Anti-dumping regulations:
anti-competitive and anti-export:
The Mixed Strategy Equilibrium

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Abstract

In a Bertrand duopoly model, it is shown that an anti-dumping regulation can be strategically exploited by the domestic firm to reduce the degree of competition in the domestic market. The domestic firm commits not to export to the foreign market which gives the foreign firm a monopoly in its own market. As a result the foreign firm will increase its price allowing the domestic firm to increase its price and its profits. If the products are sufficiently close substitutes then the higher profits in the domestic market are large enough to compensate for the loss of profits on exports.

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JEL classification: F13, L13.

1. Introduction

Eight rounds of GATT multilateral trade negotiations culminating in the Uruguay round have reduced tariffs to historically very low levels, and the Uruguay round has banned the use of voluntary export restraints. However, the inadequacy of the anti-dumping agreement negotiated under the Uruguay Round means that governments can still use anti-dumping regulations to protect their industries and, even before the implementation of the Uruguay Round agreement, anti-dumping regulations were used extensively by Australia, Canada, the EC and the US. According to the GATT (1991, p.110), the EC Commission regards its anti-dumping regulations as “one of the most important instruments of its common commercial policy”, and this view is supported by the figures on the use of anti-dumping regulations. Between January 1980 and June 1992, the EC initiated 454 anti-dumping investigations that resulted in duties being imposed in 143 cases and price undertakings in 183 cases; no dumping was found to have occurred in only 36 cases and no injury in 87 cases.[1] The exporting countries involved were mainly Japan, China and eastern European countries, while the main products involved were consumer electronics, textiles and chemicals. In the future, with few alternative instruments available, it seems likely that governments will increasingly resort to anti-dumping regulations to protect their industries.

Critics, such as Hindley (1991), argue that the economic rationale for anti-dumping regulations is limited in scope and would not provide a justification for duties or price undertakings in the vast majority of cases. They would also argue that the implementation of anti-dumping regulations has a protectionist bias with foreign firms almost always being found guilty of dumping. Another criticism is that anti-dumping regulations are anti-competitive encouraging foreign firms to compete less aggressively in the domestic market. In the EC chemical industry, Messerlin (1990) found that sectors protected by anti-dumping duties and price undertakings were often the subjects of cartel investigations within a few years. Even the EC Commission, in its reports on competition policy, recognises that anti-dumping measures may have a negative impact on competition.[2] It has also been argued that anti-dumping regulations may restrict trade and be anti-competitive even in the absence of anti-dumping dutes or price undertakings. In the US, Staiger and Wolak (1994) find that foreign firms reduce their exports to the US during the lengthy anti-dumping investigations and that some domestic firms lodge complaints solely to benefit from this effect. Given this evidence, it seems reasonable to conclude that anti-dumping regulations will be strategically exploited by domestic firms to gain protection.

In this paper a model is presented where a domestic firm may strategically exploit a domestic anti-dumping regulation to reduce competition in the domestic market and thereby to increase its profits at the expense of the domestic consumer. In a symmetric model, a domestic and a foreign firm compete as Bertrand duopolists in the domestic and the foreign markets. The introduction of a domestic anti-dumping regulation prevents the foreign firm from setting a lower price in the domestic market than in the foreign market, but this would be expected to have no effect in this symmetric Bertrand duopoly since prices are the same in both markets under free trade. However, if the domestic firm commits not to export to the foreign market then the foreign firm will have a monopoly in the foreign market while competing with the domestic firm in the domestic market, but the foreign firm will be prevented from setting a lower price in the domestic market than in the foreign market by the anti-dumping regulation. As a result, the foreign firm will either set the monopoly price and sell only in the foreign market or set a lower price and sell in both markets. In both cases the price set by the foreign firm is higher than the Bertrand duopoly price under free trade allowing the domestic firm to increase its price and its profits in response. It will be shown that if the two products are sufficiently close substitutes then the higher profits in the domestic market are large enough to compensate for the loss of profits on exports to the foreign market making this strategy profitable for the domestic firm. The foreign firm will also gain since it will earn monopoly profits. The higher profits for the firms are at the expense of the consumers in both countries who have to pay the higher prices. It will be shown that welfare in both countries is reduced by this strategic exploitation of the anti-dumping regulation with the domestic country suffering the largest welfare loss.

Recently, a number of different approaches have been used by researchers to analyse anti-dumping regulations in models of trade under imperfect competition. In a conjectural variations model with differentiated products, Dixit (1988) models dumping as a change in the foreign firms' conjectural variation that reduces the price of the foreign product. He shows that dumping will lead the domestic government to reduce its optimal tariff and, therefore, concludes that this model provides no economic basis for anti-dumping duties. In Webb (1992), a foreign firm has a monopoly in its own market and competes with a domestic firm in a Cournot duopoly in the domestic market. An anti-dumping regulation that prevents price discrimination by the foreign firm will increase domestic output and shift profits to the domestic firm, but the effect on welfare is ambiguous because the price in the domestic market will also increase. A two-period version of this model, where dumping in the first period leads to anti-dumping duties in the second period, is considered by Reitzes (1993). The threat of anti-dumping duties in the second period leads the foreign firm to reduce its exports in the first period. In Anderson *et al* (1995), domestic and foreign firms with identical costs compete in Bertrand oligopolies in both markets in the presence of a transport cost. When one country unilaterally introduces an anti-dumping regulation, domestic firms will gain while domestic consumers will lose, but if both countries have anti-dumping regulations then the firms lose while the consumers gain and world welfare may be higher than under free trade.[3]

The anti-competitive effect of anti-dumping regulations has been addressed by a number of authors. Cuevas (1992) considers a homogenous product Bertrand duopoly model where a domestic and a foreign firm compete in both markets in the presence of a transport cost. With anti-dumping regulations there is a pure strategy Nash equilibrium when the transport cost is sufficiently large otherwise there is a mixed strategy Nash equilibrium when it is low. If the domestic country unilaterally introduces an anti-dumping regulation then the domestic firm is able to increase its price to the monopoly price in the pure strategy Nash equilibrium. If both countries introduce anti-dumping regulations then both firms are able to charge the monopoly price in their own markets in the pure strategy Nash equilibrium. Noting that in the US an anti-dumping investigation allows domestic and foreign firms to negotiate about prices without the threat from anti-trust law, Prusa (1992) models price setting as a Nash bargaining game between a domestic and a foreign firm that allows the firms to achieve the collusive level of profits. Prusa (1994) considers a two-period Bertrand duopoly model where prices set in the first period affect the probability of anti-dumping duties being imposed in the second period. He shows that an anti-dumping regulation will lead the foreign firm to increase its price in the first period in an attempt to avoid anti-dumping duties in the second period while the domestic firm may feign injury to increase the probability of anti-dumping duties in the second period. In Staiger and Wolak (1992), an anti-dumping regulation leads a foreign monopolist to reduce its capacity and its exports to the domestic market. Staiger and Wolak (1991) consider an infinitely repeated game with a domestic and a foreign firm competing in the domestic market where demand is stochastic. In each period, firms invest in capacity before the state of demand is known and then after the state of demand is revealed they compete in prices. An anti-dumping regulation is shown to make it easier for the firms to sustain collusion and to increase the market share of the domestic firm even though anti-dumping duties are never imposed. The effect of an anti-dumping regulation on the profitability of collusion in static Cournot oligopoly model is analysed by Veugelers and

Vandenbussche (1996), but they do not consider the sustainability of collusion.

Section two describes the basic Bertrand duopoly model and derives the symmetric Bertrand equilibrium under free trade. The strategic exploitation of the domestic anti-dumping regulation by the domestic firm is considered in section three. Section four presents a brief analysis of the effect of adding foreign direct investment into the model.

2. The Bertrand duopoly model

A domestic firm and a foreign firm produce differentiated products and compete as Bertrand duopolists in the domestic and foreign markets. For simplicity, it is assumed that the two markets are identical in size, that the two firms have identical and constant marginal cost, and that there are no transport costs. Also, the two markets are assumed to be segmented rather than integrated so that price discrimination is possible, although it will not occur in the symmetric Bertrand equilibrium under free trade. Variables relating to the domestic market will be represented by lower case letters while those relating to the foreign market will be represented by upper case letters, and variables relating to the domestic firm will be labelled with a subscript one while those relating to the foreign firm will be labelled with a subscript two. Given the assumptions of segmented markets and constant marginal cost, each market can be analysed independently of the other market and, given the symmetry of the model, the equilibrium under free trade will be identical in both markets; hence, the analysis will concentrate on the equilibrium in the domestic market. Both firms have constant marginal cost c and any fixed costs are assumed to be sunk. In the domestic market, the price set by the domestic firm is p_1 and its sales are x_1 while the price set by the foreign firm is p_2 and its sales are x_2.

