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# WHERE TO ENCOURAGE ENTRY: UPSTREAM OR DOWNSTREAM

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August 2003

# Where to encourage entry: upstream or downstream*

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**Abstract**: In a vertically separated industry, where the input suppliers have significant market power, not only entry but also the markets (upstream or downstream) with entry possibilities might be a concern to the policy makers. While 'entry in the downstream market only' always increases welfare, 'entry in the upstream market only' increases welfare provided the technology of the upstream entrant is not sufficiently inferior to that of the incumbent. However, entry in the upstream market accompanied by entry in the downstream market may always increase welfare. Our results are important for the competition policy.

**Key Words:** Downstream market, Entry, Upstream market, Welfare
**JEL Classification:** D43, L13, 034

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* The authors are solely responsible for the views presented here but not the Universities.

**Where to encourage entry: upstream or downstream**

# 1 Introduction

Common wisdom suggests that competition increases welfare of an economy. One major challenge of the competition policy is to design government policies to increase competition through new entry. Researchers have already discussed the implications of entry on social welfare to a large extent and found that entry does not increase welfare always. For example, while analyzing the innovative activity of firms in oligopolistic markets, Stiglitz (1981), Spence (1984) and Tandon (1984) have shown the possibility of lower welfare caused by either potential entrants or free entry and exit of firms. Schmalensee (1976), von Weizsäcker (1980a, b), Mankiw and Whinston (1986) and Suzumura and Kiyono (1987) have shown that the equilibrium number of firms in a model of free entry and exit is greater than the welfare maximizing number of firms and hence, welfare increases in a less competitive market.

Ignoring the existence of fixed cost, Klemperer (1988) and Lahiri and Ono (1988) have argued that entry in a quantity setting oligopolistic market increases welfare provided the marginal cost of production of the entrant is not sufficiently high compared to that of the incumbent. Asymmetric marginal cost of production (or, uneven technologies) becomes the important ingredient in Klemperer (1988) and Lahiri and Ono (1988).

While debating on the impact of entry, previous works have ignored the possibility of vertically separated industry where the input producers have significant market power, which may raise important questions related to this debate. So, while the previous works are useful when either the input markets are perfectly competitive or the input suppliers and final good producers are vertically integrated, those analyses may not be suitable in vertically separated industries where the input market is imperfectly competitive. Empirical evidence shows that, like final goods market, the input markets are often characterized by imperfect competition. As demonstrated by Tyagi (1999), the market for microprocessors, aircraft-engines, packaged products and many others are characterized by oligopolistic competition. The energy or power-generating sector in the U.K. also shows that few firms are operating in that sector.

If the industry is vertically separated and the input suppliers have significant market power, it is important not only to analyze the impact of entry but also to consider whether entry occurs in the upstream market (producing inputs) and/or in the downstream market (producing final goods). It is easy to understand that entry in upstream or downstream market has different effects on demand for inputs. Entry in the upstream market does not affect the demand for input for a given price of the input, but increases competition and shifts production from the incumbent to the entrant. But, in case of entry in the downstream market, entry changes the demand function for input and creates a further effect by changing the demand function for input. Hence, the consideration whether the new firms enter the upstream or downstream market may have important consequences on the equilibrium outcomes and is also important to the policy makers.

In a simple model of a vertically separated industry where the input supplier is restricted to linear pricing (reason for which is given later), we examine the effects of entry in the upstream and/or downstream market. We find that 'entry in the downstream market only' always increases welfare but 'entry in the upstream market only' increases welfare when the technology of the upstream entrant is not sufficiently inferior compared to that of the incumbent. Whereas, if there is entry in both upstream and downstream markets, welfare may always be higher under entry compared to no-entry. Thus, we show that the industry, where entry occurs, and the technological differences between the incumbent and the entrant, are crucial for analyzing the effects of entry.

Our results imply that if the industries are vertically separated, where the upstream firms have market power, the policy makers do not need to be worried when entry occurs in the final goods market as it is more likely to increase the welfare of the economy. If entry occurs in the input market only, the technological inefficiency of the entrant needs to be questioned. Thus, we suggest that while government policy will be designed to encourage entry in the final goods market, entry in the input market might require careful consideration and restriction.

