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A note on firm-productivity and foreign direct investment

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Abstract

Assuming linear demand and unit transportation cost, Head and Ries (2003, 'Heterogeneity and the FDI versus export decision of Japanese manufacturers', Journal of the Japanese and International Economies) conclude that the theoretical prediction of Helpman et al. (2004, 'Export versus FDI with heterogeneous firms', The American Economic Review), which show that the more productive firms undertake FDI and the less productive firms export, does not depend on their assumptions of CES preferences and iceberg transportation costs. Considering iceberg transportation costs in an otherwise similar setup of Head and Ries (2003), we show that the theoretical prediction of Helpman et al. (2004) may not hold. Hence, CES preference in Helpman et al. (2004) is important for their theoretical results.

1. Introduction

Dominance of foreign direct investment (FDI) over international trade (UNCTAD, 2006) has generated a vast theoretical and empirical literature on FDI.[1] However, the literature is paying attention to the effects of firm-productivity on FDI only in recent years. Helpman et al. (2004), which consider CES preferences and iceberg transportation costs, show that the productivities of the firms undertaking FDI are higher than the productivities of the exporters. Head and Ries (2003) use an alternative model with a linear market demand function, which is generated by a quadratic utility function, and unit transportation cost. In this framework, Head and Ries (2003) show that the theoretical prediction of Helpman et al. (2004) remains, thus concluding that the results of Helpman et al. (2004) do not depend on the CES preferences and iceberg transportation costs.[1]

In this paper, we re-examine the relationship between firm-productivity and FDI with iceberg transportation cost in an otherwise similar model of Head and Ries (2003). We show that the result of Head and Ries (2003), which confirms the theoretical prediction of Helpman et al. (2003), may not hold in this situation. Hence, per-unit transportation cost in Head and Ries (2003) is crucial in generating the theoretical result of Helpman et al. (2003). Alternatively, it can be said that CES preference in Helpman et al. (2004) is important for their theoretical results.

More specifically, we show that if the iceberg transportation cost is small, higher productivity of a firm may reduce its incentive for FDI. Hence, the prediction of Head and Ries (2003) and Helpman et al. (2004) do not hold for small iceberg cost.

Though our contribution is theoretical, it may worth mentioning that the empirical evidence on the relationship between firm-productivity and FDI is mixed. Helpman et al. (2004), which use a cross-section of the US manufacturing firms, show that foreign investors are more productive than the exporters. Using English individual data, Girma et al. (2005) broadly confirm the finding of Helpman et al. (2004). However, considering listed Japanese firms, Head and Ries (2003) show that low productivity firms are most attracted to do FDI in low-cost host countries. Using data on Slovenian firms, Damijan et al. (2004) show that, in general, the Slovenian firms that invest abroad do not have on average higher labour productivity. They support the finding of Helpman et al. (2004), but only for Slovenian FDI in the high-wage countries. Using the same data set, Damijan et al. (2007) found some support that the firms investing in low-income countries have lower average productivity. Hence, the negative relationship between productivity and FDI also gets empirical support.[2]

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

2. The model and the results

Assume that there is a monopolist foreign firm, which wants to sell a product in a country, called the host country. Since the number of sectors is not important for the results of Head and Ries (2003) and Helpman et al. (2004), we focus on a single sector. We assume that the firm can serve the host country either through export or

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[1] Head and Ries (2003) also extend Helpman et al. (2004) to show that less productive firms may do FDI in the presences of wage difference between countries, which has not been considered in the latter paper. Mukherjee and Marjit (2009) show the implications of labour union on the relationship between firm-productivity and FDI.

[2] Greenaway and Kneller (2003) provide a survey of the recent literature on FDI and firm heterogeneity.

through FDI. If the firm exports, it incurs iceberg transportation cost at the rate of $t(<1)$. That is, if the firm exports q units of the output, it loses tq units of the output in transit and can sell $(1 – t)q$ units of the output. However, the firm incurs a fixed cost F under FDI.

The inverse market demand function for the product is $P = a – q$, where $a > 0$, P is price and q is the total output.

We consider that labour is the only factor of production, and it is immobile between the countries. Assume that the firm needs λ workers to produce one unit of output. Hence, λ is the inverse of labour productivity. A lower λ implies higher labour productivity. Since the effects of wage difference have already discussed in Head and Ries (2003) and Mukherjee and Marjit (2009), we assume that the wages are the same in the home and the host countries of the firm, and we normalize the wages in both countries to 1. It is needless to say that low wage in the host-country reinforces the negative relationship between productivity and FDI shown in this paper.

We consider the following game. At stage 1, the firm decides whether to export or to undertake FDI. At stage 2, production takes place and the profits are realized. We solve the game through backward induction.

