E C O N O M I C S B U L L E T I N

The impact of a trade embargo on quality

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Abstract

A trade embargo is a common way to punish a country. The question I ask is what effect does an embargo have on an imperfectly competitive market? I extend the standard quality duopoly model to show that if the embargo is on the high quality good the quality diminishes and causes an ambiguous effect on prices. An embargo on the low quality good raises the quality of the better good and increases both firm's price.

This is a preliminary note. I would like to thank Paul Woodburne, Eric Bond and the participants of the Pennsylvania Economic Association meetings. Please feel free to contact me with any critiques, comments, or suggestions.
Citation: McCannon, Bryan, (2004) "The impact of a trade embargo on quality." *Economics Bulletin*, Vol. 6, No. 14 pp. 1−7
Submitted: June 25, 2004. **Accepted:** September 12, 2004.
URL: http://www.economicsbulletin.com/2004/volume6/EB−04F10006A.pdf

1 Introduction

A trade embargo is an increasingly popular way for a country to punish another. Prior to 1990 the United Nations levied only two trade sanctions. Between 1990 and 1998 the United Nations has imposed eleven and since 1970 the United States has added another seventy-seven (Elliott and Hufbauer, 1999). Products produced in these countries still compete in international markets with products produced in countries without any sanctions. A straightforward question one may ask is what effect does levying a trade embargo have on a market? Many have studied the effectiveness of sanctions as well as the impact of quantity restrictions on competitive markets. I focus here on trade embargoes effect on the quality of goods produced in imperfectly competitive markets.

To address this question I extend the standard vertical product differentiation duopoly model used in Gabszewicz and Thisse (1979, 1980), Shaked and Sutton (1982, 1983) and Tirole (2002). The outcome depends on whether the embargo is levied on the country that produces a high quality product or a low quality product. If the embargo is on the former then the quality of the good decreases and the gap in quality between the two products shrinks. The effect on prices is ambiguous. The embargo has the direct effect of increasing both firm's prices but the shrinking quality gap reduces product differentiation and increases price competition. If the embargo is placed on the country that produces the lower quality good then the gap in quality increases with the higher quality firm producing an even better product. This causes the price of both goods to increase.

2 The Model

There are two firms labelled H and L and a continuum of consumers with a mass normalized to unity. Each consumers is assigned a type $\theta_i \in \left[\underline{\theta}, \overline{\theta}\right]$. The types are assigned uniformly and are not observed by either firm. First, the two firms simultaneously select a quality, s_j, from the interval $[\underline{s}, \overline{s}]$. The cost to assigning a quality s_j is denoted $X(s_j)$ where X is continuously differentiable, strictly increasing and strictly convex. Since the firms are ex ante identical they are labelled so that $s_H \geq s_L$. Next, both firms observe s_H and s_L and select a price p_j. Finally, each consumer has the option to purchase one product. Thus, he can buy H's product, L's product, or neither. A consumer of type θ_i receives a utility of

$$\theta_i s_j - p_j \tag{1}$$

from purchasing the product produced by j. A firm earns a profit of

$$(p_j - c)\,\mu_j - X\,(s_j) \tag{2}$$

where μ_j is the number of consumers that purchase j's product and c is the marginal cost of production. I focus on the subgame perfect Nash equilibrium.

As in Tirole (2002), two assumptions will be used to simplify the analysis. The first is $\overline{\theta} \geq 2\underline{\theta}$.[1] This assumption requires that there is a sufficient amount of heterogeneity in the consumers' preferences for quality. As will be shown, it guarantees the existence of a pure strategy equilibrium. Secondly, every consumer prefers to make a purchase. This is done to simplify the analysis.

Since $s_H \geq s_L$, consumers with the highest propensities for quality prefer to buy H. There will exist a threshold consumer type, $\widetilde{\theta}$, where the utility from purchasing H and L are equal. It follows that $\widetilde{\theta} = \frac{p_H - p_L}{s_H - s_L}$. Now consider modeling an embargo on one of the products. A trade embargo results in a specific population being restricted from buying the good. It is this property of trade embargoes that I introduce to the model. I first consider the case where a trade embargo is placed on the higher quality product.