The remainder of the paper is organized as follows. Section 2 and Section 3 consider the problem of entry in the 'downstream market only' and in the 'upstream market only' respectively. Section 4 discusses the possibility of entry in both markets. Section 5 concludes.

## 2 Possibility of entry in the downstream market only

Let us consider an economy with upstream and downstream markets. Assume that there is a monopolist upstream firm who produces input for the downstream firm. The upstream monopolist faces constant marginal cost of production, which is assumed to be zero, for simplicity. The upstream monopolist chooses the amount of input production. The price of the input, $w$, is determined from the demand function for input. There is no further cost associated with input production.

Our assumption of linear pricing for input is similar to Choi (1991), Gerstner and Hess (1995), Economides (1998), Villas-Boas (1998), Tyagi (1999), Rao and Srinivasan (2001) and others. Following the approach taken in the channel coordination literature (e.g., Gerstner and Hess, 1995), we assume away the possibility of upstream firm either charging a fixed fee or enforcing a contract requiring the downstream firm to buy a fixed proportion from the upstream firm for reasons outside of the model. The assumption of linear pricing may be justified by the arguments given by Rao and Srinivasan (2001) in the context of franchising. If the upstream and the downstream firms are in ongoing relationship where the demand and cost conditions vary over time, the uniform pricing of the upstream output is optimal if significant costs are involved in re-writing the contracts between the upstream and downstream firms. Our experience about the U.K. energy sector also shows that the firms do not charge fixed-fee to its customers.

We also rule out the possibility of vertical integration in our analysis. As evident from Hart and Tirole (1990), significant amount of costs involved in vertical integration can make it an unprofitable strategy.

The firms in the downstream market take the price of inputs as given while making their production decisions. For simplicity, we assume that the downstream firms need only this input for their production. Hence, input price acts as the marginal cost of production for the downstream firms. Again, for simplicity, we assume that there are no other costs associated with final goods production.

To find out the effect of 'entry in the downstream industry only' on social welfare[1], we consider two situations for the downstream industry. First, when the downstream industry is a monopoly of a final good producer. Second, when the downstream industry is a duopoly.

We assume that the incumbent and the entrant in the downstream market have different production technologies. The incumbent firm needs one unit of input to produce one unit of output and the entrant needs $\lambda$ units of input to produce one unit of output, where $\lambda > 1$. So, the incumbent firm has a better production technology compared to the entrant. We further assume that, in case of entry, firms compete like Cournot duopolists with homogeneous products. Assume that the inverse market demand for the final product is

$$P = a - q, \tag{1}$$

where the notations have usual meanings.

### *2.1 Monopoly in the downstream market*

Let us start the analysis with a situation where the incumbent firm is a monopolist in the downstream market. So, given the input price $w$, the optimal input demand is

$$q_I = \frac{(a-w)}{2}. \tag{2}$$

The upstream monopolist chooses the optimal amount of input supply to maximize the following objective function:

$$\underset{q_I}{\text{Max}}(a - 2q_I)q_I. \tag{3}$$

Maximizing (3), we find that the optimal input supply and the corresponding input prices are $\frac{a}{4}$ and $\frac{a}{2}$ respectively. Total input demand (which is also equal to the total output of the downstream incumbent) and optimal profit of the downstream incumbent firm are $\frac{a}{4}$ and $\frac{a^2}{16}$ respectively.

Therefore, if there is a monopolist in the downstream market, welfare of the economy is

[1] Social welfare is defined as the summation of consumer surplus and total profits generated in the upstream and downstream markets.

$$W_{ne} = \frac{7a^2}{32}. \tag{4}$$

*2.2 Duopoly in the downstream market*

Let us now consider a situation where a new firm (the entrant) enters the downstream market so that the market becomes a duopoly. Given the input price, the optimal outputs of the downstream incumbent and entrant are respectively

$$q_i^* = \frac{(a - 2w + \lambda w)}{3} \quad \text{and} \quad q_e^* = \frac{(a - 2\lambda w + w)}{3}. \tag{5}$$

It is important to note that the output of the entrant is zero provided $w \geq \frac{a}{(2\lambda - 1)}$.

