^{jd}$. Note that, in this case, the antidumping constraint is not actually binding since the prices are equal to the monopoly price on the two markets. Firm 2 sells abroad without actually dumping. To get the joint profits the firms must produce $x_1^{jd}=\alpha\Pi^{jd}/p_1^{jd}$, and $x_{21}^{jd}=(1-\alpha)\Pi^{jd}/p_1^{jd}$, respectively. Since total profit and price have monopoly values, it is found that $x_1^{jd}=\alpha/2$ and $x_{21}^{jd}=(1-\alpha)/2$, where α is given by the expression derived above as a function of D.

(3) Let us look at the case of deviation in the presence of antidumping, ("dd"), and begin with Firm 2 deviating from collusion. Given $x_1=x_1^{jd}$, Firm 2 maximises its profit on both markets, $\Pi_2=p_1x_{21}+p_2x_{22}$, subject to the antidumping constraint $x_{22}=(D-1+x_1^{jd}+x_{21})/D$. The solution is $x_{21}^{dd}=(2-\alpha)/4$, with the corresponding price $p_1^{dd2}=(2-\alpha)/4$, and profit $\Pi_{21}^{dd}=[(2-\alpha)/4]^2$. The superscript "dd2" denotes the price prevailing on Market 1, which has been determined by Firm 2's deviation from the joint output. Price and profit on Market 2 are $p_2^{dd2}=p_1^{dd2}/D$, $\Pi_{22}^{dd}=p_2^{dd2}x_{22}^{dd}$, and total profit to

Firm 2 is $\Pi_2^{dd}=\Pi_{22}^{dd}+\Pi_{21}^{dd}$. If the antidumping constraint allowed Firm 2 to sell at the monopoly price on Market 2, the dumping ratio would be $d^*=p_1^{dd2}/p_2^M=(2-\alpha)/2$, which is a function of D.

Whether the antidumping constraint is binding or not depends on the magnitude of D. The difference D–d*, that is, the difference between the antidumping ratio and Firm 2's desired dumping ratio in the presence of antidumping, is plotted in Figure 5 as curve D_2. Throughout the next calculations it will be assumed that the constraint is binding at optimal D, an assumption that will be shown to be correct when optimal D is determined in the remainder of this section.

At this point all the elements necessary to determine Firm 2's critical interest rate have been determined. This rate is $r_2^d=(\Pi_2^{jd}-\Pi_2^{cd})/(\Pi_2^{dd}-\Pi_2^{jd})$. This expression is a function of D, and it is plotted in Figure 5. By the same method, Firm 1's critical interest rate, r_1^{cr}, has been calculated and illustrated in Figure 5. Curve D_1 is, as before, the difference $D-p_1^{dd1}/p_2^M$, where p_1^{dd1} is the price prevailing in Market 1 if Firm 1 deviated from collusion. Curve D_1 will be used to show that the constraint is binding for Firm 2 around the optimal value of D.

Figure 5 suggests that, for the entire relevant range of D, at least one of the two critical interest rates, r_1^{cr} and r_2^{cr}, is lower than the unconstrained critical interest rate, r^u. This result shows that Market 1 is more competitive under antidumping than under free trade. Another insight is that the optimal antidumping ratio, that is, the value of D yielding the lowest critical interest rate (minimising the probability of collusion), denoted in Figure 5 by D*, is neither d^{BN} nor 1, but takes an interior value.

Once the optimal antidumping ratio has been found, it is possible to check the previous assumption that antidumping is still binding when one of the firms is deviating. Curves D_1 and D_2 in Figure 5 represent, as explained above, the difference between the antidumping ratio, exogenous for the firms, and the dumping ratio Firm 2 would choose were it allowed to charge monopoly price on Market 2. This difference is negative for values of D lower than approximately .7, whereas the optimal D chosen by the authority is around .85. Therefore, Firm 2 is always bound by the constraint.

There is an important observation connected to the result obtained above. The statement

"Market 1 is more competitive" has to be understood strictly in the sense of the present definition of the incentive of firms to sustain a tacit collusion, namely, the outcome of an infinitely repeated game. From the point of view of a static analysis, one can note that, after the introduction of the antitrust constraint, the market shares become unequal, causing the Herfindahl index to increase. According to a static definition of industry concentration, it is not true that Market 1 becomes more competitive. Still, using the Herfindahl index when dealing with tacit collusion is not appropriate since in this case, the "true" Herfindahl index must be considered equal to 1 instead of 1/4. Although when tacitly colluding the firms do share the market, the industry is indeed monopolistic.

