

Information, Incentives and Multinational Firms*

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Abstract

Theoretical approaches to information and incentive problems in analyzing multinational firms' behavior remain under-examined. I present a model that explains a multinational firm's choice of organizational form of its intermediate goods production in the south, which includes FDI and outsourcing. In the case of outsourcing in the south, the multinational firm is faced with an adverse selection problem as the productivity information about the production is the stand-alone supplier's private information. In the case of FDI, although the information problem has been resolved through integration, the foreign ownership of the supplier brings a new problem to the MNE, as the monitoring from the northern owner is more costly compared with the domestic monitoring.

Keywords: FDI; MNEs; Organization of production; Outsourcing.

JEL Classification: D21; D23; F23; L22; L23.

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1 Introduction

Recent years have witnessed rapid growth of Foreign Direct Investment (henceforth FDI), intra-firm trade and Multinational Enterprises (henceforth MNEs). Navaretti et al. (2004) illustrate some facts of FDI in their book and the first one they write is, “FDI grew dramatically in the last 15 years of the twentieth century, far outpacing the growth of trade and income”. With the rapid growth of FDI, intra-firm trade has been a dominant feature of international trade¹. In the real world, FDI and intra-firm trade are conducted by MNEs which are playing key roles in international economy today. It has been reported that MNEs-headquarters and subsidiaries combined-are responsible for 75% of the world’s commodity trade (Dunning, 1993).

Other than FDI, when going to developing countries for the production of intermediate goods, MNEs can use outsourcing, which means that MNEs buy intermediate goods from independent intermediate goods suppliers in the south, as the production pattern of intermediate goods. Outsourcing has expanded dramatically in the past two decades, especially in international trade of intermediate goods². Antràs points out, in the comparison between FDI and outsourcing, there is one important finding from the empirical work, “Intra-firm trade (FDI) is heavily concentrated in capital-intensive industries (Antràs, 2003).” This is an interesting phenomenon which some trade economists tried to explain. In the seminal work of Antràs (2003), he uses the incomplete contract theory³ to explain this empirical finding⁴. The

¹According to Antràs (2003), “roughly one third of world trade is intra-firm trade. In 1994, 42.7 percent of the total volume of U. S. imports of goods took place within the boundaries of Multinational firms, with the share being 36.3 percent for U. S. exports of goods (Zeile 1997).”

²Feenstra (1998) reports, “between 1972 and 1990, imported intermediate inputs increased from 5.3 percent of material purchases to 11.6 percent of material purchases.” Other papers related to this issue are Audet (1996), Campa and Goldberg (1997), Hummels et al.(2001) and Yeats (2001).

³For example, Grossman and Hart (1986), Hart and Moore (1990) and Hart (1995)

⁴Similar approaches applied to international trade theory can be found in Antràs (2005), Grossman and Helpman (2002, 2003, 2005) and McLaren (2000). Grossman and Helpman (2002, 2003, 2005) appeal to the idea of the incompleteness of contracts in the general equilibrium framework. But in their papers, there is a constant returns to scale matching process that occurs between the MNE and the intermediate goods supplier. For this reason alone, the existing intermediate goods supplier can make a positive profit. This crucially distinguishes Grossman and Helpman’s work from that of Antràs. In my

contracts between the MNE in the north and the intermediate goods supplier in the south are naturally incomplete. Because of this incompleteness, the hold-up problem appears and as the consequence, the under-investment in inputs of two sides comes forth. In the capital-intensive industry, the investment of the MNE's input becomes more important compared with the intermediate goods supplier's, so the MNE wants to integrate the intermediate goods supplier to improve its threshold point in the bargaining process and to increase its own incentive to invest. As a result, the loss of efficiency will be alleviated in the capital-intensive industry when the MNE integrates the intermediate goods supplier in the south.

