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Profit Reducing Outsourcing

by

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Abstract

Recent empirical evidences show negative relationship between outsourcing and profitability. This paper provides a theoretical explanation for this phenomenon. In an oligopoly model, we show that firms earn lower profits in the outsourcing equilibrium compared to the situation where neither firm does outsourcing, and it holds irrespective of the intensity of competition. So, outsourcing creates prisoner's dilemma. We show that whether outsourcing is likely to reduce profit under more intense competition (measured by the degree of product differentiation, number of firm and the type of product market competition, viz., Cournot and Bertrand competition) is ambiguous. We further show that outsourcing may be "excessive" and will hurt overall welfare.

Keywords: Outsourcing; Profit; R&D

JEL Classification: F12; L14; L22; D23

Outline

Non-Technical Summary

There have been concerns that large number of jobs will be lost in the developed countries due to off shoring of unskilled and semi-skilled activities and therefore, laws should be designed to regulate such contracts. While the main debate on outsourcing is to see its effect on labor market, recent evidences cast doubt on the profitability of the outsourced firms. Recent empirical evidences show negative relationship between outsourcing and profitability. This paper provides a theoretical explanation for this phenomenon. In an oligopoly model, we show that firms earn lower profits in the outsourcing equilibrium compared to the situation where neither firm does outsourcing, and it holds irrespective of the intensity of competition. So, outsourcing creates prisoner's dilemma. We also show that whether outsourcing is likely to reduce profit under more intense competition (measured by the degree of product differentiation, number of firm and the type of product market competition, viz., Cournot and Bertrand competition) is ambiguous. We further show that outsourcing may be "excessive" and will hurt overall welfare.

1. Introduction

A popular discussion in the academic circle and the media is the growth of outsourcing of production from developed countries to developing countries. Cheap labor in the developing countries is one of the main reasons for outsourcing (Abraham and Taylor, 1996). Hence, there have been concerns that large number of jobs will be lost in the developed countries due to off shoring of unskilled and semi-skilled activities and therefore, laws should be designed to regulate such contracts. However, critiques of this argument have shown that there are substantial benefits from outsourcing as well. The recent loss of jobs in USA is primarily due to technological restructuring rather than outsourcing. An interesting write up in this context is by Drezner (2004).

While the main debate on outsourcing is to see its effect on labor market, recent evidences cast doubt on the profitability of the outsourced firms. More specifically, they ask whether outsourcing increases profits of the outsourced firms. Kimura (2002) does not find any evidence that outsourcing increases profits of the Japanese manufacturing firms. Using the date on German firms, Görzig and Stephen (2002) find that while outsourcing of materials shows a positive relationship with profits, there is a negative relationship between profitability and outsourced services. Using the data on Irish firms, Görg and Hanley (2004) also show that outsourcing reduces profit of the small plants while it increases profit of the large plants.

This paper provides a theoretical explanation for the negative relationship between outsourcing and profitability. In an oligopoly model, we show that outsourcing can reduce profits of the outsourced firms in a strategic environment when firms decide to outsource their productions. Outsourcing can create prisoner's dilemma such that the outsourced firms earn lower profits under outsourcing compared to the situation whether neither firm does outsourcing. Our result holds irrespective of the intensity of product market competition. To the best of our knowledge, this is the first theoretical paper, which shows that outsourcing makes the firms worse

off compared to no outsourcing. We show that whether profit-reducing outsourcing is likely to occur under higher competition (measured by the degree of product differentiation, number of firm and the type of product market competition, viz., Cournot and Bertrand competition) is ambiguous. We further show that the extent of outsourcing can be excessive and is likely to hurt welfare.