A paradoxical result of models of infinitely repeated games is that a policy that enhances market concentration is procompetitive in the long run as it destabilises the duopolistic collusion. That is, the greater the inequality between firms, the greater the incentive to deviate from collusion.[2]

6. Co-ordinated antidumping and antitrust policies

Trade policy will be characterised here by the antidumping ratio D, such that $p_{21}=Dp_{22}$, $0<D\leq 1$. Parameter D allows for the possibility that the government may not impose duties for the full margin of dumping (that is, for the whole difference p_{22}-p_{21}). Such a policy is encouraged in trade agreements such as the GATT Antidumping Code by what is called the "Lesser Duty" principle. I assume, further, that the antitrust authority is able to enforce a set of regulations equivalent to imposing a certain value of λ, the conjectural variation parameter.

The conjectural variation parameter is assumed to be the same for the two firms. It expresses the belief of Firm 1 that a change dx_1 in its own output would induce a change dx_1/λ in Firm 2's output. It is generally assumed that $\lambda\in[-1,1]$, with the following significance: λ=–1 corresponds to perfect competition, λ=0 is Cournot competition, and λ=1 stands for monopoly. Put another way, the closer λ is to 1, the more concentrated the industry is.[3] Using λ as a concentration index may be justified as long as one can establish a correspondence between λ and a concentration index. The literature on oligopoly theory has established that such a relationship exists.[4]

By definition, uncoordinated trade and competition policies emerge when the trade authority chooses the parameter under its control, given that the antitrust authority has chosen the other parameter independently. That is to say, D and λ are chosen separately. Since one of the firms is foreign, assume the two authorities maximise a welfare function equal to the sum of consumer surplus and profit to the domestic firm. Co-ordinated policies mean joint maximisation of the national welfare function by the two authorities. The sequence of the game is as follows: First, the authorities choose λ and D simultaneously. Then, given λ and D, the firms simultaneously choose their output to maximise profits.

Firm 1's maximisation problem is: $\underset{x_1}{\text{Max}}\,(1-x_1-x_{21})x_1$. Firm 2 maximises the sum of its profits earned both in Market 1 and in Market 2. Demand in Market 2 is $x_{22}=1-p_2$. The antidumping provision translates into a constraint on quantities sold in the two markets: $p_1=Dp_2$ implies $x_{22}=1-(1-x_{21}-x_1)/D$. Therefore, Firm 2 has only x_{21} as a control variable. Its maximisation problem is: $\underset{x_{21}}{\text{Max}}\,\{[(1-x_{22})x_{22}+(1-x_{21}+x_1)x_{21}]:\ x_{22}= 1-(1-x_{21}-x_1)/D\}$. The solution to the two simultaneous profit maximisation problems is: $x_1=(b+c)/((2+\lambda)b-a)$, $x_{21}=(a+(2+\lambda)c)/(a-(2+\lambda)b)$, $p_1=(1+\lambda)(b+c)/((2+\lambda)b-a)$, $p_2=p_1/D$, $x_{22}=1-p_2$, where $a\equiv-2-2\lambda-D^2$, $b\equiv-2+2\lambda+(2+\lambda)D^2)$, $c\equiv-(1+\lambda)D+D^2+2(1+\lambda)$.

Assume the welfare function is the sum of consumer surplus in Country 1, $CS_1=(x_1+x_{21})^2/2$, and Firm 1's profit, $\Pi_1=p_1x_1$. With the equilibrium price and quantities calculated above, welfare is a function of λ and D. The contours of this function have

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[2] A similar point is made by Shapiro (1989).

[3] There is a notorious problem concerning the consistency of the conjectural variation parameter: the ex-ante value of the parameter is in general not confirmed after the game is solved.

[4] See, for instance, Davies et al. (1989).

the shape illustrated in Figure 6, where the value of welfare increases in the direction indicated by the arrow.

An interesting area in Figure 6 is above the curve labelled $d^*(\lambda)$, since Firm 2 is obliged by antidumping provisions to sell at a price ratio $d=p_1/p_2$ *not less* than D. In the absence of antidumping, Firm 2 would sell at an optimal price ratio[5] $d^*(\lambda)=p^*_1/p^*_2$, where prices would correspond to the unconstrained profit maximisation in the two markets, given λ. Suppose the trade authority imposed $D<d^*$ for a given value of λ. Since Firm 2 is free to choose a higher d, it will choose d^*. That is to say, any $D<d^*$ is not binding for Firm 2. On the contrary, any $D>d^*$ is binding since Firm 2 would like to come down to d^*. In this case, Firm 2 chooses $d=D$, that is, $p_1=Dp_2$. Translated into graphical language, any value of d situated under the curve $d^*(\lambda)$ illustrated in Figure 6 is not enforceable by the authority; hence, it is not of interest for this analysis. Curve $d^*(\lambda)$ is a two-dimensional version of Figure 2.