In each country there is a representative consumer with identical quasi-linear preferences that are described by a quadratic utility function; the utility function of the representative consumer in the domestic country is:

$$u = v(x_1, x_2) + y = \alpha x_1 + \alpha x_2 - \frac{1}{2}\left(x_1^2 + x_2^2 + 2\gamma x_1 x_2\right) + y \tag{1}$$

where y is consumption of the numeraire good which is produced by a perfectly competitive industry using constant returns to scale technology. The parameters of the utility function are assumed to satisfy the following conditions: the maximum willingness to pay of consumers exceeds the marginal cost of the firms, $\alpha > c > 0$; and the products of the two firms are imperfect substitutes, $0 \le \gamma < 1$. It turns out that the key parameter in the model is γ which measures the degree of product differentiation, where $\gamma = 1$ means that the products of the two firms are perfect substitutes and $\gamma = 0$ means that the demands for the two products are independent. Utility maximisation, subject to the budget constraint, yields the inverse demand functions facing the two firms in the domestic market:

$$p_1 = \alpha - x_1 - \gamma x_2 \qquad\qquad p_2 = \alpha - \gamma x_1 - x_2 \tag{2}$$

In a Bertrand duopoly, where price is the strategic variable of the firms, the direct demand functions will generally be more useful than the inverse demand functions; inverting (2) yields the direct demand functions:

$$x_1 = \frac{1}{1-\gamma^2}\left(\alpha(1-\gamma) - p_1 + \gamma p_2\right) \qquad\qquad x_2 = \frac{1}{1-\gamma^2}\left(\alpha(1-\gamma) + \gamma p_1 - p_2\right) \tag{3}$$

The profits of the two firms from sales in the domestic market are:

$$\pi_1 = (p_1 - c)x_1 \qquad\qquad \pi_2 = (p_2 - c)x_2 \tag{4}$$

Given the linear demand functions, the profit functions are obviously quadratic but this does not imply concavity.[4]

Ignoring distributional questions, the welfare of the domestic country is given by the sum of consumer surplus and the profits of the domestic firm from the two markets:

$$w = v(x_1, x_2) - p_1 x_1 - p_2 x_2 + \pi_1 + \Pi_1 \tag{5}$$

Before looking at Bertrand duopoly it is useful to analyse the situation under autarky when the domestic firm has a monopoly in the domestic market. If the foreign firm does not sell in the domestic market then the demand facing the domestic firm is given by substituting $x_2 = 0$ into its inverse demand function (2) and inverting to obtain $x_1 = \alpha - p_2$. Faced with this demand curve, the domestic firm will set the monopoly price $p_1^M = (\alpha + c)/2$, sell the monopoly output $x_1^M = (\alpha - c)/2$, and earn monopoly profits $\pi_1^M = (\alpha - c)^2/4$. The welfare of the domestic country under autarky with a domestic monopoly is $w^M = 3(\alpha - c)^2/8$. In the foreign market under autarky, the foreign firm will have a monopoly. It will set the monopoly price $P_2^M = (\alpha + c)/2$, sell the monopoly output $X_2^M = (\alpha - c)/2$, and earn monopoly profits $\Pi_1^M = (\alpha - c)^2/4$. The welfare of the foreign country under autarky, when the foreign firm has a monopoly, is $W^M = 3(\alpha - c)^2/8$.

Under free trade there is a Bertrand duopoly in both markets with the two firms independently and simultaneously setting prices to maximise profits; hence, using the direct demand functions (3) in profits (4) and assuming there is an interior solution where both firms sell positive quantities, the first-order conditions for the Bertrand equilibrium are:

$$\begin{aligned} \frac{\partial \pi_1}{\partial p_1} &= \frac{1}{1-\gamma^2}\left(\alpha(1-\gamma) - 2p_1 + \gamma p_2 + c\right) = 0 \\ \frac{\partial \pi_2}{\partial p_2} &= \frac{1}{1-\gamma^2}\left(\alpha(1-\gamma) + \gamma p_1 - 2p_2 + c\right) = 0 \end{aligned} \tag{6}$$

These first-order conditions can be rearranged to give the reaction functions of the domestic and the foreign firm:

$$p_1 = b_1(p_2) \equiv \frac{1}{2}\left(\alpha(1-\gamma)+c+\gamma p_2\right) \qquad\qquad p_2 = b_2(p_1) \equiv \frac{1}{2}\left(\alpha(1-\gamma)+c+\gamma p_1\right) \quad (7)$$

Figure one shows the Bertrand duopoly reaction functions of the two firms in bold, and allows for the possibility of boundary solutions where one firm has zero sales. The price set by the domestic firm is plotted on the horizontal axis and the price set by the foreign firm on the vertical axis. Shown in figure one are the locus of prices where the sales of the domestic firm are zero, $x_1 = 0$, and the locus of prices where the sales of the foreign firm are zero, $x_2 = 0$. Sales of the domestic firm are zero below the $x_1 = 0$ locus and sales of the foreign firm are zero above the $x_2 = 0$ locus. In the region between these two lines there will be an interior solution, where the sales of both firms are positive, and the reaction functions of the two firms are given by $b_1(p_2)$ and $b_2(p_1)$ from (7). It will never be profitable for the firms to set a price below marginal cost so the reaction function of the domestic firm is vertical at c when the foreign firm sets a low price, and the reaction function of the foreign firm is horizontal at c when the domestic firm sets a low price. If the foreign firm sets a sufficiently high price then its sales will be zero; the reaction function of the domestic firm intersects the $x_2 = 0$ locus where the price set by the domestic firm is $\tilde{p}_1 \equiv \left(\alpha(1-\gamma^2)+c\right)/\left(2-\gamma^2\right)$ and the price set by the foreign firm is $\hat{p}_2 \equiv \left(\alpha(2-\gamma-\gamma^2)+\gamma c\right)/\left(2-\gamma^2\right)$. For $p_2 > \hat{p}_2$, the domestic firm can increase its profits by raising its price above that given by $b_1(p_2)$ in (7) until it reaches the $x_2 = 0$ locus or the monopoly price $p_1^M = (\alpha + c)/2$, but beyond this point profits will be decreasing; hence, the reaction function of the domestic firm is given by the $x_2 = 0$ locus upto the monopoly price and is then given by the vertical line at the monopoly price. Given the symmetry of the model, the analysis for the foreign firm is identical to that above and the reaction function of the foreign firm is the mirror image of the reaction function of the domestic firm.

The intersection of the two reaction functions, labelled as B in figure one, gives the prices of the two firms in the symmetric Bertrand equilibrium under free trade:

$$p_1^B = p_2^B = \frac{\alpha(1-\gamma)+c}{2-\gamma} \tag{8}$$

Substituting these prices into the direct demand functions (3) yields the sales of the two firms in the Bertrand equilibrium:

$$x_1^B = x_2^B = \frac{\alpha - c}{(2-\gamma)(1-\gamma)} \tag{9}$$

Using these prices (8) and quantities (9) in (4) yields the profits of the two firms in the Bertrand equilibrium:

$$\pi_1^B = \pi_2^B = \frac{(1-\gamma)(\alpha-c)^2}{(2-\gamma)^2(1+\gamma)} \tag{10}$$

Given the symmetry of the model, the equilibrium of the Bertrand duopoly in the foreign market will be identical to that in the domestic market. Substituting (8) to (10) into (5), and noting that $\Pi_1^B = \pi_1^B$ by symmetry, yields the welfare of the domestic country under free trade and, by symmetry, the welfare of the foreign country under free trade:

$$w^B = W^B = \frac{(3-2\gamma)(\alpha-c)^2}{(2-\gamma)^2(1+\gamma)} \tag{11}$$

These will provide useful benchmarks for welfare comparisons in the next section. Comparison with welfare under autarky, when each firm has a monopoly in its own market, shows that there are always gains from multilateral free trade.

3. Exports and anti-dumping regulations

This section analyses the export decision of the domestic firm in the presence of an anti-dumping regulation imposed by the domestic government that levies a duty on the foreign firm if it sets a lower price in the domestic market than in the foreign market. The anti-dumping duty is set equal to the dumping margin, which is defined as the difference in price of the foreign product between the foreign and the domestic market. Faced with such an anti-dumping regulation, the foreign firm will never dump in the domestic market as it is always more profitable to increase the price it sets in the domestic market to avoid the anti-dumping duty. Thus, the anti-dumping regulation deters the foreign firm from practising price discrimination between the domestic and foreign markets. In this situation, if the domestic firm takes the strategic decision not to export to the foreign market then the foreign firm will have a monopoly in its own market while competing with the domestic firm in the domestic market, but it will be deterred from setting a lower price in the domestic market than in the foreign market by the anti-dumping regulation. This will lead the foreign firm either to set a price somewhat higher than the Bertrand duopoly price and supply both markets, or to set the monopoly price and only supply the foreign market. In both cases, the domestic firm faces less competition and will earn higher profits in the domestic market than under Bertrand duopoly, but it will lose the profits it would have made from exports to the foreign market under Bertrand duopoly. It will be shown that this strategic decision not to export to the foreign market will be profitable for the domestic firm if the products of the domestic and foreign firms are sufficiently close substitutes.