Theoretical research on outsourcing is gradually growing in number. Papers by Grossman and Helpman (2002, 2003 and forthcoming), Buehler and Haucap (2003), Egger and Egger (2003), Shy and Stenbacka (2003), Rossini and Lambertini (2003), Antràs and Helpman (2004) and Grossman et al. (2004) talk about contractual and strategic implications of outsourcing and show the advantage of international outsourcing over other organizational structures such as vertical integration and foreign direct investment. Feenstra and Hanson (1999) and Jones (2004) provide a trade theoretic angle to the problem. While Feenstra and Hanson (1999) estimates the impact of outsourcing on relative wage within USA, Jones (2004) compares immigration and outsourcing since both tend to affect local wage.[1] However, unlike the above-mentioned works, outsourcing in our paper may make firms worse off compared to no outsourcing by any firm.

The remainder of the paper is organized as follows. Section 2 builds up the basic model and derives the results. Section 3 concludes.

2. The Model and the results

Let us consider a country, called domestic country, with n firms, who want to sell their products in the world market. These firms can produce in the domestic country, where the competitive labor cost is w, or each of them can outsource their production to another with a cheap labor, called foreign country, where the competitive labor cost is $w^* < w$. However, if a firm wants to outsource their production, it has to incur a cost of outsourcing (see, e.g., Glass and Saggi, 2001 and

[1] A special issue of the journal 'International Review of Economics and Finance' in 2004 has devoted to the recent works on outsourcing.

Grossman and Helpman, 2003), which is assumed to be F. We further assume that each firm needs one labor to one unit of output irrespective of their production in the domestic country or in the foreign country. Therefore, marginal cost of each firm is w in the domestic country and w^* in the foreign country.

Define the reduced form profit functions of firm i by π_i, $i = 1,2,...,n$, which depends on the marginal costs of the firms, the degree of substitution and the type of product market competition. We use the terms γ and θ in the profit functions to indicate the degree of substitution and the type of product market condition. We will consider Cournot and Bertrand competition as different types of product market competition and will consider that $\gamma \in (0,1]$.[2]

As in Boone (2001), we provide the following restrictions on the profit function:

A1: Profit of a firm is negatively related to its own cost.

A2: Profit of a firm is positively related to the competitor's cost.

A3: The rate, at which profit of a firm changes with its own cost, is increasing with the competitor's cost.

We will consider symmetric equilibrium only, which is enough to serve the purpose of this analysis. It is easy to check that all firms doing outsourcing is the equilibrium outcome if and only if

$$\pi_i(w^*, w^*_{-(n-1)}, \gamma, \theta) - \pi_i(w, w^*_{-(n-1)}, \gamma, \theta) \equiv \underline{F} > F, \quad (1)$$

where the first argument shows marginal cost of the ith firm and the other argument(s) shows marginal cost of each of the other firms with the number of such firm is shown in the bracket.

Proposition 1: *If* $F < \underline{F}$*, outsourcing is a dominant strategy equilibrium for all firms.*

Proof: Given that k firms outsource their productions and $(n-1-k)$ firms produce in the domestic country, it is better for firm i, $i = 1,2,...,n$, to outsource its production if and only if

$$\pi_i(w^*, w^*_{-k}, w_{-(n-1-k)}, \gamma, \theta) - \pi_i(w, w^*_{-k}, w_{-(n-1-k)}, \gamma, \theta) \equiv F^*(k) > F \,. \tag{2}$$

As k increases, it reduces both $\pi_i(w^*, w^*_{-k}, w_{-(n-1-k)}, \gamma, \theta)$ and $\pi_i(w, w^*_{-k}, w_{-(n-1-k)}, \gamma, \theta)$, but A3 implies that the former reduces more than the later term and therefore, $F^*(k)$ is negatively related to k. So, when all other firms outsource, it is better for firm i, $i = 1,2,...,n$, to outsource its production if and only if $F < \underline{F}$. Therefore, when $F < \underline{F}$, each firm does outsourcing irrespective of the strategies of the other firms. This proves the result. Q.E.D.