Antràs and Helpman (2004) adopt a unified model to study the choice of production location and the form of organization. The tradeoff between FDI and outsourcing in their study is similar to Antràs (2003), but the governance cost, a new ingredient in the tradeoff, is higher in integration compared with outsourcing. In fact, the weakness of their model is here, as the assumption that the governance cost is higher in the integration case is crucial to their results. In my paper, I will give an explanation for this assumption and turn it into a result of the model. More precisely, the reason why the governance cost is higher in the integration case is that the monitoring from the northern owner is more costly compared with the domestic monitoring.

Turning from the trade literature, I would like to review a classic question in the contract theory of why some firms seek to integrate other firms and different firms do not seek integration. Coase (1937) stresses the importance of transaction costs when a firm wants to buy intermediate goods from the supplier⁵. So there are some demerits in outsourcing. On the contrary, there are some demerits in integration also, such as higher governance costs. Crémer (1995) stresses that the tradeoff between outsourcing and integration is a tradeoff between credible commitment and better information environment. When a firm integrates another firm, it will get clearer information about the integrated firm. But as the integrating firm has already known the type of the integrated firm, it will become more costly for the

model, the independent intermediate goods supplier can also make a positive profit in equilibrium. But the cause for this is the asymmetric information held by the supplier, not the matching process.

⁵This approach in the contract theory has been developed largely by Williamson (1975, 1985).

integrating firm to give incentives to the integrated firm to make it work hard as compared with outsourcing. Schmidt (1996) uses a similar idea to analyze the cost and benefit of privatization. Compared with their models, the demerit of integration across border (i.e., FDI) in my model is also the costly incentives, whereas the origin of this problem is the costly monitoring from the foreign owner.

In my model, I use the contract theory to explain the economic force behind the multinational firm's choice of the form of organization. I will focus on the comparison of two types of production: *outsourcing in the south* and *FDI*. When going to the south for the production of intermediate goods⁶, the MNE has two options and the first one is to outsource the production to an independent supplier in the south⁷ (i.e. outsourcing in the south). In this case, the asymmetric information problem occurs as the productivity of intermediate goods production is the supplier's private information⁸. Accordingly, in the case of outsourcing in the south, the multinational firm is faced with an adverse selection problem. Intuitively, when the MNE and the stand-alone supplier which has private information of its production cost negotiate the transfer pricing of intermediate goods, it is impossible for the MNE to push the profit of the supplier to its outside option in equilibrium⁹, since the MNE has to transfer rents to elicit a truthful report of its productivity from the supplier. Therefore, the MNE has to design an incentive compatible contract which involves non-linear pricing to induce the intermediate goods supplier in the south to report its productivity truthfully. Due to this, the MNE has to pay information rents.

When comparing between FDI and outsourcing in the south, we have to investigate the inner structure of MNE's southern affiliate and see what is happening there. The tradeoff between them is that although the multinational firm has to pay information rents when outsourcing, the unit labor cost in this case is lower compared with the FDI case. This is because the

⁶The reason why the MNE goes to the south is that the wage rate in the south is much lower than the north.

⁷In this case, the MNE is not a real MNE as it does not own foreign affiliates. For convenience, in this paper, I call the northern final goods maker that undertakes outsourcing in the south the MNE also.

⁸In reality, there may be adverse selection problems for the MNE even the independent intermediate goods supplier is located in the north. But we stress that it is more likely that the adverse selection problem arises when two firms are located in different countries.

⁹In this model, the outside option is normalized to zero.

southern owner of the stand-alone supplier can monitor southern employees using a relatively lower cost. On the other hand, when the multinational firm decides to integrate the intermediate goods supplier in the south, the information about the supplier's productivity will become clear. It will become more costly for the northern owner of the supplier to induce southern employees to work hard, however, as the monitoring from the north is more costly compared with the domestic one. Intuitively, as the monitoring across border is more costly, the northern owner will choose a lower monitoring intensity and higher wage rates to make southern employees work hard. As a result, the total unit labor cost which equals to the sum of the unit monitoring cost and the wage rate is higher in the FDI case. We believe that this is one important aspect of what is happening inside the MNE's foreign affiliate—owners from the developed countries monitor southern employees less and pay them higher wage rates to make them work hard.