Therefore, total demand for input is given by

$$q_I = q_i^* + \lambda q_e^* = \frac{(a(1+\lambda) - 2w(1+\lambda^2) + 2\lambda w)}{3}, \qquad \text{for } w \leq \frac{a}{(2\lambda - 1)} \tag{6}$$

and

$$q_I = q_i^* = \frac{(a - w)}{2}, \qquad \text{for } w \geq \frac{a}{(2\lambda - 1)}. \tag{7}$$

In our study there is no input demand for $w > a$.

Given this structure of the input demand, it is easy to understand that, in case of entry, whether the upstream monopolist supplies for both downstream firms (i.e., the corresponding input price is less than $\frac{a}{(2\lambda - 1)}$) or only for the technologically efficient downstream firm (i.e., the corresponding input price is higher than $\frac{a}{(2\lambda - 1)}$) is also a decision of the upstream monopolist. As we will show in the following analysis, if the value of $\lambda$ is less than $2$, it is better for the upstream monopolist to produce for both downstream firms. We assume that $\lambda \in [1, 2)$, since, otherwise, entry does not have any real impact in our analysis.

If the upstream monopolist supplies to both downstream firms, i.e., faces the demand for input as in (6), the upstream monopolist maximizes the following expression:

$$\underset{q_I}{Max} \frac{(a(1+\lambda) - 3q_I)q_I}{(2 + 2\lambda^2 - 2\lambda)}. \tag{8}$$

Maximizing (8), we find that the optimal input supply and the corresponding input prices are $\frac{a(1+\lambda)}{6}$ and $\frac{a(1+\lambda)}{(4+4\lambda^2-4\lambda)}$ respectively. It is easy to verify that $\frac{a(1+\lambda)}{(4+4\lambda^2-4\lambda)}$ is less than $\frac{a}{(2\lambda-1)}$ for $\lambda \in [1,2)$.

The total output of the downstream incumbent and entrant together is $\frac{a(7+7\lambda^2-10\lambda)}{12(1+\lambda^2-\lambda)}$. The profits of the upstream monopolist, downstream incumbent and downstream entrant are respectively $\frac{a^2(1+\lambda)^2}{24(1+\lambda^2-\lambda)}$, $\frac{a^2(2+5\lambda^2-5\lambda)^2}{9(4+4\lambda^2-4\lambda)^2}$ and $\frac{a^2(5+2\lambda^2-5\lambda)^2}{9(4+4\lambda^2-4\lambda)^2}$. Therefore, in case of entry in the downstream market only, welfare of the economy is

$$W_e = \frac{a^2(5+2\lambda^2-5\lambda)^2 + a^2(2+5\lambda^2-5\lambda)^2}{9(4+4\lambda^2-4\lambda)^2} + \frac{a^2(1+\lambda)^2}{24(1+\lambda^2-\lambda)} + \frac{a^2(7+7\lambda^2-10\lambda)^2}{288(1+\lambda^2-\lambda)^2}. \quad (9)$$

Hence, we have the following proposition.

**Proposition 1:** W*elfare is higher under entry compared to no-entry for any* $\lambda \in [1,2)$.

**Proof:** We subtract (4) from (9) and plot this difference in Figure 1[2].

**Figure 1**

The inspection of Figure 1 proves the result. Q.E.D.

If there is entry in the downstream market, it has three effects on social welfare. Firstly, entry increases competition. Given the price of the input, higher competition in the downstream market tends to increase social welfare. Secondly, entry shifts production from the incumbent to the entrant. Given the price of the input, entry of a firm in the downstream market reduces the market share of the incumbent and reduces its profit. If the entrant is inferior compared to the incumbent, entry creates production inefficiency by shifting production from the technologically efficient incumbent to the technologically inefficient entrant. Hence, this has a

[2] We used 'The Mathematica 4.2' for Figure 1.

negative impact on social welfare. These two effects are similar to the effects demonstrated by the previous works of the literature. However, entry in the vertically separated market creates another effect on social welfare by affecting the demand function for the input. Entry in the downstream industry changes the demand for input and reduces the price of the input. In case of no entry, price of the input is $\frac{a}{2}$, while under entry it is $\frac{a(1+\lambda)}{(4+4\lambda^2-4\lambda)}$. This lower input price reduces the marginal cost of the downstream market and creates a positive impact on social welfare. The effect of changing demand function for input along with higher competition outweighs the negative effect of production inefficiency created by entry. As a result, entry always increases social welfare.