So, if $F < \underline{F}$, each firm does outsourcing and net profit of each firm is $\pi_i(w^*, w^*_{-(n-1)}, \gamma, \theta) - F$. However, each firm earns higher profit in the outsourcing equilibrium compared to the situation where none of them does outsourcing if and only if

$$\pi_i(w^*, w^*_{-(n-1)}, \gamma, \theta) - \pi_i(w, w_{-(n-1)}, \gamma, \theta) \equiv \hat{F}\,, \tag{3}$$

where $\hat{F} < \underline{F}$.

Therefore:

Proposition 2: *If* $F \in (\hat{F}, \underline{F})$*, outsourcing is the equilibrium outcome and each firm earns lower profit under outsourcing compared to the situation where none of them does outsourcing.*

[2] We ignore perfect substitutes to avoid 'Bertrand paradox'. However, our results hold for perfect substitutes if the product market is characterized by Cournot competition.

The above proposition shows that if the cost of outsourcing is not very small but it is small enough to induce all firms to do outsourcing, then outsourcing creates prisoner's dilemma. Hence, Proposition 2 provides a theoretical explanation for the empirical findings, showing outsourcing reduces profits of the firms. Further, given that the cost of outsourcing is likely to be more for the manufacturing sector than the service sector, this result is also consistent with Görzig and Stephen (2002), which shows that there is a negative relationship between profits and outsourcing for outsourced services but the relationship is positive for materials.

In a symmetric Cournot oligopoly, Seade (1987) shows that if the marginal costs of all firms reduce by same amounts, it reduces profit of the firms for certain non-linear demand functions. Note that this paper provides a different reason for a profit reducing outsourcing and our result is not based either on the non-linearity of the demand function or the intensity of product market competition.

Now, we will see how the range of fixed cost of outsourcing, over which outsourcing reduces profit, is affected by the degree of product differentiation, number of firms and the type of product market competition. Both $\pi_i(w, w_{-(n-1)}, \gamma, \theta)$ and $\pi_i(w, w^*_{-(n-1)}, \gamma, \theta)$ are negatively related to the degree of product differentiation, γ, and the number of firms, n. Hence, it is not clear a priori how the difference $\underline{F} - \hat{F} = \pi_i(w, w_{-(n-1)}, \gamma, \theta) - \pi_i(w, w^*_{-(n-1)}, \gamma, \theta)$ behaves with respect to γ and n. Appendices A and B consider examples under Cournot and Bertrand competition to show that the relationship between $(\underline{F} - \hat{F})$ and γ and, $(\underline{F} - \hat{F})$ and n are ambiguous.

Hence:

Proposition 3: *The effect of (i) product differentiation and (ii) the number of firms on the interval* $(\hat{F}, \underline{F})$ *is ambiguous.*

Both the degree of product differentiation and the number of firms affect the intensity of competition in the product market. Hence, the above proposition implies that whether a more competitive environment is more likely to reduce profit under outsourcing is ambiguous.

As product differentiation reduces, i.e., γ increases, on one hand, it reduces price of the products for a given output and, on the other hand, it reduces output of each firm. Therefore, as product differentiation reduces, it reduces profit of each firm, i.e., both $\pi_i(w, w_{-(n-1)}, \gamma, \theta)$ and $\pi_i(w, w^*_{-(n-1)}, \gamma, \theta)$ reduces with higher γ. However, the effect of profit reduction varies with the degree of product differentiation. Consider the situation where the products are almost isolated, i.e., $\gamma \to 0$. In this situation, output of firm i is almost the same under both $\pi_i(w, w_{-(n-1)}, \gamma, \theta)$ and $\pi_i(w, w^*_{-(n-1)}, \gamma, \theta)$. Now, if there is a slight increase in γ, the effect through lower price, for a given output, is almost the same on both these profits. However, as γ increases, the reduction in the output of firm i is more for the profit function $\pi_i(w, w^*_{-(n-1)}, \gamma, \theta)$, than profit function $\pi_i(w, w_{-(n-1)}, \gamma, \theta)$, since firm i competes with relatively more cost efficient other firms in the former situation than the latter. Hence, if the products are very much differentiated, a slight reduction in the product differentiation, i.e., a slight higher γ, increases $(\underline{F} - \hat{F})$.