The hidden information problem (i.e. adverse selection problem) in the outsourcing in the south case and the costly monitoring problem in the FDI case are serious problems in practice, although they have been overlooked by trade economists for many years¹⁰. In fact, in the field of international management, some researchers take them seriously. In Dunning (1993), "Such cognitive deficiencies give rise to bounded rationality, opportunism, adverse selection, moral hazard," he writes, "This kind of market failure is particularly likely to be associated with cross-boarder transaction" (p.78). In Rugman (1981), he writes, "There are presumably more imperfections and greater transactions costs in international than in domestic markets. These give rise to the MNE. It can enjoy worldwide economies of internal organization. These internal advantages must be sufficient to offset the additional costs of operation abroad in unfamiliar political and economic environments in order to have FDI replace potential indigenous production" (p.42). this paper will shed some light on these important issues in international trade theory.

The main result of this paper is that in the equilibrium, the MNE outsources the production of intermediate goods which are labor intensive and

¹⁰One exception is Horstmann and Markusen (1996). In their model, the MNE is faced with an asymmetric information problem when contracting with a stand-alone agent in the foreign country. However, different from my model, the demerit of the FDI in their paper is assumed to be a one-time set-up cost.

uses FDI to produce capital intensive intermediate goods. Due to this, my paper's main result is consistent with the empirical finding that, compared with the outsourcing, the intra-firm trade (FDI) is concentrated in capital-intensive industries. The intuition behind this result is that although the adverse selection problem is not related to the capital intensity of production, the importance of costly monitoring and higher labor costs in the FDI case is crucially affected by the capital intensity. In other words, higher labor costs hurt firms producing labor intensive intermediate goods more as firms do not have to give any incentive to capital¹¹. From above reasoning, it is straightforward to see that while the main result of my paper is the same as those of Antràs (2003, 2005), the economic intuition contrasts markedly. One thing I want to stress is the role of cross-border transaction. It can be seen from the above reasoning that it is the cross-border transaction that causes the adverse selection problem in the outsourcing case and the costly monitoring problem in the FDI case. Because of this, this paper differs from those papers concerning the decision of outsourcing and integration within a country.

The rest of this paper is organized as follow. Section 2 gives a model and calculates the expected profits in two cases. Section 3 compares them and describes the production patterns in equilibrium. Section 4 concludes. The proofs of main results are relegated to Appendixes.

2 The Model

When going to the south for the production of intermediate goods, the MNE has two options. It can integrate a southern intermediate goods supplier and produce intermediate goods in its southern affiliate through its command. The other option is to outsource the production of intermediate goods to a stand-alone southern supplier through contracting.

¹¹There are many reasons why the MNE does not want to use southern managers in its southern affiliates such as the low quality of southern managers and the problem of southern managers' loyalty. Obviously, the northern owner can employ southern managers to monitor southern employees. But in this case, the communication between them must be much more difficult than the communication between the northern owner and northern managers of the supplier. Consequently, in this paper, I assume that the communication between the northern owner and southern managers is so difficult that the northern owner always wants to employ northern managers to run its southern affiliate. We believe this assumption is consistent with many examples in reality.

2.1 Environment

There are two countries called the north and south. There are two factors—labor and capital. Consumer's preferences are such that a producer of final goods y in industry j faces the following iso-elastic demand function¹²:

$$y = \lambda_j p_j^{-1/(1-\alpha)},$$

where p_j is the price of good and λ_j is a constant term that the producer takes as given. The production technology for the intermediate goods supplier in the south is Cobb-Douglas type:

$$x = \theta \left(\frac{K}{\beta} \right)^\beta \left(\frac{L}{1-\beta} \right)^{1-\beta},$$

where the parameter θ indicates the productivity of the intermediate goods supplier and is uniformly distributed on $[\theta^*, 1]$ ($0 < \theta^* < 1$). What is important in this setup is that the information about productivity is the intermediate goods supplier's private information when it stands out of the MNE. For convenience, I assume that the production of final goods from intermediate goods requires no further cost:

$$y = x.$$

The timing of events is stated as follow. At t_0 , the MNE decides whether to integrate a southern intermediate goods supplier or to outsource the production to a southern supplier. Through random matching, the MNE meets a supplier who does not know its productivity of production at t_0 . At t_1 , the value of θ is realized. If the MNE has already integrated this supplier, the information of productivity is also available for the MNE. At t_2 , owners of the supplier decide their monitoring intensity and wage schedules for employees. At t_3 , the MNE and the supplier make decision about the production plan and the transfer price through command (in the case of an integrated supplier) or through contract (in the case of a stand-alone supplier). At t_4 ,

¹²This demand function is derived from the CES utility function (See Dixit and Stiglitz (1977)) such that $\frac{1}{(1-\alpha)}$ is the elasticity of substitution and the price elasticity of demand. The term λ_j depends on the total expenditure on industry j and prices of all commodities sold in industry j .

employees of the supplier choose their behavior (i.e. hard working or shirking) and the production occurs. At t_5 , production takes place; employees of the supplier get their wages; the supplier obtains its monetary transfer from the MNE for the delivery of intermediate goods; the MNE receives intermediate goods. Before solving this game through backward induction, we have to derive the optimal monitoring intensity and wage schedules.

2.2 Determination of Wage Schedules

The labor cost for the owner of the supplier is composed of two parts. The first one is the wage paid to employees and the second one is the monitoring cost. Because I consider homogenous employees in this model, only the analysis of one wage contract is needed.

The employees of the intermediate goods supplier choose between hard working and shirking. The disutility of hard working is d , while the disutility of shirking is normalized to 0. Assume that the owner¹³ of the supplier always wants to induce employees to choose hard working and the production will be completed successfully with probability 1 under hard working¹⁴. In order to do this, the owner has to exert monitoring with the intensity q to every labor input. Monitoring intensity q means that if the employee shirks, he will be caught shirking and fired with probability q . The employees being fired at this stage can obtain the reservation wage rate \underline{w} elsewhere. I assume that employees' behavior and results of the production are noncontractible, but can be verified by the owner. The owner of the supplier cannot fire employees without demonstrated shirking¹⁵. Based on the reason above, the wage rate that induces employees to choose hard working (henceforth, the incentive compatible wage rate) must satisfy¹⁶

$$w - d \geq (1 - q)w + q\underline{w}.$$

The left-hand side of the above inequality is the net benefit from hard working

¹³In reality, firms can be owned by more than one individuals. But in this paper, for simplicity, I take owners of the supplier as a whole, and do not consider potential conflicts between different owners.

¹⁴For example, when shirking means the failure of the production and hard working means the success of the production, the owner of the supplier always wants to induce employees to choose hard working.

¹⁵For the justification of these assumptions, see Calvo and Wellisz (1978).

¹⁶For the justification of this setup, see Pagano and Volpin (2005).

and the right-hand side is the net benefit from shirking. Accordingly, the incentive compatible wage rate is

$$w = \underline{w} + \frac{d}{q}.$$

Intuitively, when the monitoring intensity decreases, the incentive compatible wage rate will be increased as the firm wants to make the current job more precious for the employee to prevent the employee from shirking. In order to monitor employees, the owner has to incur some cost. The cost of monitoring one labor input with intensity q is

$$M(q) = \eta q^2,$$

where η indicates the monitoring difficulty of the owner.

In any case (i.e. integrated or stand-alone), the owner of the supplier always wants to minimize the unit labor cost which equals to $w + M(q)$. Obviously, there is a tradeoff between monitoring intensity and the incentive compatible wage rate. When the monitoring intensity goes up, the incentive compatible wage rate can be reduced as the chance of shirking without being penalized decreases. But at the same time, the monitoring cost must go up. Solving the problem

$$\min_q \left(\underline{w} + \frac{d}{q} + \eta q^2 \right),$$

we can get the optimal monitoring intensity and the optimal incentive compatible wage rate:

$$q^*(\eta) = \left(\frac{d}{2\eta} \right)^{\frac{1}{3}}; \quad w^*(\eta) = \underline{w} + (2\eta d^2)^{\frac{1}{3}}; \quad M(q^*(\eta)) = \left(\frac{\eta d^2}{4} \right)^{\frac{1}{3}}.$$