In our analysis we restrict $\lambda$ to be greater than or equal to 1. If $\lambda < 1$, it implies that the entrant is technologically superior compared to the incumbent. In this situation, entry creates production efficiency by shifting output from the incumbent to the entrant. So, when $\lambda < 1$, all the above-mentioned effects of entry have positive impact on social welfare and therefore, entry always increases welfare.

So far we have assumed that, in case of entry, the upstream monopolist produces for both downstream firms when $\lambda \in [1,2)$. Now, we examine the validity of this assumption.

In case of entry, if the upstream monopolist produced for the technologically efficient downstream firm only (i.e., effectively the downstream market becomes a monopoly) then the upstream firm faces the input demand function given in (7). In this situation, the optimal input supply is $\frac{a}{4}$ and the corresponding price of the input is $\frac{a}{2}$. However, $\frac{a}{2}$ satisfies the restriction given in (7), i.e., greater than or equal to $\frac{a}{(2\lambda-1)}$, provided $\lambda \geq \frac{3}{2}$. So, while producing for the technologically efficient downstream firm only, optimal input supply is $\frac{a}{4}$ for $\lambda \in [\frac{3}{2},2)$. But, $\frac{a}{2}$ is less than $\frac{a}{(2\lambda-1)}$ for $\lambda \in [1,\frac{3}{2}]$. Hence, if the upstream firm produces $\frac{a}{4}$ amount of inputs

when $\lambda \in [1, \frac{3}{2}]$, it encourages both downstream firms to buy the inputs. So, to prevent the technologically inefficient downstream firm from buying the inputs, total input supply cannot exceed $\frac{a(\lambda-1)}{(2\lambda-1)}$ when $\lambda \in [1, \frac{3}{2}]$, and, also, it will not be less than $\frac{a(\lambda-1)}{(2\lambda-1)}$ since, $\frac{a(\lambda-1)}{(2\lambda-1)}$ is less than $\frac{a}{4}$ for $\lambda \in [1, \frac{3}{2}]$. Therefore, the optimal input supply of the upstream firm is $\frac{a(\lambda-1)}{(2\lambda-1)}$ for $\lambda \in [1, \frac{3}{2}]$, and $\frac{a}{4}$ for $\lambda \in [\frac{3}{2}, 2)$.

So, if producing for the technologically efficient downstream firm only, the optimal profits of the upstream monopolist are $\frac{a^2(\lambda-1)}{(2\lambda-1)^2}$ for $\lambda \in [1, \frac{3}{2}]$, and $\frac{a^2}{8}$ for $\lambda \in [\frac{3}{2}, 2)$. But, as mentioned in the above analysis, if, in case of entry, the upstream firm produces for both downstream firms, the optimal input price is $\frac{a(1+\lambda)}{(4+4\lambda^2-4\lambda)}$ and the optimal profit of the upstream monopolist is $\frac{a^2(1+\lambda)^2}{6(4+4\lambda^2-4\lambda)}$. Comparing the profit levels we find that $\frac{a^2(1+\lambda)^2}{6(4+4\lambda^2-4\lambda)}$ is greater than $\frac{a^2(\lambda-1)}{(2\lambda-1)^2}$ and $\frac{a^2(1+\lambda)^2}{6(4+4\lambda^2-4\lambda)}$ is greater than $\frac{a^2}{8}$ for $\lambda < 2$. Hence, it is optimal for the upstream monopolist to produce for both downstream firms when $\lambda \in [1,2)$.

## 3 Possibility of entry in the upstream market only

In this section, we will consider entry in the upstream market only. Again we will consider two situations. One, when there is an upstream monopolist and a downstream monopolist, and the other, when there is a downstream monopolist with the upstream market as a duopoly. We assume that the upstream incumbent has a constant marginal cost of production, which is for simplicity, assumed to be zero, and the upstream entrant has a constant marginal cost of production $c$. In case of entry in the upstream market, the upstream firms compete like Cournot duopolists with homogeneous input.

*3.1 No-entry in the upstream market*

In presence of an upstream monopolist and a downstream monopolist with no-entry in the upstream market, our analysis becomes similar to that analyzed in subsection 2.1. Hence, the welfare of the economy is given by the expression (4).