Figure 6 shows the contour of Firm 2's profit together with the welfare function contours. The dark area is the domain where Π_2 is less than 1/4, which is Firm 2's monopoly profit in Market 2. For these (λ, D) pairs, Firm 2 does not benefit from selling in Market 1 since the obligation of lowering price p_2 in turn lowers its profit.

The restriction on d refines the interpretation of the contours of the welfare function. Looking at Figure 6, one can see that maximum welfare corresponds to lower values of λ and to as high values of D as possible. In a very competitive Market 1, the maximum price ratio that can be imposed is limited by the profit Firm 2 would earn by selling only in Market 2.

As the graph in Figure 6 shows, national welfare is much more sensitive to changes in competition policy than to changes in antidumping policy. That is to say, any given policy (λ_1, $D_1=1$) can be replaced by an equivalent policy (λ_2, $D_2<1$), where λ_2 is slightly less than λ_1, but D_2 is significantly less than 1.

Figure 7 displays the world welfare contours, defined as $W_w = CS_1+CS_2+\Pi_1+\Pi_2$. Figure 7 suggests that, in the possible region, raising D (i.e., imposing antidumping) leads to higher world welfare. This is possible since imposing antidumping lowers price p_2, and consumers in Market 2 are better off. It turns out that antidumping is a means of "exporting" competition, a point made also in Section 3.

This effect is stronger the more competitive Market 1 is; that is, Market 1 has a "comparative advantage" in competition policy and it is able to "export" it. One should note, nevertheless, that country 1 "exports" competition at the expense of "importing" market power. Still, opening up trade is preferable to the alternative of having a domestic monopoly.

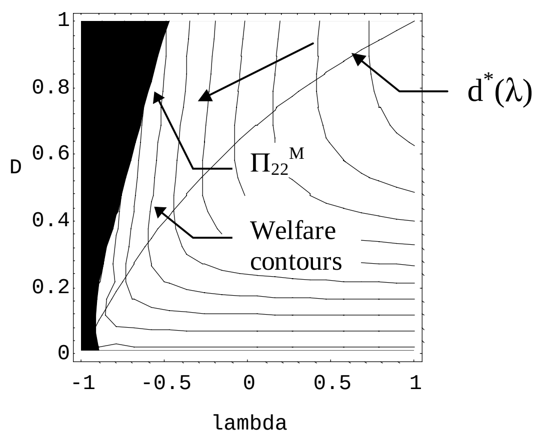

Figure 6. Firm 2 is willing to sell on Market 1 only for pairs (λ,D) situated in the light area

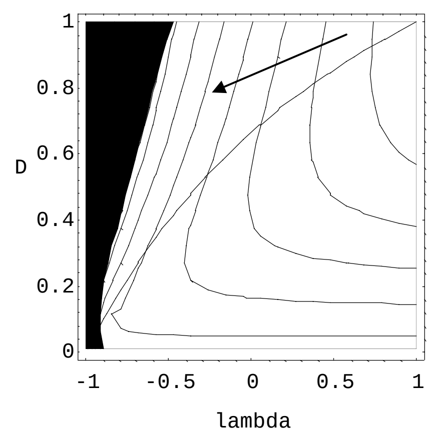

Figure 7. World welfare increases as indicated by arrow

One result from the graphical analysis of welfare functions is that the effect of national antidumping policy on national welfare is weaker than the effect of national antidumping on world welfare, as the positive slopes of contours in Figure 6 are higher than those in Figure 7. Another important result is that, although increasing the antidumping parameter is welfare-improving, for any given domestic market structure there is the possibility of significantly lowering antidumping duties by slightly strengthening the competition policy along the same welfare contour.

7. Summary and conclusion

[5] By solving the unconstrained Cournot problem, $d^*(\lambda)=2(1+\lambda)/(3+\lambda)$.

Antitrust policy, modelled as a constraint on the maximum market share of a single firm, may have perverse effects by changing the nature of the strategic interaction between firms. An unexpected effect is increasing market prices, hence the anticompetitive effect of the antitrust policy. If the competitiveness of an industry is defined as the willingness of firms to deviate from collusion in a repeated game, then antidumping is procompetitive.

In an international setting, antidumping itself is anticompetitive at home, but procompetitive abroad. A country with a more competitive industry may "export" competition and "import" market power by imposing antidumping duties. The anticompetitive effect of antitrust is enhanced by an antidumping provision.

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