The total unit labor cost equals to

$$w^*(\eta) + M(q^*(\eta)) = \underline{w} + 3 \left(\frac{\eta d^2}{4} \right)^{\frac{1}{3}}.$$

Because in the case of outsourcing, it is the southern owner who monitors southern employees and in the case of FDI, it is the northern owner (i.e., the owner of the MNE) who monitors southern employees, it is natural to assume that the monitoring from the northern owner is more difficult than that from the southern owner. Due to this, I make the following assumption.

Assumption 1

$$\eta_n > \eta_s,$$

where η_n represents the monitoring difficulty of the northern owner and η_s represents the monitoring difficulty of the southern owner. Due to the above assumption, the following lemma is straightforward.

Lemma 1 *The optimal monitoring intensity is lower in the case of FDI; the optimal incentive compatible wage rate, the unit monitoring cost and the unit labor cost are higher in the case of FDI.*

Proof: Because $\eta_n > \eta_s$, from above results, we have

$$q^*(\eta_n) < q^*(\eta_s) ; w^*(\eta_n) > w^*(\eta_s) ; M(q^*(\eta_n)) > M(q^*(\eta_s)).$$

If we define the unit labor cost as

$$\tilde{w}(\eta) = w^*(\eta) + M(q^*(\eta)),$$

the result that

$$\tilde{w}_n \equiv \tilde{w}(\eta_n) = w^*(\eta_n) + M(q^*(\eta_n)) > \tilde{w}_s \equiv \tilde{w}(\eta_s) = w^*(\eta_s) + M(q^*(\eta_s))$$

is straightforward. \square

The above result tells us that the northern owner pays a higher wage rate to induce employees to choose the *same* level of effort (i.e. hard working) as in the case of outsourcing. Because the monitoring cost is relatively high for the northern owner, as a natural response, the northern owner will monitor less compared with the southern owner. But on the other hand, the northern owner pays a higher wage rate to make employees work hard. The employees will work hard even under a relatively less intensive monitoring, as the wage premium in the MNE's affiliate is higher and accordingly the opportunity cost of shirking is higher. Because of this, the job of working at the MNE's affiliate is more precious for employees. In fact, This is exactly what the theory of efficiency wage tells us. We believe that the explanation of wage premium in MNEs' affiliates from the viewpoint of monitoring can shed light on some empirical findings¹⁷ and the result above can be seen

¹⁷Aitken et al. (1996) and Lipsey et al. (2004) find that even the education level of workers and the profitability level of affiliates of MNEs have been control, the wage premium in affiliates of MNEs still exist. In other words, the foreign ownership makes a big difference.

as an explanation for the higher governance cost in the integration case in Antràs and Helpman (2004), if we take the monitoring cost ($M(q^*(\eta))$) as the governance cost.

2.3 Expected Profits

Because there are two subgames (i.e. the FDI case and the outsourcing case), we derive the MNE's expected profit in the case of outsourcing first. As in this case, the stand-alone supplier holds some private information (i.e. the value of θ), the adverse selection problem occurs when the MNE negotiates with the independent supplier. The MNE has to design an incentive compatible contract which makes the intermediate goods supplier report its productivity truthfully. Because of this, the MNE has to give information rent to the intermediate goods supplier and the supplier can make positive expected profit in the equilibrium. The cost function of intermediate goods is

$$c(x) = \tilde{w}_s^{1-\beta} r^\beta x / \theta,$$

where \tilde{w}_s is the unit labor cost in the outsourcing case and r is the capital rental rate in the south. The MNE's expected profit (V) and the intermediate goods supplier's expected profit (U) are (T is the monetary transfer the MNE has to pay to buy the intermediate goods and we use $y = x$.)