The formal structure of this two stage game is as follows: At the first stage of the game, the domestic firm decides whether or not to export to the foreign market.[5] At the second stage, if the domestic firm decides to export then there is a subgame where the two firms compete in the domestic and foreign markets; and if the domestic firm decides not to export then there is a subgame where the foreign firm has a monopoly in the foreign market while the two firms compete in the domestic market with the anti-dumping regulation deterring the foreign firm from setting a lower price in the domestic market than in the foreign market. As usual the game is solved by backwards induction to obtain a subgame perfect equilibrium. For simplicity, it will be assumed that the foreign firm has already committed itself to export to the domestic market and that the foreign government does not have an anti-dumping regulation.[6]

In the subgame where the domestic firm has decided to export to the foreign market, the game is completely symmetric and the foreign firm will not want to price discriminate between the two markets. Therefore, the outcome in both markets will be as in the Bertrand duopoly equilibrium described in the previous section. In both markets, the prices are given by (8), the sales by (9) and the profits by (10); thus, the total profits of the domestic firm from the two markets are $2\pi_1^B$. The anti-dumping regulation does not alter the outcome of the game when the firms simultaneously and independently set prices in both markets, and the Bertrand duopoly equilibrium is the unique outcome of the game.

In the subgame where the domestic firm has decided not to export to the foreign market, the foreign firm will have a monopoly in the foreign market while competing in a Bertrand duopoly with the domestic firm in the domestic market, and the domestic government's anti-dumping regulation will deter the foreign firm from setting a lower price in the domestic market than in the foreign market. The foreign firm can either set a price somewhat higher than the Bertrand duopoly price and sell in both markets or set the monopoly price and sell only in the foreign market. This will affect competition between the two firms in the domestic market as it will alter the reaction function of the foreign firm.

Since the foreign firm has a monopoly in its own market, its demand curve in this market is obtained by setting $X_1 = 0$ in its inverse demand function, which is similar to (2), and inverting to obtain $X_2 = \alpha - P_2$. In the domestic market, the foreign firm competes with the domestic firm in a Bertrand duopoly so its demand is given by its inverse demand function (3). As the anti-dumping regulation prevents the foreign firm from setting a lower price in the domestic market than in the foreign market, it must set the same price in both markets so $p_2 = P_2$. The total profits of the foreign firm are the sum of its profits from the foreign market and its profits from the domestic market:

$$\Omega_2 = \Pi_2 + \pi_2 = (p_2 - c)\left[(\alpha - p_2) + \frac{1}{1-\gamma^2}\left(\alpha(1-\gamma) + \gamma p_1 - p_2\right)\right] \tag{12}$$

Assuming there is an interior solution where the foreign firm sells positive quantities in both markets and the domestic firm sells a positive quantity in the domestic market, then the first order condition for profit maximisation by the foreign firm is:

$$\frac{\partial \Omega_2}{\partial p_2} = (\alpha - 2p_2 + c) + \frac{1}{1-\gamma^2}\left(\alpha(1-\gamma) + \gamma p_1 - 2p_2 + c\right) = 0 \tag{13}$$

The first term is the marginal effect on profits of a price increase in the foreign market and the second term is the marginal effect on profits of a price increase in the domestic market. The first term is positive as the foreign firm could increase its profits in the foreign market by raising its price, while the second term is negative as the foreign firm could increase its profits in the domestic market by reducing its price. Solving (13) yields the profit-maximising price of the foreign firm as a function of the price set by the domestic firm in the domestic market:

$$p_2^A = a_2(p_1) \equiv \frac{1}{2(2-\gamma^2)}\left[(1-\gamma^2)(\alpha+c)+\alpha(1-\gamma)+c+p_1\right] \qquad (14)$$

where $a_2(p_1)$ is the reaction function of the foreign firm when there is an interior solution. Substituting the profit-maximising price (14) into total profits (12) yields the maximised profits from selling in both markets as a function of the price set by the domestic firm in the domestic market:

$$\Omega_2^A = \frac{(\alpha-c)^2}{4} + \frac{1}{4(1-\gamma^2)}\left[(\alpha-c)^2 - 2\gamma(\alpha-c)(\alpha-p_1) + \frac{\gamma^2}{(2-\gamma^2)}(\alpha-p_1)^2\right] \qquad (15)$$

Alternatively, there may be a boundary solution where the sales of the foreign firm in the domestic market are zero. Then, the foreign firm will set the monopoly price in both markets, $p_2 = P_2^M = (\alpha+c)/2$, sell the monopoly output in the foreign market, $X_2^M = (\alpha-c)/2$, but nothing in the domestic market, and earn monopoly profits in the foreign market, $\Pi_2^M = (\alpha-c)^2/4$. The foreign firm will compare the profits from selling in both markets, which depends upon the price set by the domestic firm, with the profits from setting the monopoly price and selling nothing in the domestic market, and then choose the most profitable option. The difference in profits between the two options is:

$$\Delta = \Omega_2^A - \Pi_2^M = \frac{1}{4(1-\gamma^2)}\left[(\alpha-c)^2 - 2\gamma(\alpha-c)(\alpha-p_1) + \frac{\gamma^2}{(2-\gamma^2)}(\alpha-p_1)^2\right] \qquad (16)$$

This is a quadratic in $(\alpha - p_1)$, and the foreign firm will set the price p_2^A and sell in both markets if it is positive, $\Delta \geq 0$. The quadratic has two positive roots:

$$\alpha - p_1 = \frac{\alpha-c}{\gamma}\left(2-\gamma^2 \pm \sqrt{(1-\gamma^2)(2-\gamma^2)}\right) \qquad (17)$$

The largest root can be ruled out as it does not yield a sensible interior solution; it implies that the domestic firm sets a price below marginal cost and that the sales of the foreign firm in the domestic market are zero. The sensible solution is given by the the smallest root; hence, the foreign firm will set the price, p_2^A, and sell in both markets if the price set by the domestic firm is greater than:

$$p_1^* \equiv \alpha - \frac{\alpha - c}{\gamma}\left(2 - \gamma^2 - \sqrt{\left(1-\gamma^2\right)\left(2-\gamma^2\right)}\right) \quad (18)$$

It is now possible to describe the complete reaction function for the foreign firm when the domestic firm decides not to export to the domestic market and the foreign firm is prevented from practising price discrimination by the anti-dumping regulation. The reaction function of the foreign firm is shown in bold in figure two, which is drawn for $\gamma = 4/5$. When the domestic firm sets a low price in the domestic market, $p_1 < p_1^*$, the best response of the foreign firm is to set the monopoly price in which case its sales in the domestic market will be zero; hence, the reaction function of the foreign firm is the horizontal line at the monopoly price. If the domestic firm sets the price $p_1 = p_1^*$ then the foreign firm will be indifferent between selling only in the foreign market at the monopoly price $p_2 = P_2^M$ and selling in both markets at the price $p_2 = p_2^L \equiv a_2\left(p_1^*\right)$, from (14), since it will earn the monopoly profits $\Pi_2^M = \left(\alpha - c\right)^2/4$ in both cases. When the domestic firm sets a high price in the domestic market, $p_1 > p_1^*$, the reaction function of the foreign firm is given by $p_2 = a_2\left(p_1\right)$ until it reaches the $x_1 = 0$ locus. After this point, the reaction function of the foreign firm is given by the $x_1 = 0$ locus upto the monopoly price, and thereafter it is given by the horizontal line at the monopoly price. Also shown in figure two is the reaction function of the domestic firm in the domestic market which is unaffected by the anti-dumping regulation and is therefore the same as the reaction function shown in figure one.

Having obtained the reaction functions of the two firms when the domestic firm decides not to export at the first stage of the game, it is now possible to derive the Nash equilibrium of this subgame. There will be a pure strategy Nash equilibrium in prices when the products of the two firms are not very close substitutes and a mixed strategy Nash equilibrium when the products are very close substitutes.