*3.2 Entry in the upstream market*

Now, consider a situation where the downstream market is a monopoly with two upstream firms. The input demand function is given by the expression $q_I = \frac{(a-w)}{2}$, or, $w = (a - 2q_I)$. So, the upstream incumbent and the entrant maximize the following expressions respectively

$$\underset{q_I^i}{Max}\, q_I^i (a - 2q_I^i - 2q_I^e) \tag{10}$$

and

$$\underset{q_I^e}{Max}\, q_I^e (a - 2q_I^i - 2q_I^e - c), \tag{11}$$

where $q_I^i$ and $q_I^e$ are the outputs of the incumbent and the entrant respectively. We find that the optimal input supply of the upstream incumbent and the entrant are $\frac{(a+c)}{6}$ and $\frac{(a-2c)}{6}$ respectively. It is important to note that the upstream entrant produces positive output provided $c < \frac{a}{2}$. To make entry meaningful, we will consider the value of $c \in [0, \frac{a}{2})$.

Total input supply and the corresponding price of the input are $\frac{(2a-c)}{6}$ and $\frac{(a+c)}{3}$ respectively. The profit of the downstream monopolist, the upstream incumbent and the entrant are respectively $\frac{(2a-c)^2}{36}$, $\frac{(a+c)^2}{18}$ and $\frac{(a-2c)^2}{18}$.

Therefore, in case of entry in the upstream market only, welfare is

$$W^e = \frac{(2a-c)^2}{36} + \frac{(a+c)^2 + (a-2c)^2}{18} + \frac{(2a-c)^2}{72}. \tag{12}$$

**Proposition 2:** *Welfare under entry is higher compared to no-entry provided* $c$ *is less than* $c^*$*, where* $c^* \in (0, \frac{a}{2})$.

**Proof:** The relevant expressions for welfare are (4) and (12). The expression (12) is convex with respect to $c$ over $[0, \frac{a}{2}]$ and reaches a minimum value at $c = \frac{10a}{23}$. Expression (12) is greater than and equal to (4) at $c = 0$ and $c = \frac{a}{2}$ respectively. Further, (12) is less than (4) at $c = \frac{10a}{23}$. This implies that (12) is greater than (4) provided $c$ is less than the critical value, say $c^*$, where $c^* \in (0, \frac{a}{2})$. Hence, it proves the result. Q.E.D.

In case of entry in the upstream market only, the demand function for input remains *same* under entry and no-entry in the upstream market. While entry increases competition in the upstream market, it also creates production inefficiency because of a shift in production from the technologically efficient incumbent to the technologically inefficient entrant. If the technological difference between the incumbent and the entrant is not very much, production inefficiency due to entry of a technologically inferior firm is sufficiently small. So, in this situation, the former effect dominates the latter and for sufficiently low technological differences between these firms, entry increases welfare. On the other hand, if the technological difference between the incumbent and the entrant is sufficiently large, the benefit from competition is sufficiently small. But, sufficiently high cost of production of the entrant creates significant amount of production inefficiency. Hence, for large technological differences between these firms, the latter effect dominates the former and entry reduces welfare. So, 'entry in the upstream market only' creates similar effects of Klemperer (1988) and Lahiri and Ono (1988) even under vertically separated industry.

# 4 Possibility of entry in both upstream and downstream markets

The purpose of this section is to show that the Proposition 2 may be different when there is entry in both markets. In particular, we show that entry may increase welfare for all possible technological differences between the incumbent and the entrant in the upstream market.

## *4.1 No-entry scenario*

Like the previous sections assume that, in case of no-entry, both upstream and downstream markets are monopoly. So, in case of no-entry, welfare is given by the expression (4).

## *4.2 Entry in both upstream and downstream markets*

Now let us consider entry of a new firm in both markets. For simplicity, we will assume that the downstream incumbent and entrant have similar technology, i.e., $\lambda = 1$. However, we assume that the marginal cost of production of the upstream incumbent and the entrant is $0$ and $c$ respectively. In case of entry, Cournot competition prevails in both markets.