$$V = \lambda_j^{1-\alpha} y^\alpha - T(y),$$

$$U = T(y) - \frac{\tilde{w}_s^{1-\beta} r^\beta y}{\theta}.$$

The objective function of the MNE is

$$\begin{aligned} \Pi_O &= \max_y \int_{\theta^*}^1 [\lambda_j^{1-\alpha} y(\theta)^\alpha - T(y(\theta))] \frac{d\theta}{1 - \theta^*} \\ s.t. \quad & T(y^*(\theta)) - \frac{\tilde{w}_s^{1-\beta} r^\beta y^*(\theta)}{\theta} \geq T(y^*(\hat{\theta})) - \frac{\tilde{w}_s^{1-\beta} r^\beta y^*(\hat{\theta})}{\theta}, \quad \forall \hat{\theta} \neq \theta \\ & T(y^*(\theta)) - \frac{\tilde{w}_s^{1-\beta} r^\beta y^*(\theta)}{\theta} \geq 0, \quad \forall \theta \end{aligned}$$

where y^* is the optimal design of production plan based on the productivity the supplier reports. The principal (the MNE) makes the decision of y^* and the agent (the intermediate goods supplier) takes it as given when deciding

its strategy of reporting its productivity. The first constraint above is the incentive compatible condition that in the equilibrium, the supplier which has the productivity θ has the incentive to report its productivity truthfully. The second constraint above is the individual rationality or participation constraint condition that the supplier which has any possible productivity can earn non-negative profit in equilibrium. Through some calculation, the above problem can be reduced to the following¹⁸:

$$\begin{aligned} \Pi_O = \max_y \int_{\theta^*}^1 & \left[(\lambda_j^{1-\alpha} y^\alpha - \frac{\tilde{w}_s^{1-\beta} r^\beta y}{\theta}) - \frac{\tilde{w}_s^{1-\beta} r^\beta y}{\theta^2} (1 - \theta) \right] \frac{d\theta}{1 - \theta^*} - U(\theta^*) \\ \text{s.t.} \quad & U(\theta^*) \geq 0, \\ & y'(\theta) > 0. \end{aligned}$$

The term $\lambda_j^{1-\alpha} y^\alpha - \frac{\tilde{w}_s^{1-\beta} r^\beta y}{\theta}$ is the total surplus created by the MNE and the supplier; the term $\frac{\tilde{w}_s^{1-\beta} r^\beta y}{\theta^2}$ is the information rent. When the intermediate goods supplier is the most productive (i.e., $\theta=1$), it can get information rent most which equals to $\int_{\theta^*}^1 (\tilde{w}_s^{1-\beta} r^\beta y) / \theta^2 d\theta$. On the contrary, when the intermediate goods supplier is the most unproductive (i.e., $\theta = \theta^*$), it cannot get any information rent (i.e. $\int_{\theta^*}^{\theta^*} (\tilde{w}_s^{1-\beta} r^\beta y) / \theta^2 d\theta = 0$). The MNE takes into account the information rent which it has to pay while maximizing the total surplus. Solving the problem, we can get the expected profit in the outsourcing case:

$$\Pi_O = \left[(1 - \alpha) \lambda_j \left(\frac{\alpha}{\tilde{w}_s^{1-\beta} r^\beta} \right)^{\frac{\alpha}{(1-\alpha)}} \frac{(1 - \alpha)(1 - \theta^{*\frac{1+\alpha}{1-\alpha}})}{(1 + \alpha)(1 - \theta^*)} \right]. \quad (1)$$

Differentiating Π_O with respect to θ^* , we find that Π_O is a monotonic increasing function of θ^* . There are two effects concerning the increase of θ^* . The first one which I call the efficiency effect is a positive one. Because the realized productivity of the intermediate goods supplier becomes higher on average, the MNE will make more expected profit. The second effect which I call the information rent effect is an ambiguous one. Although the pure rent for the more productive supplier becomes less, as the range of the type that it can mimic narrows, the distribution of information rent which

¹⁸The problem here is a mechanism design problem under asymmetric information about agent's continuous type. For details, see Mirrless (1971), Baron and Myerson (1982) or Fudenberg and Tirole (chapter 7, 1991).

the MNE has to pay now first-order stochastically dominates the former distribution¹⁹. It turns out the total effect is positive.