2.1 An Embargo on the High Quality Good

First suppose that Country A bans H's product.[2] I assume that the distribution of tastes is the same in every country. Thus, let A denote the fraction of the population that is in the country that has enacted the trade embargo on H. A value of $A = 0$ represents the model without the trade embargo and a larger A represents a larger proportion of the world that levies the trade embargo. The demand for H is now $\mu_H = (1 - A)\left(\overline{\theta} - \widetilde{\theta}\right)$. L not only sells to those consumers whose taste for quality is relatively small but also sells to all consumers in Country A. L's demand is $\mu_L = \left(\widetilde{\theta} - \underline{\theta}\right) + A\left(\overline{\theta} - \widetilde{\theta}\right)$.[3] Hence, in the pricing game, the best responses for the firms are

$$\begin{aligned} BR_H^E &= \frac{p_L + c + (s_H - s_L)\,\overline{\theta}}{2} \\ BR_L^E &= \frac{p_H + c + (s_H - s_L)\left(\frac{A\overline{\theta} - \underline{\theta}}{1 - A}\right)}{2}. \end{aligned} \tag{3}$$

[1] Since there is a mass of one distributed uniformly over $\left[\underline{\theta}, \overline{\theta}\right]$ I assume $\underline{\theta} \geq 0$ and that the interval is of length one, $\overline{\theta} - \underline{\theta} = 1$, so that the size of an interval corresponds to a proportion of the population.

[2] Assume that neither firm is located in Country A. Also, in practice, this could represent a coalition of countries enacting a trade embargo (e.g. the United Nations).

[3] The second assumption, which requires that every consumer prefers to make a purchase, implies that $c + \frac{(\overline{s} - \underline{s})(\overline{\theta} - 2\underline{\theta} + A\overline{\theta})}{3(1 - A)} \leq \underline{\theta}\ \underline{s}$.

Notice that H's best response function is the same with and without the trade embargo. L's with the trade embargo is simply a parallel shift out in its best response function without a trade embargo. Solving, the equilibrium prices are

$$\begin{aligned} p_H^E &= c + \frac{(s_H - s_L)}{3}\left(\frac{2\overline{\theta} - \underline{\theta} - A\overline{\theta}}{1-A}\right) \\ p_L^E &= c + \frac{(s_H - s_L)}{3}\left(\frac{\overline{\theta} - 2\underline{\theta} + A\overline{\theta}}{1-A}\right). \end{aligned} \tag{4}$$

Now consider the choice of quality. The prices give rise to a demand of $\mu_H = \frac{2\overline{\theta}-\underline{\theta}-A\overline{\theta}}{3}$ for H. Profits are

$$\begin{aligned} \pi_H^E &= \frac{(s_H - s_L)\left(2\overline{\theta} - \underline{\theta} - A\overline{\theta}\right)^2}{9(1-A)} - X(s_H) \\ \pi_L^E &= \frac{(s_H - s_L)\left(\overline{\theta} - 2\underline{\theta} + A\overline{\theta}\right)^2}{9(1-A)} - X(s_L). \end{aligned} \tag{5}$$

L's profit is decreasing in s_L. This is because lowering its quality reduces costs and increases the differentiation of the products. As a result, L chooses the smallest value, $s_L^E = \underline{s}$. H selects s_H^E as the value of s_H that solves

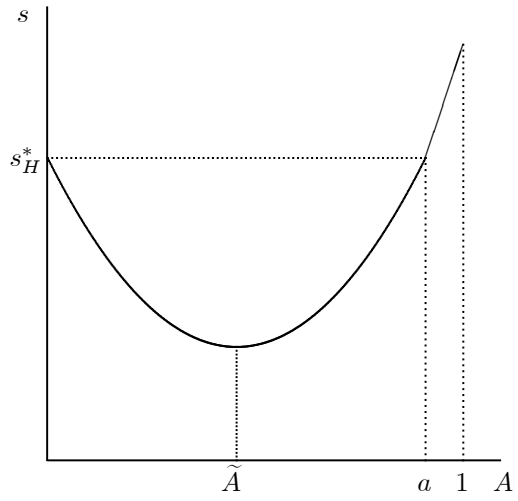
$$\frac{\left(2\overline{\theta} - \underline{\theta} - A\overline{\theta}\right)^2}{9(1-A)} = X'(s_H). \tag{6}$$

For small values of A the left hand side of (6) is decreasing in A. Therefore, as the size of the population restricted from buying H increases from zero (no trade embargo) the left hand side decreases and, as a result, the quality of H decreases. For large values of A the left hand side is increasing in A. The turning point occurs at $\widetilde{A} = 1 - \frac{1}{\overline{\theta}}$. Since, for values of A larger than $\widetilde{A}$, the left hand side is increasing in A, there exists a large value for which the quality is no longer less.[4] Figure 1 illustrates the decrease in the quality of Firm H's product and the change as A increases from zero.