Since, the downstream firms are symmetric, the upstream firms will produce for both the downstream firms. The upstream firms face the following input demand function:

$$q_I = q_i^* + q_e^* = \frac{2(a-w)}{3}. \tag{13}$$

The optimal input supply by the upstream incumbent and the entrant are $\frac{2(a+c)}{9}$ and $\frac{2(a-2c)}{9}$ respectively. Therefore, total input supply and the corresponding input prices are $\frac{(4a-2c)}{9}$ and $\frac{(a+c)}{3}$ respectively. It is important to note that both upstream firms produce positive output for $c < \frac{a}{2}$, which is assumed to hold.

The optimal profit of the upstream incumbent, upstream entrant, downstream incumbent and downstream entrant are respectively $\frac{2(a+c)^2}{27}$, $\frac{2(a-2c)^2}{27}$, $\frac{(2a-c)^2}{81}$ and $\frac{(2a-c)^2}{81}$. So, welfare of the economy is given by

$$W_e^e = \frac{4(2a-c)^2 + 6(a+c)^2 + 6(a-2c)^2}{81}. \qquad (14)$$

**Proposition 3:** *Consider entry in both upstream and downstream markets, where the upstream entrant's technology is inferior to the upstream incumbent's technology but the technology of the downstream incumbent and the entrant is similar. Here, entry always increases welfare.*

**Proof:** Comparing (4) with (14) and after rearranging, we find that (14) is greater than (4) provided

$$329a^2 - 896ac + 1088c^2 > 0. \qquad (15)$$

Left hand side (LHS) of (15) is continuous and convex in $c$ over $[0, \frac{a}{2}]$ and attains a minimum value at $c = \frac{7a}{17}$. Further, LHS of (15) is positive at $c = \frac{7a}{17}$. This implies that LHS of (15) is positive for all $c \in [0, \frac{a}{2}]$. This proves the result. Q.E.D.

Entry in the downstream market changes the demand function for input. So, in case of entry in both markets, the effects due to change in the demand function for input is in force along with higher competition and production inefficiency. We find that the positive effects due to change in the demand function for input along with higher competition outweighs the negative impact of production inefficiency and entry creates higher welfare.

In Proposition 3, we have considered no technological difference between the downstream firms. It is easy to check that welfare is continuous with respect to the technological differences between the downstream incumbent and the entrant. This immediately implies that, like Proposition 3, entry always increases welfare even for some degree of technological differences between the downstream firms.

The above results suggests that, from the point of view of the policy makers, it is important to consider the industrial structure along with the technological differences of the firms while encouraging entry in an industry. In presence of market power of the input suppliers, while government policies might be designed to encourage entry in the final goods market, policies might need to restrict entry in the input market. Hence, our findings are important for the competition policies.

# 5 Conclusion

Contrary to the common wisdom, previous research have shown that entry may reduce welfare of an economy. While, some researchers have argued that the existence of fixed cost can reduce welfare due to entry, others have showed that difference in marginal cost (or, technologies) is the reason for lower welfare under entry. However, the previous literature have ignored the role of industrial structure and are relevant for the industries where either the input markets are perfectly competitive or the firms are vertically integrated.

Like the final goods market, often the input markets are imperfectly competitive where the input suppliers have significant power. So, in case of vertically separated industry, entry as well as the market where entry occurs is an important concern.

We find that ‘entry in the downstream market only’ always increases welfare. In case of ‘entry in the upstream market only’, welfare increases provided the technology of the upstream entrant is not sufficiently inferior compared to the technology of the upstream incumbent. However, welfare may always be higher for entry in both markets.

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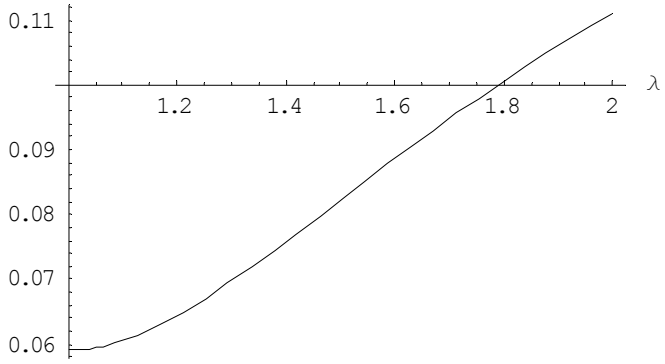


**Figure 1:** Subtracting (4) from (9).