Now, consider the other extreme situation where the products are almost perfect substitutes, i.e., $\gamma \to 1$. Here, a slight reduction in γ does not have much impact on output since the intensity of competition is very high, and therefore, the effect on the profits through lower outputs are negligible in this situation. However, the effects through lower price, for a given output, become significant, as the output of firm i is sufficiently higher under the profit function $\pi_i(w, w_{-(n-1)}, \gamma, \theta)$ than the profit function $\pi_i(w, w^*_{-(n-1)}, \gamma, \theta)$, since the former situation corresponds to more cost inefficient other firms than the latter situation. So, the profit increase through this price effect is more under $\pi_i(w, w_{-(n-1)}, \gamma, \theta)$ than $\pi_i(w, w^*_{-(n-1)}, \gamma, \theta)$. Therefore, if the products are almost close

substitutes, a slight increase in product differentiation, i.e., a slight lower γ, increases $(\underline{F} - \hat{F})$. Further, it should be clear that the above intuition did not refer to any particular type of product market competition, and therefore, it holds for both Cournot and Bertrand competition.

Since, the arguments for the number of firms will be similar to the above logic, we are omitting the discussion here.

Lastly, we see how the type of product market competition affects the difference $(\underline{F} - \hat{F})$, i.e., whether it is higher under Cournot competition or Bertrand competition. We provide an example in Appendix C, which gives the following result immediately.

Proposition 4: *Whether the interval* $(\hat{F}, \underline{F})$ *is high under Cournot competition or Bertrand competition is ambiguous.*

As the degree of product differentiation increases, the effect of Cournot and Bertrand competition become the same and at the extreme situation of isolated products, the market outcomes will be the same under these two types of product market competition. On the other hand, the difference in the intensity of competition under Bertrand and Cournot competition is the maximal for perfect substitutes. Hence, it should be clear that the intuition for the above proposition follows the intuition provided for Proposition 3.

2.1 Excessive outsourcing

We have seen that if the fixed cost of outsourcing is not very large, i.e., $F < \underline{F}$, it is profitable for all firms to do outsourcing. Now, we will show that outsourcing by all firms may be excessive for the domestic country. In other words, welfare of the domestic country, which is the summation of net industry profit and the share of domestic country in world consumption, could be higher if all

firms do not outsource. To show this in the simplest way, it would be enough to consider that domestic welfare reduces with outsourcing by the nth firm, when all other firms do outsourcing. Further, we start our analysis with the extreme assumption where the share of the domestic country in world consumption is zero.

If there is no domestic consumption, welfare of the domestic country is given by the net industry profit only. Hence, given that $(n-1)$ firms do outsourcing, domestic welfare reduces with outsourcing by the n the firm provided

$$\pi_n(w^*, w^*_{-(n-1)}) + \sum_{i=1}^{n-1}\pi_i(w^*, w^*_{-(n-1)}) - \pi_n(w, w^*_{-(n-1)}) - \sum_{i=1}^{n-1}\pi_i(w, w^*_{-(n-1)}) < F$$

or
$$\pi_n(w^*, w^*_{-(n-1)}) - \pi_n(w, w^*_{-(n-1)}) + \sum_{i=1}^{n-1}\pi_i(w^*, w^*_{-(n-1)}) - \sum_{i=1}^{n-1}\pi_i(w, w^*_{-(n-1)}) < F \qquad (4)$$

where π_n and $\sum_{i=1}^{n-1}\pi_i$ show profit of the nth firm and total profit of other $(n-1)$ firms, and the first (second) argument in the profit function shows the marginal cost of the nth firm (other $(n-1)$ firms).