If the firm exports, it determines output by maximizing the following expression:

$$\underset{q}{Max}(a-(1-t)q)(1-t)q-\lambda q. \tag{1}$$

Expression (1) shows that if the firm produces q units, it can sell $(1 – t)q$ units of output and gets the price equal to $P = a – (1 – t)q$. However, the production cost to the firm is λq.

The equilibrium output is

$$q_x^* = \frac{a(1-t)-\lambda}{2(1-t)^2}. \tag{2}$$

The equilibrium output is positive if $t < 1 - \dfrac{\lambda}{a} \equiv \bar{t}$, where $0 < \bar{t} < 1$.

The equilibrium profit of the firm under export is

$$\pi_x^* = \frac{(a(1-t)-\lambda)^2}{4(1-t)^2}. \tag{3}$$

On the other hand, if the firm undertakes FDI, it determines output to maximize the following expression:

$$\underset{q}{Max}(a-q)q-\lambda q-F. \tag{4}$$

The equilibrium output is

$$q_f^* = \frac{a-\lambda}{2}. \tag{5}$$

The equilibrium output is positive for $a > \lambda$.

The equilibrium profit of the firm under export is

$$\pi_f^* = \frac{(a-\lambda)^2}{4}-F. \tag{6}$$

It is immediate from (3) and (6) that the firm prefers FDI than export if $\pi_f^* > \pi_x^*$ or $F < \overline{F}$ where

$$\overline{F} = \frac{(a-\lambda)^2}{4}-\frac{(a(1-t)-\lambda)^2}{4(1-t)^2}, \tag{7}$$

which shows the maximum gain from FDI compared to export. That is, the firm has

the incentive for FDI provided the cost of FDI, F, is less than $\overline{F}$. Higher value of $\overline{F}$ implies that the firm has higher incentive for FDI.

Proposition 1: (a) *If $a > 2\lambda$, higher productivity, i.e., lower λ, increases (reduces) the incentive for FDI if $t \in (t^*, \overline{t})$ ($t \in (0, t^*)$), where $t^* \equiv 1 - \dfrac{\lambda}{a - \lambda}$.*

(b) If $a < 2\lambda$, higher productivity increases the incentive for FDI for $t \in (0, \overline{t})$.

Proof: Straightforward calculation shows that $\dfrac{\partial \overline{F}}{\partial \lambda} < (>) 0$ for $t > (<) 1 - \dfrac{\lambda}{a - \lambda} \equiv t^*$, where $t^* < \overline{t}$. However, $t^* > 0$ if $a > 2\lambda$. The rest of the proof follows immediately. ∎

The above result is in contrast to Head and Ries (2003) and Helpman et al. (2004) for $t < t^*$.

The intuition for our result is easy to understand once we see the effects of productivity on the profits under export and under FDI. We get that $\dfrac{\partial \pi_x^*}{\partial \lambda} = -q_x^*$ and $\dfrac{\partial \pi_f^*}{\partial \lambda} = -q_f^*$. Hence, whether higher productivity increases or reduces the firm's incentive for FDI depends on its output under export and under FDI. Higher productivity reduces the incentive for FDI if $q_f^* < q_x^*$, which occurs if $a > 2\lambda$ and $t^* < \overline{t}$. Otherwise, $q_f^* > q_x^*$ and higher productivity increases the incentive for FDI.

The firm's output under FDI does not depend on t, and it is equal to its output under export if $t = 0$. However, if $a > 2\lambda$, as t increases from 0, it initially increases the firm's output until t reaches a critical value, and then higher t reduces the firm's output under export. This happens due to two opposing effects. On one hand, higher t encourages lower production by increasing wastage. On the other hand, higher t reduces the amount sold for a given production, thus increasing the price and encourages higher production. The latter effect dominates for small t, while the former effect dominates for large t.

It must be clear now why our result differs from Head and Ries (2003). The unit transportation cost in their work does not create the above-mentioned price effect. The equilibrium output of the firm in their analysis is always lower under export compared to FDI, and higher productivity always increases the incentive for FDI.

3. Conclusion

In an influential paper, Helpman et al. (2004), which consider CES preferences and iceberg transportation costs, show that the productivities of the foreign investors are higher than the productivities of the exporters. Using linear demand and unit transportation cost, Head and Ries (2003) argue that the theoretical results of Helpman et al. (2004) do not depend on their assumptions of CES preferences and iceberg costs. Considering iceberg transportation cost in an otherwise similar setup of Head and Ries (2003), we show that the productivities of the exporters may be higher than the foreign investors if the transportation cost is small. Thus, we show that the CES preferences in Helpman et al. (2004) play an important role for their theoretical results. Hence, more empirical works are required to see the relative productivities of the foreign investors and the exporters.

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