3.1 Pure strategy Nash equilibrium in prices

Assuming that the intersection of the two reaction functions occurs to the right of the discontinuity in the foreign reaction function at p_1^*, there will be a pure strategy Nash equilibrium that is given by the intersection of the domestic reaction function, $p_1 = b_1(p_2)$ from (7), and the foreign reaction function, $p_2 = a_2(p_1)$ from (14). Solving for the pure strategy Nash equilibrium prices yields:

$$p_1^N = \alpha - \frac{(2+\gamma)(2-\gamma^2)}{8-5\gamma^2}(\alpha - c) \qquad\qquad p_2^N = \alpha - \frac{(4+\gamma-2\gamma^2)}{8-5\gamma^2}(\alpha - c) \tag{19}$$

where the superscript N denotes the pure strategy Nash equilibrium when the domestic firm does not export. In this Nash equilibrium, labelled as N in figure two, both firms set a higher price than in the symmetric Bertrand equilibrium, labelled as B in figure two, and the foreign firm clearly sets a higher price than the domestic firm since N is above the diagonal. There will only be a pure strategy Nash equilibrium if $p_1^N \geq p_1^*$ and comparison of p_1^* from (18) with p_1^N from (19) shows that this will be the case if:

$$(8-5\gamma^2)\left(2-\gamma^2-\sqrt{(1-\gamma^2)(2-\gamma^2)}\right) \geq \gamma(2+\gamma)(2-\gamma^2) \tag{20}$$

As this inequality cannot be solved by analytical methods, numerical methods have to be used and it turns out that there will be a pure strategy Nash equilibrium if the degree of product differentiation is less than the critical value: $\gamma \leq 0 \cdot 826343$.

Since the foreign firm has increased its price in the pure strategy Nash equilibrium, the profits earned by domestic firm in the domestic market will be higher than in the Bertrand equilibrium. Substituting the Nash equilibrium prices (19) into the profits of the domestic firm (4) yields:

$$\pi_1^N = \frac{(1-\gamma)\left(4+2\gamma-\gamma^2\right)^2}{(1+\gamma)\left(8-5\gamma^2\right)}(\alpha-c)^2 \tag{21}$$

At the first stage of the game, the domestic firm decides whether or not to export to the foreign market. If it decides to export then the domestic firm will earn the Bertrand equilibrium profits in both markets, $2\pi_1^B$, whereas if it decides not to export then it will earn higher profits in the domestic market, π_1^N but zero profits in the foreign market. Hence, the domestic firm will decide not to export to the foreign market if $\pi_1^N > 2\pi_1^B$. Figure three shows π_1^N and $2\pi_1^B$ plotted against the degree of product differentiation for $0 \leq \gamma \leq 0 \cdot 826343$ with $(\alpha - c)$ normalised at unity. Clearly, exporting to the foreign market is always the more profitable strategy and this leads to the following proposition:

Proposition 1: *For* $0 \leq \gamma \leq 0 \cdot 826343$, *the domestic firm will export to the foreign market and the outcome of the game will be as in the Bertrand duopoly equilibrium in both markets.*

In this case, when the products are not very close substitutes, the anti-dumping regulation does not affect the behaviour of the firms as it is never profitable for the domestic firm to make the strategic decision not to export to the foreign market. Therefore, the anti-dumping regulation has no effect on the welfare of the two countries.

3.2 Mixed strategy Nash equilibrium in prices

When the products of the two firms are very close substitutes, $0\cdot826343 \le \gamma < 1$, there is no pure strategy Nash equilibrium in the subgame where the domestic firm decides not to export in the presence of the anti-dumping regulation. In figure four, drawn for $\gamma = 9/10$, the reaction functions of the two firms do not intersect as the domestic firm's reaction function passes through the discontinuity in the foreign firm's reaction function. Nevertheless, since the profit functions are continuous, the existence of a mixed strategy Nash equilibrium is ensured by Glicksberg's theorem.[7] The most likely candidate for a mixed strategy Nash equilibrium is where the domestic firm sets the price p_1^* while the foreign firm sets the high (monopoly) price P_2^M with some probability, say μ, and the low price p_2^L with probability $(1-\mu)$. However, this mixed strategy Nash equilibrium turns out to be valid only for $0\cdot826343 \le \gamma \le 0\cdot893353$.

If the domestic firm sets the price p_1^* then the foreign firm is indifferent between setting the high (monopoly) price and the low price since it earns monopoly profits in both cases; hence, randomising over the two prices is a best response for the foreign firm to the domestic firm setting the price p_1^*. The low price p_2^L is obtained by evaluating the foreign reaction function (14) at p_1^* which yields:

$$p_2^L \equiv a_2\left(p_1^*\right) = c + \frac{(\alpha - c)}{2}\sqrt{\frac{1-\gamma^2}{2-\gamma^2}} \tag{22}$$

The probability μ is chosen by the foreign firm so that the price p_1^* is the best response of the domestic firm to the randomised prices set by the foreign firm. If the foreign firm sets the high (monopoly) price then the domestic firm will have a monopoly in the domestic market whereas if the foreign firm sets the low price then there will be a duopoly in the domestic market; hence, the expected profits of the domestic firm are:

$$E\pi_1 = \mu\left(p_1 - c\right)\left(\alpha - p_1\right) + \left(1-\mu\right)\left(p_1 - c\right)\frac{1}{1-\gamma^2}\left(\alpha\left(1-\gamma\right) - p_1 + \gamma p_2^L\right) \tag{23}$$

The price p_1^* is the best response of the domestic firm to the randomised prices set by the foreign firm if expected profits are maximised at this price, and this will be the case if the first-order condition for profit maximisation is zero when evaluated at this price:

$$\left.\frac{\partial E\pi_1}{\partial p_1}\right|_{p_1 = p_1^*} = \mu\left(\alpha - 2p_1^* + c\right) + \left(1-\mu\right)\frac{1}{1-\gamma^2}\left(\alpha\left(1-\gamma\right) - 2p_1^* + \gamma p_2^L + c\right) = 0 \tag{24}$$

Using (14) and (18) to solve for the probability μ that makes p_1^* the best response of the domestic firm to the randomised prices set by the foreign firm yields:

$$\mu = \frac{1}{\gamma^2}\frac{2\left(1-\gamma\right)\left(2-\gamma^2\right)\left(4+3\gamma\right) - \left(8-5\gamma^2\right)\sqrt{\left(1-\gamma^2\right)\left(2-\gamma^2\right)}}{2\left(1-\gamma\right)\left(2-\gamma^2\right)\left(3+2\gamma\right) - \left(7-4\gamma^2\right)\sqrt{\left(1-\gamma^2\right)\left(2-\gamma^2\right)}} \tag{25}$$

The probability of the foreign firm setting the high (monopoly) price, μ, is plotted in figure five against the degree of product differentiation, γ, and it can clearly be seen that μ is strictly increasing in γ from $\mu = 0$ at $\gamma = 0\cdot 826343$ to $\mu = 1$ at $\gamma = 1$. This probability can now be used to evaluate the expected profits of the domestic firm when it decides not to export to the foreign market. If the foreign firm sets the high (monopoly) price then its sales in the domestic market will be zero, and the profits of the domestic firm are:

$$\begin{aligned} \pi_1^H &= \left(p_1^* - c\right)\left(\alpha - p_1^*\right) \\ &= \frac{\left(\alpha - c\right)^2}{\gamma^2}\left[1 - \left(\left(2-\gamma^2\right) - \sqrt{\left(1-\gamma^2\right)\left(2-\gamma^2\right)}\right)\right]\left[\left(2-\gamma^2\right) - \sqrt{\left(1-\gamma^2\right)\left(2-\gamma^2\right)}\right] \end{aligned} \tag{26}$$

If the foreign firm sets the low price then both firms will sell in the domestic market, and the profits of the domestic firm will be:

$$\pi_1^L = \left(p_1^* - c\right)\frac{1}{1-\gamma^2}\left(\alpha(1-\gamma) - p_1^* + \gamma p_2^L\right)$$
$$= \frac{(\alpha - c)^2}{2\gamma^2}\left[1 - \left(\left(2-\gamma^2\right) - \sqrt{\left(1-\gamma^2\right)\left(2-\gamma^2\right)}\right)\right]\left[4 - \frac{\left(4-3\gamma^2\right)}{\sqrt{\left(1-\gamma^2\right)\left(2-\gamma^2\right)}}\right] \tag{27}$$

The expected profits of the domestic firm in the mixed strategy Nash equilibrium are:

$$E\pi_1^* = \mu\pi_1^H + (1-\mu)\pi_1^L \tag{28}$$

The domestic firm will decide not to export to the foreign market if its expected profits in the mixed strategy Nash equilibrium exceed its total profits from both markets in the Bertrand equilibrium; hence, it will not export if $E\pi_1^* > 2\pi_1^B$. Figure six shows $E\pi_1^*$ and $2\pi_1^B$ plotted against the degree of product differentiation for $0\cdot 826343 \le \gamma \le 0\cdot 893353$, with $(\alpha - c)$ normalised at unity. In figure six, profits under Bertrand duopoly decrease as the products become closer substitutes but expected profits when the domestic firm decides not to export increase and, for $\gamma \ge 0\cdot 854656$, the domestic firm will find it profitable to commit not to export to the foreign market. This leads to the following proposition:

Proposition 2: *For* $0\cdot 826343 \le \gamma \le 0\cdot 854656$*, the domestic firm exports to the foreign market and the outcome of the game will be as in the Bertrand duopoly equilibrium in both markets. For* $0\cdot 854656 < \gamma < 0\cdot 893353$*, the domestic firm does not export to the foreign market and the outcome of the game is the mixed strategy Nash equilibrium.*

For $0\cdot 826343 \le \gamma \le 0\cdot 854656$, as in the previous section, the anti-dumping regulation does not affect the outcome of the game or the welfare of the two countries. However, when the products of the two firms are sufficiently close substitutes, $0\cdot 854656 < \gamma < 0\cdot 893353$, the anti-dumping regulation does affect the outcome of the game as the domestic firm can increase its profits by committing not to export to the foreign market. Then, the foreign firm has a monopoly in its own market while competing with the domestic firm in the domestic market, and is deterred from setting a lower price in the domestic market than in the foreign market by the anti-dumping regulation.