Now, we turn to the FDI case. As there is no adverse selection problem²⁰, the optimal strategy for the MNE is to set the quantity of production which maximizes the total profit created by the headquarters and the foreign affiliate after learning the productivity of the supplier and then leave zero profit to its southern affiliate through transfer pricing. Consequently, the MNE's objective function in the FDI case is

$$\max_{y(\cdot)} \lambda_j^{1-\alpha} y^\alpha - \tilde{w}_n^{1-\beta} r^\beta \frac{y}{\theta},$$

where \tilde{w}_n is the unit labor cost in the case of FDI. Solving this problem, we get

$$y(\theta) = \lambda_j \left(\frac{\alpha \theta}{\tilde{w}_n^{1-\beta} r^\beta} \right)^{1/(1-\alpha)}.$$

The expected profit in the FDI case is

$$\begin{aligned} \Pi_F &= \int_{\theta^*}^1 \left[\left(\lambda_j^{1-\alpha} y(\theta)^\alpha - \frac{\tilde{w}_n^{1-\beta} r^\beta y(\theta)}{\theta} \right) \right] \frac{d\theta}{1-\theta^*} \\ &= (1-\alpha)^2 \lambda_j \left(\frac{\alpha}{\tilde{w}_n^{1-\beta} r^\beta} \right)^{\frac{\alpha}{1-\alpha}} \frac{(1-\theta^* \frac{1}{1-\alpha})}{(1-\theta^*)}. \end{aligned}$$

It is straightforward to see Π_F is an increasing function of θ^* . The economic intuition is straightforward, since there is no adverse selection problem in the FDI case. The only effect of an increase in θ is the efficiency effect which is positive.

3 The Sorting of Production Patterns

In this section, we compare the expected profits in the outsourcing case and the FDI case for the MNEs needing intermediate goods whose production process has different capital intensities.

¹⁹In other words, the probability of being a more productive supplier increases and the more productive supplier earns information rent more.

²⁰I assume that if the MNE integrates the intermediate goods supplier, the information about the productivity of the intermediate goods supplier becomes clear for the MNE.

3.1 The Comparison between FDI and Outsourcing

First, we derive the condition that ensures the coexistence of FDI and outsourcing in equilibrium. It is easy to see that the ratio of the expected profit in the outsourcing case over the expected profit in the FDI case is

$$\frac{\Pi_O}{\Pi_F} = \left(\frac{\tilde{w}_n}{\tilde{w}_s} \right)^{\alpha(1-\beta)/(1-\alpha)} \frac{1}{L(\theta^*)},$$

where

$$L(\theta^*) = \frac{(1+\alpha)(1-\theta^{*\frac{1}{1-\alpha}})}{(1-\theta^{*\frac{1+\alpha}{1-\alpha}})}.$$

Here, we have Lemma 2 and Lemma 3²¹.

Lemma 2

$$0 < \frac{1}{L(\theta^*)} < 1$$

Lemma 3

$$L'(\theta^*) < 0$$

The economic meaning of Lemma 3 is that when θ^* goes up, which means that the productivity difference in one industry narrows, the outsourcing should be more profitable compared with the FDI. This is so, because there is an additional effect from the improvement of southern suppliers' productivity in the outsourcing case—the asymmetric information problem has been mitigated since the range that a more productive supplier can mimic narrows. From Lemma 2, we have the following result.

If

$$\left(\frac{\tilde{w}_n}{\tilde{w}_s} \right)^{\alpha/(1-\alpha)} > \frac{(1+\alpha)(1-\theta^{*\frac{1}{1-\alpha}})}{(1-\theta^{*\frac{1+\alpha}{1-\alpha}})},$$

then the FDI and outsourcing coexist in the equilibrium.