Using (1), we can write (4) as

$$\underline{F} + \sum_{i=1}^{n-1}\pi_i(w^*, w^*_{-(n-1)}) - \sum_{i=1}^{n-1}\pi_i(w, w^*_{-(n-1)}) \equiv \tilde{F} < F\,. \qquad (5)$$

Since the assumption **A2** implies that $\sum_{i=1}^{n-1}\pi_i(w^*, w^*_{-(n-1)}) - \sum_{i=1}^{n-1}\pi_i(w, w^*_{-(n-1)}) < 0$, it is immediate that $\underline{F} > \tilde{F}$. Therefore, for the domestic country, outsourcing by the nth firm reduces welfare for $F \in (\tilde{F}, \underline{F})$.

It should be clear that if the difference between w and w^* is very large such that the nth firm's profit is zero without outsourcing, left hand side of (4) is negative for any $n > 2$, since

outsourcing increases the number of effective producers in the market. In this situation, $\tilde{F} = 0$, and, outsourcing by the nth firm is excessive for the domestic country when $F < \underline{F}$.

However, as the share of domestic consumption in the world consumption increases, it reduces the possibility of excessive outsourcing from the point of view of the domestic country. In the other extreme, where all the consumption is by the domestic country, outsourcing is excessive for the domestic country (which is also similar to excessive outsourcing for the world) when

$$\underline{F} + \sum_{i=1}^{n-1} \pi_i(w^*, w^*_{-(n-1)}) + CS(w^*, w^*_{-(n-1)}) - \sum_{i=1}^{n-1} \pi_i(w, w^*_{-(n-1)}) - CS(w, w^*_{-(n-1)}) \equiv \breve{F} < F, \qquad (6)$$

where CS stands for the consumer surplus.

Hence:

Proposition 5: *Outsourcing is likely to be excessive for the domestic country when the share of domestic consumption is low in the world consumption. If the domestic consumption is negligible, outsourcing is always excessive for the domestic country.*

3. Conclusion

Recent empirical evidences show that outsourcing reduces profits of the outsourced firms. This paper provides a theoretical explanation for this phenomenon. We show that outsourcing may create prisoner's dilemma and therefore, reduce profits of the outsourced firms in a strategic environment compared to the situation where none of them outsource their productions. We use examples to show that the effect of competition (measured by the degree of product differentiation, number of firm and the type of product market competition, viz., Cournot and Bertrand competition) on profit reducing outsourcing is ambiguous. We further show that outsourcing can be excessive in the sense of reducing overall welfare.

Appendix

A The relationship between $(\underline{F}-\hat{F})$ and γ and, $(\underline{F}-\hat{F})$ and n under Cournot competition:

Let us consider the inverse market demand function

$$P_i = 1 - q_i - \gamma \sum_{i \neq j} q_j \,, \tag{A.1}$$

where $i, j = 1,2,...,n$.

Given the inverse demand function (A.1), we find that

$$\pi_i(w, w^*_{-(n-1)}, \gamma) = \frac{((2-\gamma) - w(2+\gamma(n-2) + w^*\gamma(n-1))^2}{(2-\gamma)^2(2-\gamma+\gamma n)^2}$$

and

$$\pi_i(w, w_{-(n-1)}, \gamma) = \frac{((2-\gamma) - w(2+\gamma(n-2) + w\gamma(n-1))^2}{(2-\gamma)^2(2-\gamma+\gamma n)^2}.$$

Therefore,

$$\pi_i(w, w_{-(n-1)}, \gamma) - \pi_i(w, w^*_{-(n-1)}, \gamma)$$

$$= \frac{((2-\gamma) - w(2+\gamma(n-2) + w\gamma(n-1))^2}{(2-\gamma)^2(2-\gamma+\gamma n)^2} - \frac{((2-\gamma) - w(2+\gamma(n-2) + w^*\gamma(n-1))^2}{(2-\gamma)^2(2-\gamma+\gamma n)^2}. \tag{A.2}$$

We plot the RHS of (A.2) in Figure 1 for $n = 5$, $w^* = 0$, $w = .2$ and $\gamma \in [0,1]$, and in Figure 2 for $\gamma = 1$, $w^* = 0$, $w = .1$ and $n \in [2,10]$.[3] Hence Figure 1 shows the effect of product differentiation for a given number of firms, whereas Figure 2 shows the effect of the number of firms for a given degree of product differentiation. Both the figures show that the relationship between $(\underline{F}-\hat{F})$ and γ, $(\underline{F}-\hat{F})$ and n are ambiguous.