The welfare of the domestic country (5) is the sum of the consumer surplus of the representative domestic consumer and the total profits of the domestic firm. Without the anti-dumping regulation, domestic welfare is equal to the sum of consumer surplus and the profits of both firms in the domestic market, since given the symmetry of the model the profits of the domestic firm from exports are equal to the profits of the foreign firm in the domestic market. When the introduction of the anti-dumping regulation leads the domestic firm to commit not to export to the foreign market, domestic welfare is the sum of consumer surplus and the profits of the domestic firm in the domestic market. Since both firms increase their prices in the domestic market, there will be a reduction in the sum of domestic consumer surplus and the profits of both firms in the domestic market so domestic welfare must be reduced since domestic welfare does not include the profits of the foreign firm. Higher profits for the domestic firm are at the expense of the domestic consumer who also has to pay a higher price for the foreign product.

The foreign consumer is even worse off than the domestic consumer since, as well as the foreign firm increasing its price, the foreign market is not supplied by the domestic firm. However, the foreign firm is better off than the domestic firm since it earns the monopoly profits whether it sets the high price or the low price, whereas the domestic firm earns less than the monopoly profits as it still has to compete with the foreign firm in the domestic market. The overall effect on the welfare of the foreign country is difficult to assess intuitively since, although it will obviously lose when the foreign firm sets the high (monopoly) price, it will probably gain when the foreign firm sets the low price as the foreign firm earns higher profits from exports to the domestic market than under free trade. However, it seems likely that the gain for the foreign firm will not be sufficient to compensate the foreign consumer for the loss of consumer surplus.

Using Mathematica, it is possible to calculate the expected welfare of the domestic country and the foreign country in the mixed strategy Nash equilibrium when the domestic firm decides not to export to the foreign market as a result of the anti-dumping regulation. These are shown in figure seven, together with welfare under free trade, plotted against the degree of product differentiation for $0 \cdot 826343 \le \gamma \le 0 \cdot 893353$ with $(\alpha - c)$ normalised at unity. Clearly, both countries are worse off as a result of the anti-dumping regulation when the domestic firm decides not to export, and the welfare loss is largest for the domestic country. These results are summarised in the following proposition:

Proposition 3. *For* $0 \cdot 854656 \le \gamma \le 0 \cdot 893353$*, when the domestic firm decides not to export, the effects of the anti-dumping regulation are: (i) to increase the prices in both markets; (ii) to increase the profits of both firms with the foreign firm gaining more than the domestic firm; (iii) to reduce consumer surplus in both countries with foriegn consumers suffering the largest reduction in consumer surplus; (iv) to reduce welfare in both countries with the domestic country suffering the largest welfare loss.*

This mixed strategy Nash equilibrium breaks down for because the profits of the domestic firm are not quasi-concave, and will have two local maxima when the foreign firm randomises over the two prices. There is the local interior maximum at , described above, and a second local maximum at $\overline{p}_1$, shown in figure four, where the domestic firm sells zero output when the foreign firm sets the low price. For $0 \cdot 826343 \le \gamma \le 0 \cdot 893353$, the global maximum is at p_1^*, but for $\gamma > 0 \cdot 893353$, the probability of the foreign firm setting the high price, μ, is large enough to make $\overline{p}_1$ the global maximum, and then the mixed strategy equilibrium described above will break down. Using Mathematica, it is possible to solve for a mixed strategy equilibrium when $\gamma > 0\cdot 893353$.[8] In this second mixed strategy equilibrium, the foreign firm randomises over three prices, one of which is the monopoly price, while the domestic firm randomises over two prices. It is always profitable for the domestic firm to commit not to export to the foreign market when there is an anti-dumping regulation, and consumers in both countries face higher expected prices as a result. The expected profits of the foreign firm are equal to its profits under monopoly while the expected profits of the domestic firm are approximately equal to half its profits under monopoly. Both countries have lower welfare than under free trade with the domestic country suffering the largest welfare loss. Therefore, the qualitative results of proposition three continue to hold for $\gamma > 0\cdot 893353$, and it seems reasonable to conjecture that proposition three will be valid for $0\cdot 854656 \leq \gamma \leq 1$.

4. Foreign direct investment and the domestic anti-dumping regulation

The model can be extended to consider foreign direct investment by the foreign firm in response to the domestic anti-dumping regulation as in Haaland and Wooton (1995). Faced with the domestic anti-dumping regulation, the foreign firm is unable to price discriminate when the domestic firm decides not to export to the foreign market, but it could circumvent this regulation by setting up a production plant in the domestic country.[9] Suppose that the game analysed above is changed to allow the foreign firm to invest in a plant in the domestic country by incurring a sunk cost k before the domestic firm decides whether or not to export to the foreign market. If the foreign firm invests in the domestic plant then the domestic firm will realise that the foreign firm will be able to price discriminate between markets and that it will not gain by committing not to export to the foreign market. The outcome will be the

Bertrand equilibrium in both markets, and the total profits of the foreign firm will be $2\pi_2^B - k$. Whereas, if the foreign firm does not invest in the plant then the domestic firm will commit not to export to the foreign market and the foreign firm will earn the monopoly profits Π_2^M as above. Since the monopoly profits are more than twice as large as duopoly profits, $\Pi_2^M > 2\pi_2^B - k$, the foreign firm will decide not to invest in a domestic plant and both firms will be better off than under free trade.[10] By deciding not to invest in a domestic plant, the foreign firm is opting to take advantage of the anti-competitive nature of the anti-dumping regulation.

5. Conclusions

It has been shown that the domestic firm may strategically exploit a domestic anti-dumping regulation to reduce competition in the domestic market and thereby to increase its profits at the expense of the domestic consumer. The domestic anti-dumping regulation prevents the foreign firm from practising price discrimination between the two markets, but it would be expected to have no effect in this symmetric Bertrand duopoly since prices are the same in both markets under free trade. However, if the domestic firm commits not to export to the foreign market then the foreign firm will have a monopoly in the foreign market while competing with the domestic firm in the domestic market, but the foreign firm will be prevented from setting a lower price in the domestic market than in the foreign market by the anti-dumping regulation. As a result, the foreign firm will either set the monopoly price and sell only in the foreign market or set a lower price and sell in both markets. In both cases the price set by the foreign firm is higher than the Bertrand duopoly price under free trade allowing the domestic firm to increase its price and its profits in response. If the two products are sufficiently close substitutes then the higher profits in the domestic market are large enough to compensate for the loss of profits on exports to the foreign market making this strategy profitable for the domestic firm, and even more profitable for the foreign firm. The higher profits for the firms are at the expense of the consumers in both countries who have to pay the higher prices. Welfare in both countries is reduced by this strategic exploitation of the anti-dumping regulation with the domestic country suffering the largest welfare loss.

Two important conclusions about anti-dumping regulations follow from this analysis: Firstly, anti-dumping regulations are anti-competitive. By deterring dumping by foreign firms, anti-dumping regulations may increase the prices set by foreign firms in the domestic market even in the absence of an anti-dumping investigation or anti-dumping duties, and this will allow the domestic firms to raise their prices. Secondly, anti-dumping regulations may be strategically exploited by domestic firms. By not exporting to the foreign market, or by joining a cartel in the foreign market, domestic firms can reduce competition in the domestic market. In general, if the domestic firms compete less aggressively in the foreign market then anti-dumping regulations will induce foreign firms to compete less aggressively in the domestic market.

This analysis may also provide an alternative explanation as to why Japan is 'different'. Many policymakers and economists have argued that, given the low formal barriers to trade, Japan imports less than expected from US and EC firms, and that the Japanese market is monopolistic with higher consumer prices than in the US and EC. Their explanation for these facts is that the Japanese market is protected by invisible barriers to trade. Alternatively, since Japanese firms are the main targets of US and EC anti-dumping regulations, it may be the case that US and EC firms are strategically exploiting anti-dumping regulations by restricting their exports to Japan so as to reduce competition in their domestic markets. It would be ironic if the invisible barriers to trade are not Japanese restrictions but US and EC anti-dumping regulations. Although there is no evidence to support this explanation, all of the facts mentioned are consistent with proposition three of this paper. Such strategic behaviour, by creating a trade imbalance with Japan, would also strengthen the political case for retaining anti-dumping regulations in the US and EC.