I can summarize the predictions of the effect of a trade embargo placed on a country that produces the higher quality good. First, the quality of the restricted good decreases. The lost consumers lower marginal revenue leading to a reduction of marginal cost by producing a cheaper product. Second, the high quality good loses sales. Finally, there is an ambiguous effect on prices. The restriction on trade has the direct effect of increasing both firms' prices, (4), but the reduced differentiation of the goods causes stronger price competition and lower prices. Thus, the cumulative impact on prices is ambiguous.

[4] Denoted as a, the value can be found by setting the left hand side of (6) when $A = 0$ equal to (6) with $A = a$. Thus, $a = 1 - \frac{1}{\overline{\theta}^2}$.

Figure 1: Quality with an Embargo on H



2.2 An Embargo on the Low Quality Good

Instead, suppose that Country A does not allow the sale of L's product. Thus, a proportion of the customers that would have preferred L now only have H to buy. Much of the work follows analogously from the previous section. The demand for L is now $\mu_L = (1-A)\left(\widetilde{\theta} - \underline{\theta}\right)$. H not only sells to those consumers whose taste for quality is relatively large but also sells to all consumers in Country A. Again, $A = 0$ is the model without the embargo. In the pricing game, the best responses for the firms are

$$\begin{aligned} BR_H^e &= \frac{p_L + c + (s_H - s_L)\left(\frac{\overline{\theta} - A\underline{\theta}}{1-A}\right)}{2} \\ BR_L^e &= \frac{p_H + c - (s_H - s_L)\,\underline{\theta}}{2}. \end{aligned} \tag{7}$$

In the previous section, when the embargo is levied on H, its best response function is unaffected. Here, the trade embargo is on L and its best response function is unchanged. As before, the prices selected by the firms in the pricing stage increase with the trade embargo. The equilibrium prices are now

$$\begin{aligned} p_H^e &= c + \frac{(s_H - s_L)\left(2\overline{\theta} - \underline{\theta} - A\underline{\theta}\right)}{3\,(1-A)} \\ p_L^e &= c + \frac{(s_H - s_L)\left(\overline{\theta} - 2\underline{\theta} + A\underline{\theta}\right)}{3\,(1-A)}. \end{aligned} \tag{8}$$

The resulting profit functions are

$$\begin{aligned} \pi_H^e &= \frac{(s_H - s_L)\left(2\overline{\theta} - \underline{\theta} - A\underline{\theta}\right)^2}{9(1-A)} - X(s_H) \\ \pi_L^e &= \frac{(s_H - s_L)\left(\overline{\theta} - 2\underline{\theta} + A\underline{\theta}\right)^2}{9(1-A)} - X(s_L). \end{aligned} \tag{9}$$

Again, L's profit function is strictly decreasing in its quality so that $s_L^e = \underline{s}$. Firm H's equilibrium choice solves

$$\frac{\left(2\overline{\theta} - \underline{\theta} - A\underline{\theta}\right)^2}{9(1-A)} = X'(s_H). \tag{10}$$

Again, I can summarize the predictions of the effect of a trade embargo placed on a country that produces the lower quality good. First, the relative quality of the restricted good decreases. The low quality producer maintains the lowest quality possible. The gained consumers increase the high quality firm's marginal revenue, (10), leading to a increase in marginal cost by producing a better product thus lowering the restricted firm's relative quality. Second, the high quality good loses sales. The high quality producer disproportionately increases its price limiting its sales to only those consumers with exceptionally high propensities for quality. Finally, the embargo increases both firms' prices. The restriction on trade again has the direct effect of increasing both firms' prices, (8), and the increased differentiation of the goods causes weaker price competition and higher prices. Thus, the cumulative impact increases prices.

3 Conclusion

The goal of this paper is to illustrate the effect of a trade embargo on the quality of products produced in an imperfectly competitive market. To address this question I extend the standard vertical product differentiation duopoly model. Since the majority of trade embargoes are enacted by one country a firm in the sanctioned country often competes internationally. Therefore, I focus on integrated duopoly markets. I show that an embargo lowers the restricted goods (relative) quality. The trade embargo has the direct effect of raising both firms' prices due to the restricted trade. The overall impact on prices depends on whether the embargo causes more or less differentiation of the products. The model also applies to other forms of domestic policy, such as "Buy American" campaigns, where a group of consumers do not purchase a particular good. Future work could deal with more complicated trade restrictions. Also, the model lends itself to clear empirical predictions that could be tested.

4 References

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