Figures 1 and 2

B The relationship between $(\underline{F}-\hat{F})$ and γ and, $(\underline{F}-\hat{F})$ and n under Bertrand competition:

The demand function corresponding to (A.1) is given by

[3] We use 'The Mathematica 4' (see Wolfram, 1999) for the figures of this paper.

$$q_i = \frac{(1-\gamma) - p_i(1+(n-2)\gamma) + \gamma \sum_{i \neq j} p_j}{(1-\gamma)(1+(n-1)\gamma)}. \qquad \text{(B.1)}$$

Like Appendix A, assume that $w^* = 0$. Given the inverse demand function (A.1), we find that

$$\pi_i(w, w^*_{-(n-1)}, \gamma) = \frac{((1-\gamma)(2+\gamma)(3n-5) - 2w(1+\gamma(n-2))^2 + \gamma^2 w(n-1))^2 (1+\gamma(n-2))}{(1-\gamma)(1+\gamma(n-1))(4(1+\gamma(n-2))^2 - \gamma^2(n-1))^2}$$

and

$$\pi_i(w, w_{-(n-1)}, \gamma) = \frac{((1-\gamma)(1+\gamma(n-2))(1-w)^2}{(1+\gamma(n-1))(2+\gamma(n-3))^2}.$$

Now, we plot $\pi_i(w, w_{-(n-1)}, \gamma) - \pi_i(w, w^*_{-(n-1)}, \gamma)$ in Figure 3 for $n = 5$, $w^* = 0$, $w = .00042$ and $\gamma \in [0,.999]$, and in Figure 4 for $\gamma = .5$, $w^* = 0$, $w = .151$ and $n \in [2,10]$.

Figure 3 and 4

C The value of $(\underline{F} - \hat{F})$ under Cournot and Bertrand competition: Let us consider our previous example with $\gamma = .5$, $w^* = 0$, $w = .151$ and $n \in [2,10]$. We subtract the value of $(\underline{F} - \hat{F})$ under Bertrand competition from that of under Cournot competition in Figure 5.

Figure 5

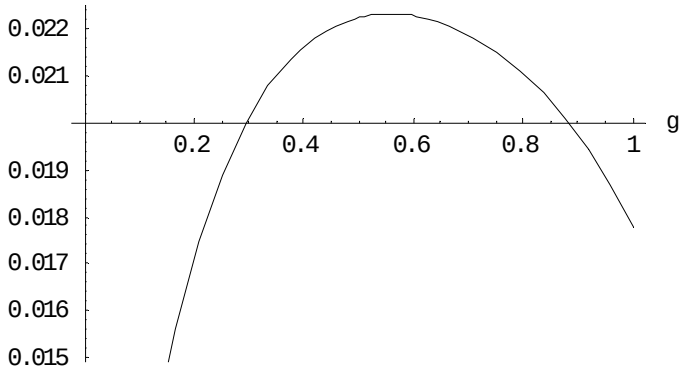

Figure 1: Right hand side of (A.2) for $n = 5$, $w^* = 0$, $w = .2$ and $\gamma \in [0,1]$.