Regarding policy implications, on the question of anti-dumping regulations and competition, it is hard to disagree with the conclusion of the Director-General of the UK Office of Fair Trading in his discussion of the soda ash case in the EC:

> "There may be lessons in husbandry, here, which everyone concerned with competition should heed: that restrictions on external trade and on internal competition very often go hand-in-hand; and that those who wish to avoid either of them probably do best to avoid both."[11]

Finally, for modern mercantilists, unconcerned about the anti-competitive effect of anti-dumping regulations on consumers, the possibility that their favourite policy may reduce exports must surely be a matter for grave concern.

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Footnotes

[1]Figures derived from GATT(1991 and 1993).

[2]See GATT (1993, p. 86).

[3]The effect of the anti-dumping regulations is to transform the two segmented markets into one integrated world market.

[4] The profit function is not concave because when a firm sets a sufficiently high price its sales and profits will be zero so the profit function will be flat. This does not matter when looking at the symmetric Bertrand equilibrium, since the interior maximum will be the global maximum of the profit function, but will be important in section three.

[5]The firm is assumed to be able to costlessly commit itself to its decision. In reality, the decision to export to the foreign market will incur a sunk cost to cover the setting up of a distribution network, market research in the foreign market, testing of the product to satisfy foreign health and safety regulations, translation of instructions, marketing and advertising, etc. Incorporating such a cost in the model would strengthen the results of the paper.

[6]The latter assumption is reasonable since the main target of anti-dumping regulations is Japan which has seldom used its anti-dumping regulation.

[7]The non-existence of a pure strategy Nash equilibrium is due to the discontinuity in the foreign firm's reaction function caused by the profit function of the foreign firm not being quasi-concave and having two local maxima. For details of Glicksberg's theorem see Dasgupta and Maskin (1986a and b).

[8] A Mathematica notebook describing the numerical methods used to find this mixed strategy equilibrium is available from the author. This second mixed strategy Nash equilibrium also breaks down as the products become even closer substitutes.

[9]The EC introduced a regulation to prevent foreign firms from circumventing anti-dumping duties by setting up screw-driver plants, but this was found to be inconsistent with the GATT.

[10]Of course, if the order of moves is reversed then the domestic firm will always decide to export to the foreign market and the firms will not gain from the anti-dumping regulation at the expense of consumers. If the firms move simultaneously then there will be a mixed

strategy equilibrium where the domestic firm sometimes commits not to export to the foreign market.

[11] Office of Fair Trading (1989, p. 20).

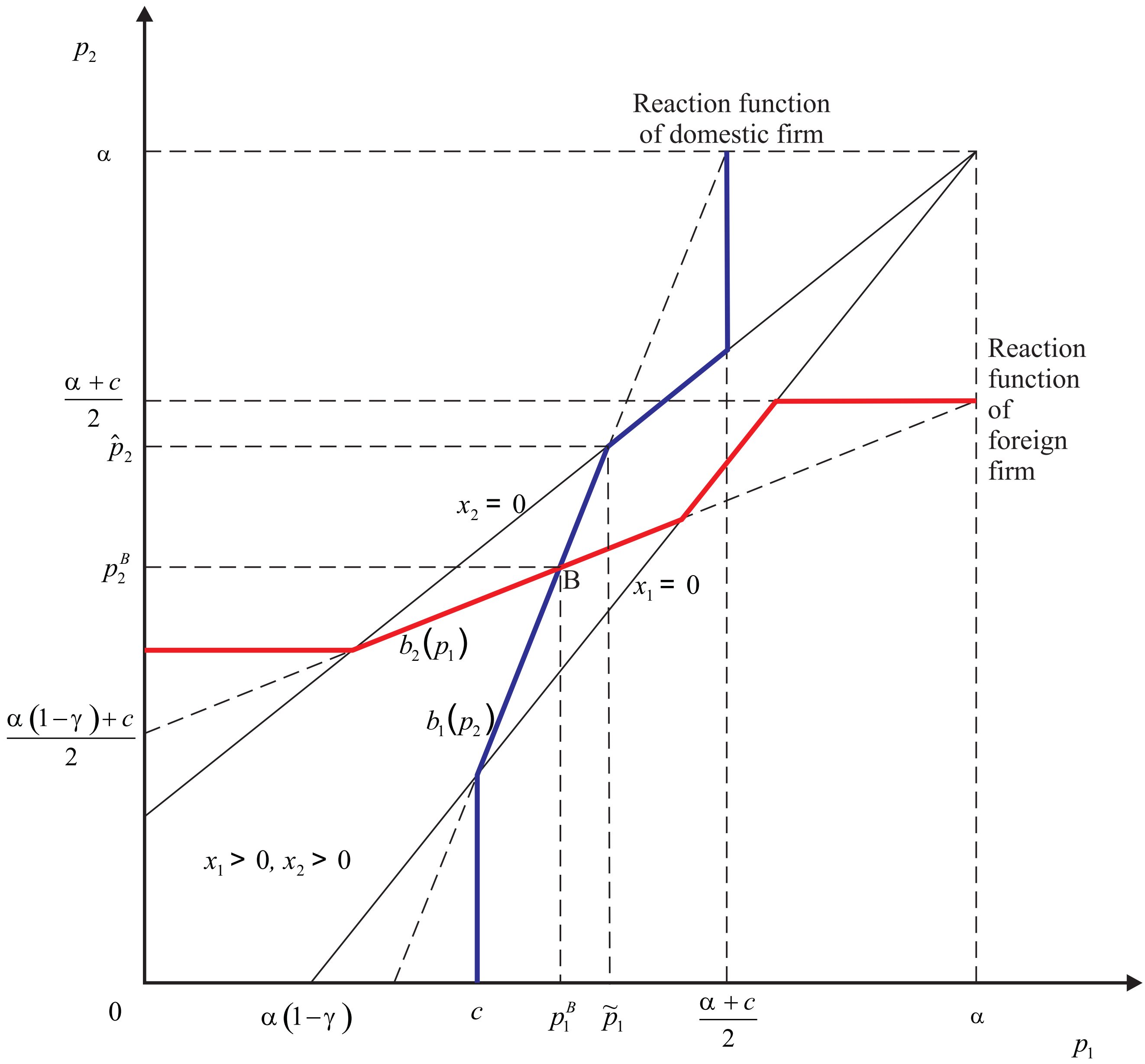


Figure One: Bertrand duopoly reaction functions

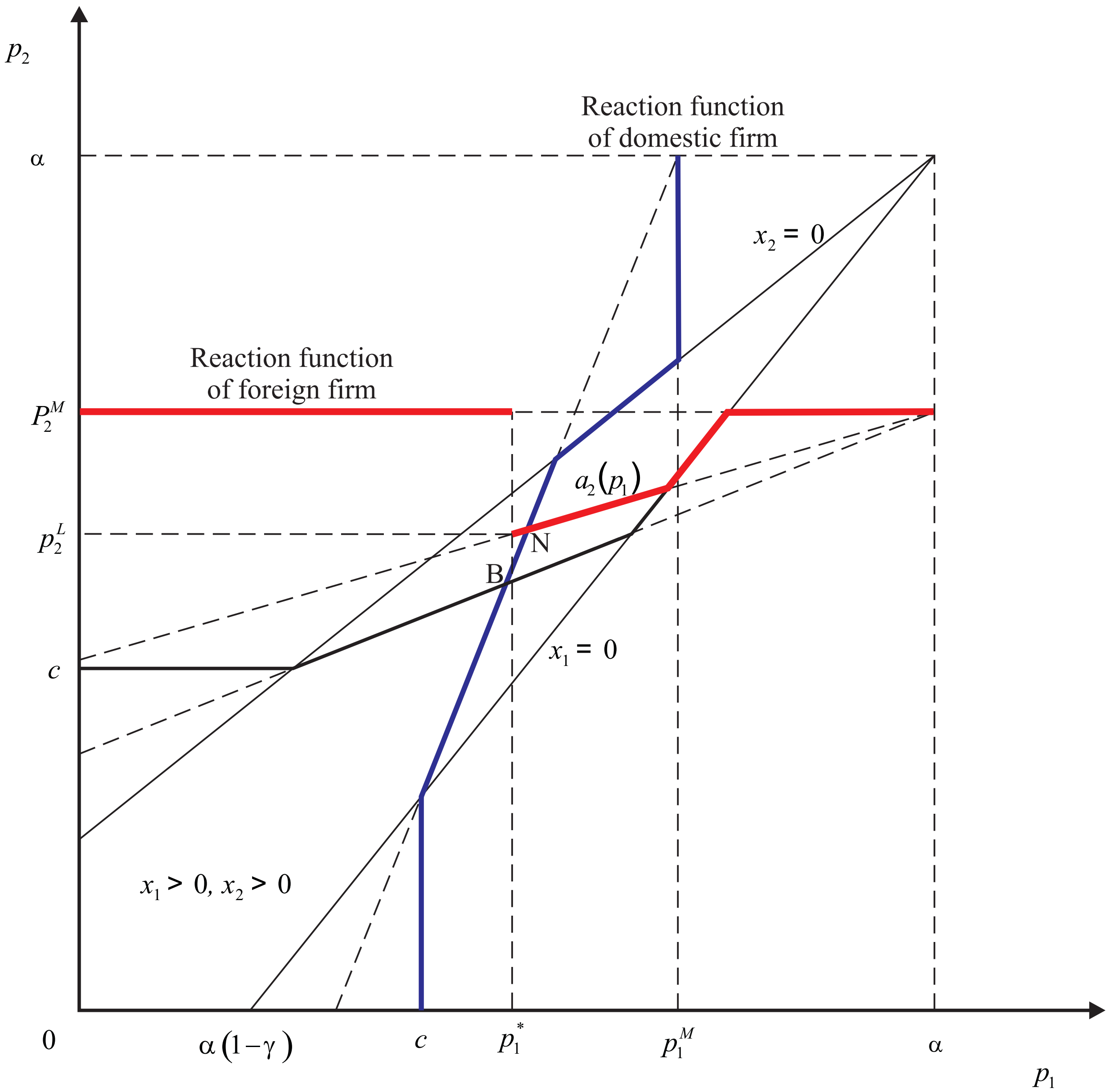
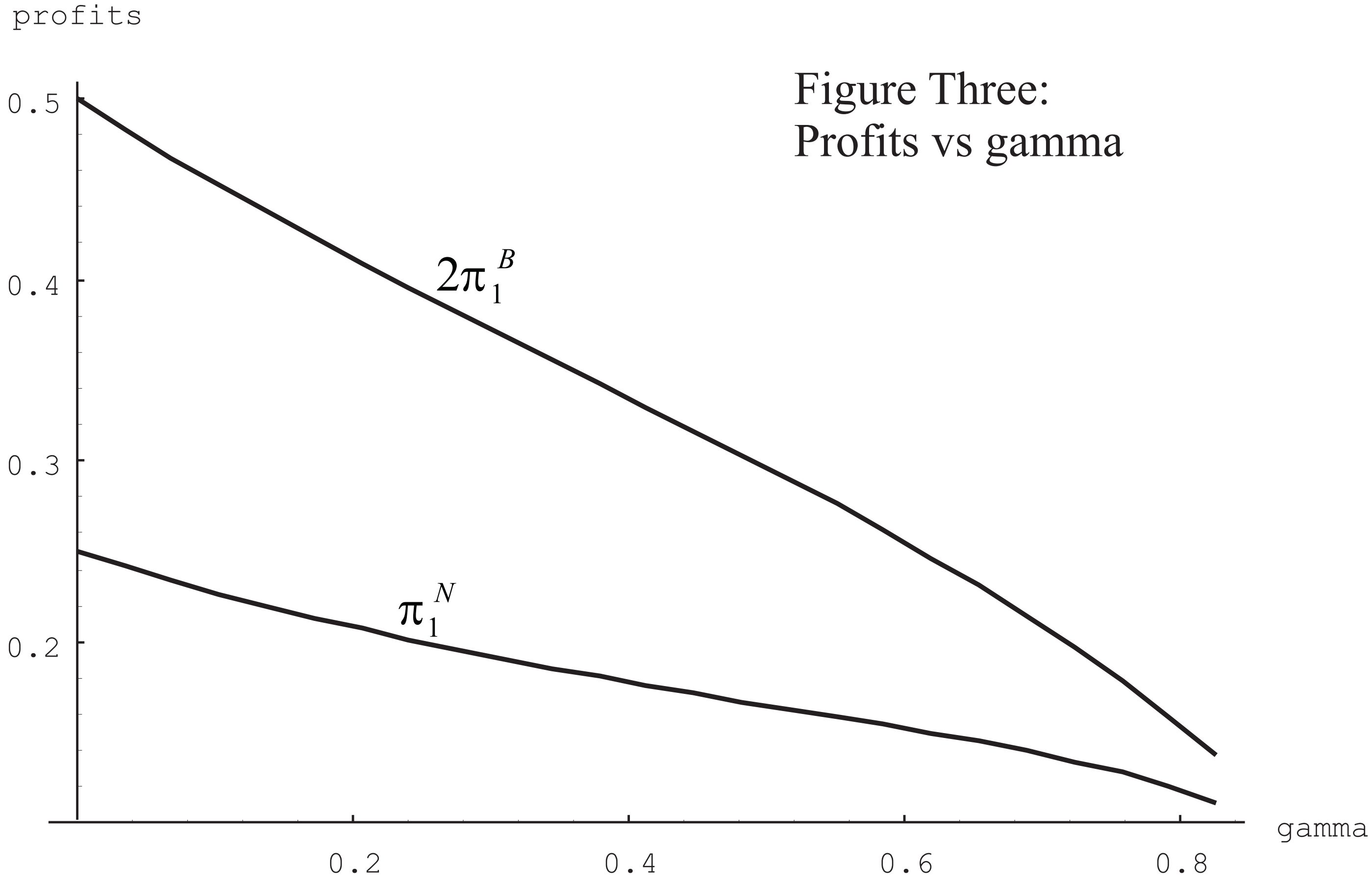
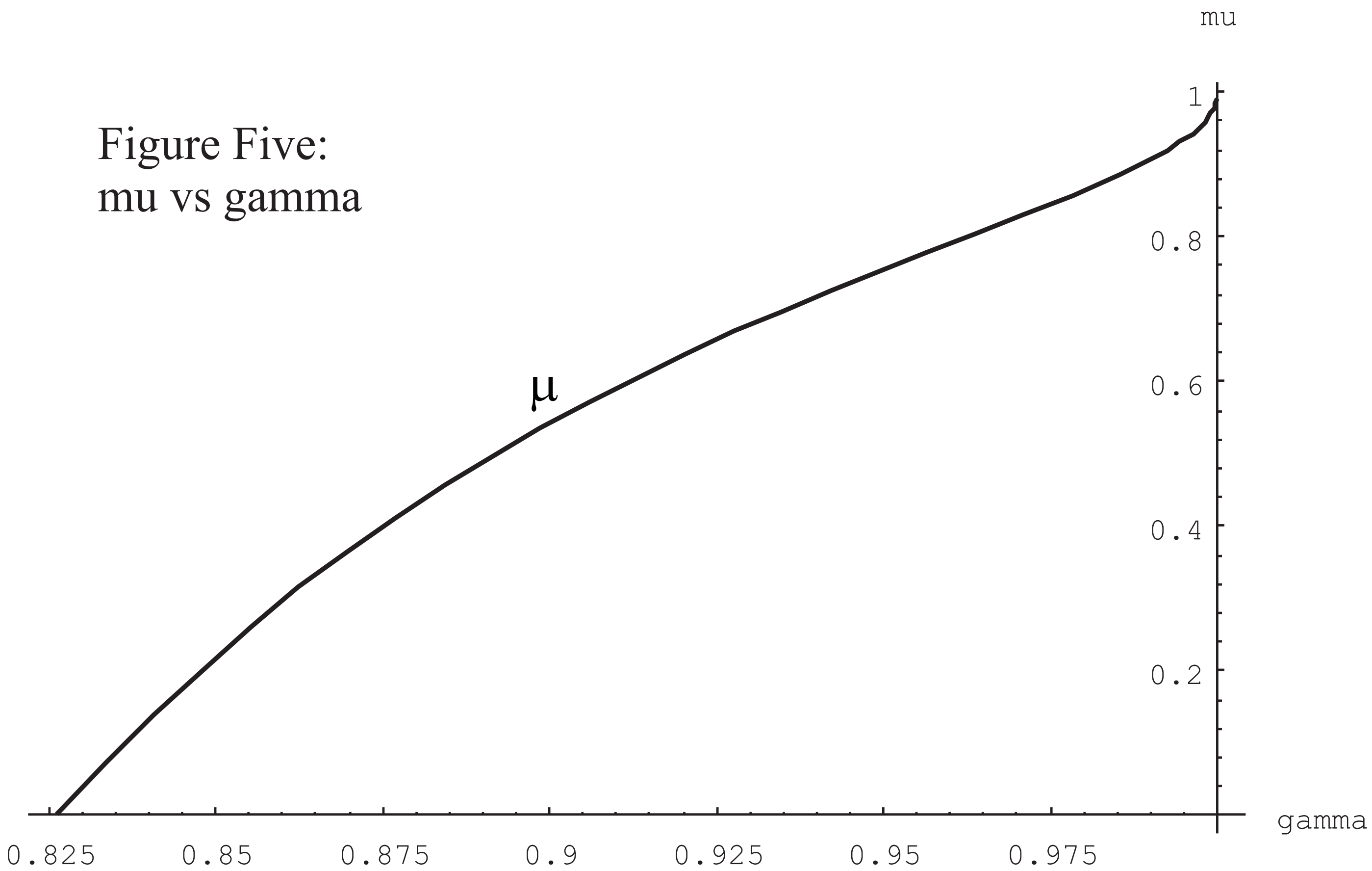