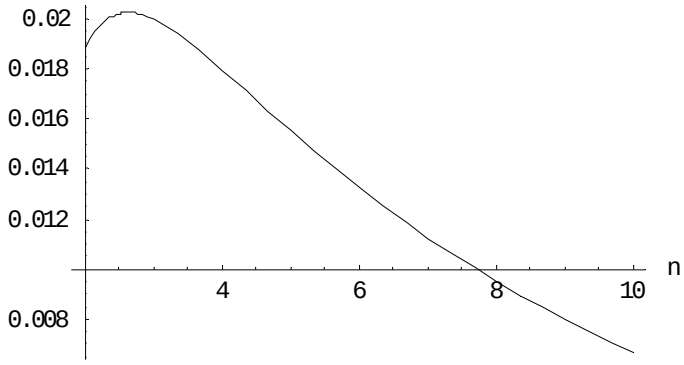

Figure 2: Right hand side of (A.2) for $\gamma = 1$, $w^* = 0$, $w = .1$ and $n \in [2,10]$.

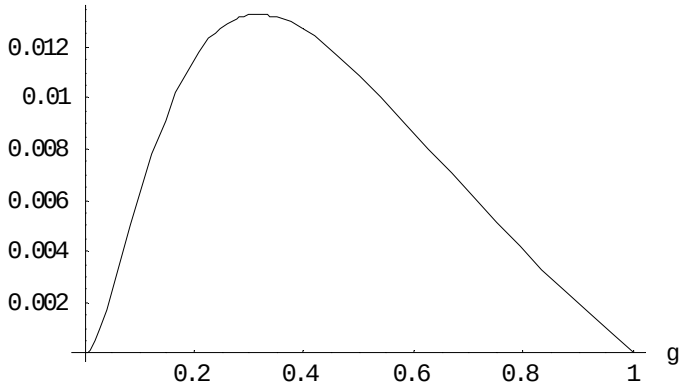

Figure 3: $\pi_i(w, w_{-(n-1)}, \gamma) - \pi_i(w, w^*_{-(n-1)}, \gamma)$ for $n = 5$, $w^* = 0$, $w = .00042$ and $\gamma \in [0,.999]$ under Bertrand competition.

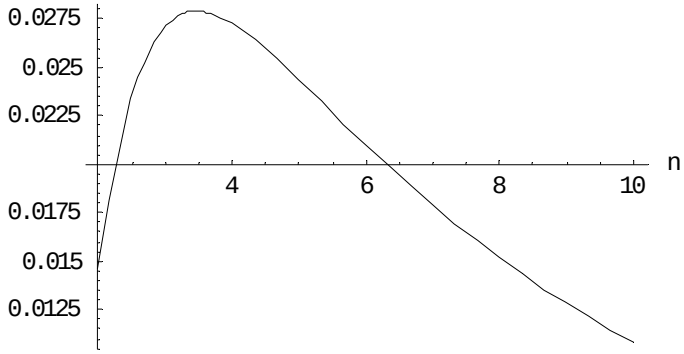

Figure 4: $\pi_i(w, w_{-(n-1)}, \gamma) - \pi_i(w, w^*_{-(n-1)}, \gamma)$ for $\gamma = .5$, $w^* = 0$, $w = .151$ and $n \in [2,10]$ under Bertrand competition.

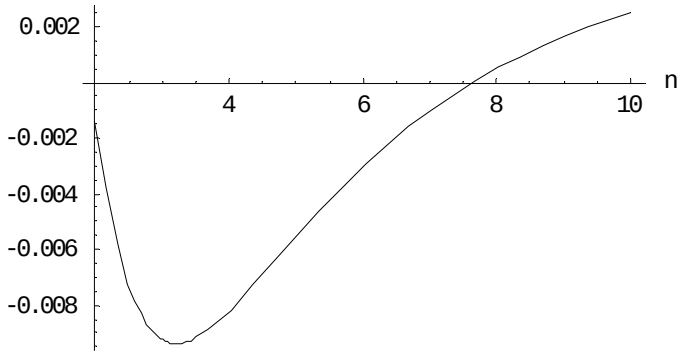

Figure 5: Subtracting the value of $(\underline{F} - \hat{F})$ under Bertrand competition from that of under Cournot competition for $\gamma = .5$, $w^* = 0$, $w = .151$ and $n \in [2,10]$.

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