Figure Two: Pure strategy Nash equilibrium


profits
Figure Three:
Profits vs gamma
$2\pi_1^B$
π_1^N
0.5
0.4
0.3
0.2
0.2
0.4
0.6
0.8
gamma


mu
Figure Five:
mu vs gamma
μ
1
0.8
0.6
0.4
0.2
0.825
0.85
0.875
0.9
0.925
0.95
0.975
gamma

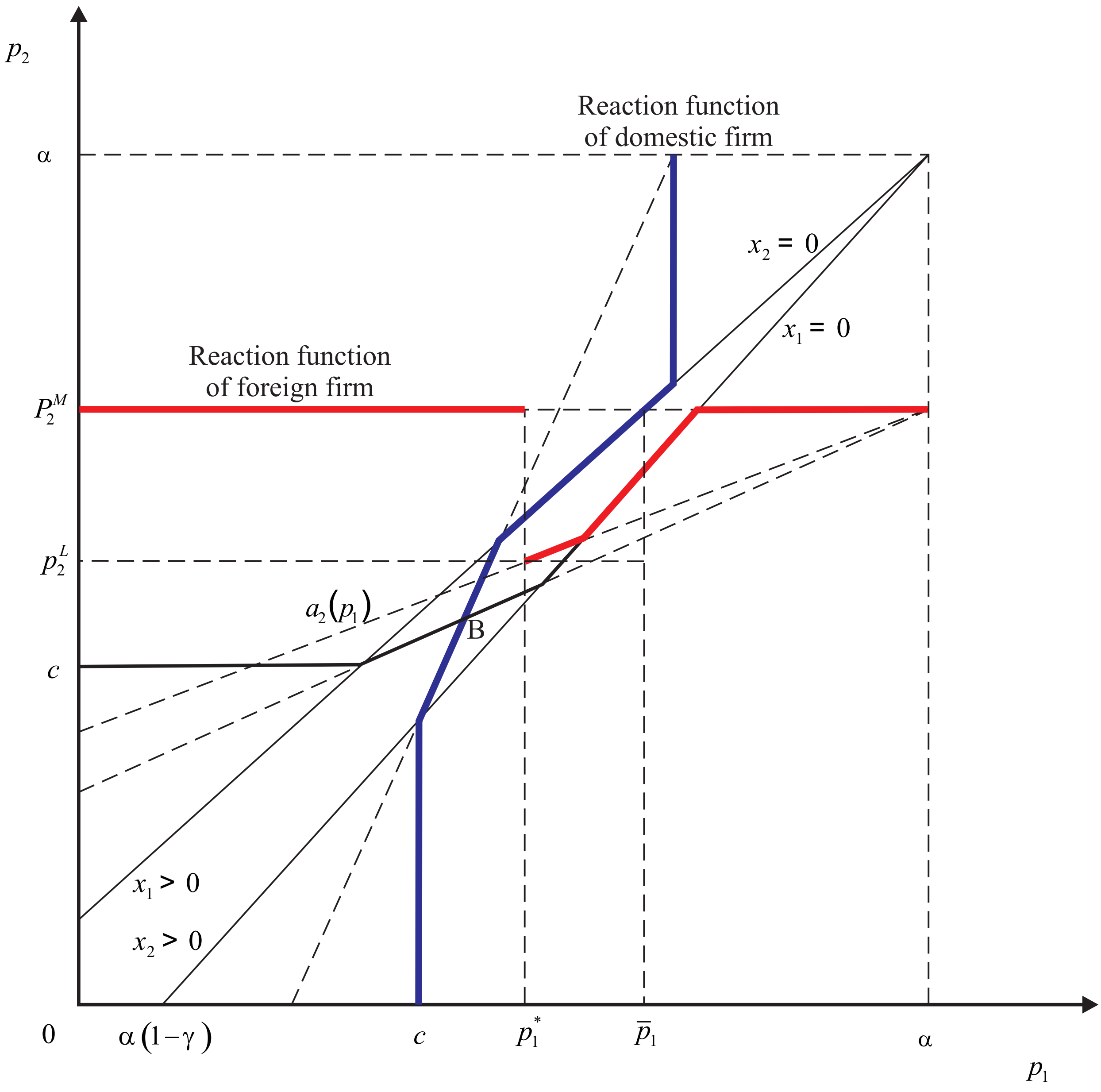


Figure Four: Mixed strategy Nash equilibrium

Figure Six:
Profits vs gamma in mixed strategy equilibrium

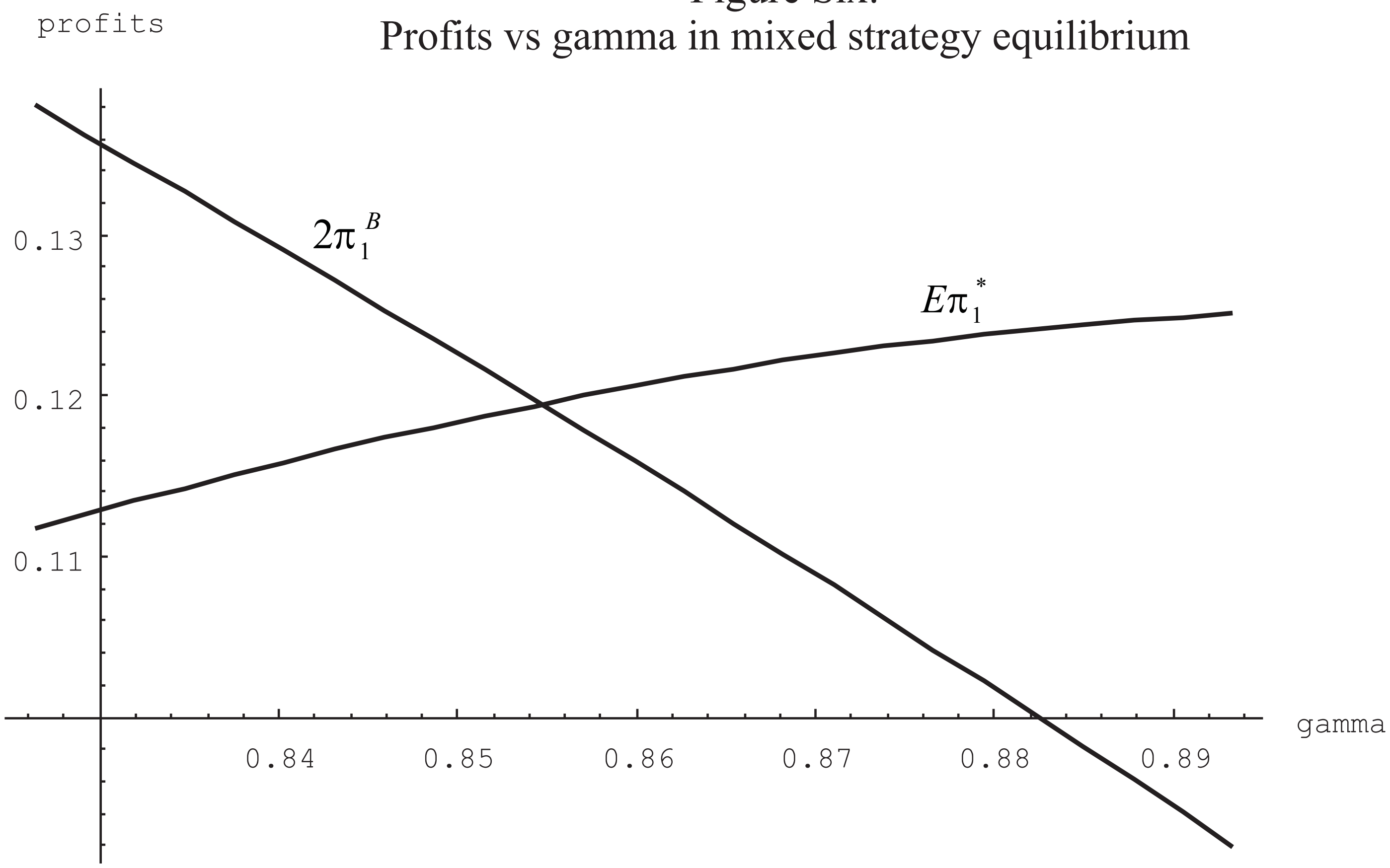


Figure Seven:
Welfare vs gamma in mixed strategy equilibrium