If

$$\left(\frac{\tilde{w}_n}{\tilde{w}_s} \right)^{\alpha/(1-\alpha)} \leq \frac{(1+\alpha)(1-\theta^{*\frac{1}{1-\alpha}})}{(1-\theta^{*\frac{1+\alpha}{1-\alpha}})},$$

²¹Proofs are relegated to Appendix A and B.

the FDI always dominates the outsourcing for any given value of $\beta \in (0, 1)$, since the asymmetric information problem is so severe that the MNE even wants to produce the most labor intensive product within firm's boundary to resolve the information problem.

In the latter case, the cutoff point between FDI and outsourcing is negative. To make the story interesting, I make the following assumption.

Assumption 2

$$\left(\frac{\tilde{w}_n}{\tilde{w}_s}\right)^{\alpha/(1-\alpha)} > \frac{(1+\alpha)(1-\theta^{*\frac{1}{1-\alpha}})}{(1-\theta^{*\frac{1+\alpha}{1-\alpha}})}$$

3.2 Capital Intensity and FDI

Under Assumption 2, we have a cutoff point β_{OF} between OS and FS and the following proposition²².

Proposition 1 *Under Assumptions 1–2, there exists one cutoff point (i.e., $\beta_{OF} = [1 - ((1-\alpha) \log L(\theta^*)) / (\alpha \log(\tilde{w}_n/\tilde{w}_s))]$ $\in (0, 1)$) between the outsourcing and FDI. When $\beta < \beta_{OF}$ (i.e., the capital intensity of intermediate goods production is relatively low.), the outsourcing is optimal for the MNE; when $\beta > \beta_{OF}$ (i.e., the capital intensity of intermediate goods production is relatively high.), the FDI is optimal for the MNE.*

Because the proof of Proposition 1 is straightforward, we can use figure 1 to illustrate this proposition. In figure 1, $S(\beta)$, which equals to $(\frac{\tilde{w}_n}{\tilde{w}_s})^{\alpha(1-\beta)/(1-\alpha)}$, is the advantage of lower unit labor cost of outsourcing. $L(\theta^*)$ is the disadvantage of outsourcing in the south related to the adverse selection problem. Compared with the disadvantage of outsourcing (i.e., $L(\theta^*)$) being independent of the variation of β , the advantage of outsourcing (i.e., lower unit labor cost) is much more important when the capital intensity goes down as more labor is needed in the production process. Consequently, when the production is relatively labor intensive, the expected profit in the outsourcing case exceeds that in the FDI case. Accordingly, under Assumption 2, we have a cutoff point between outsourcing and FDI. From Proposition 1, we have the following main result of this paper.

²²See figure 1.

Proposition 2 *Compared with outsourcing, intra-firm trade (FDI) is heavily concentrated in capital-intensive industries.*

Although the adverse selection problem is not related to the capital intensity of the production, the importance of costly monitoring and the relatively higher unit labor cost in the FDI case is crucially affected by the capital intensity. When the capital intensity goes up, the MNE pays less wage premium to employees in the FDI case, as the production needs less labor. Accordingly, The choice of FDI compared with outsourcing becomes more attractive. As a result, MNEs needing the intermediate goods whose production is capital intensive will choose FDI instead of outsourcing.

3.3 The Comparative Statics

It is interesting to see the relationship between θ^* and the cutoff point β_{OF} . The following lemma is the result²³.

Lemma 4 *When θ^* goes up, the cutoff point between outsourcing and FDI (i.e., β_{OF}) increases.*

An increase in θ^* is good news for both types of MNEs which undertake outsourcing and FDI because the average productivity of the supplier in the south increases. It is better news for the MNEs which are engaged in outsourcing as the productivity difference narrows and hence the adverse selection problem has been mitigated. Melitz (2003) argues that a trade liberalization in the southern intermediate goods suppliers' industry forces less productive intermediate goods suppliers to exit the market, hence as a result, the productivity difference between suppliers in the south becomes narrow. Our result predicts that trade liberalization entails the expansion of the outsourcing of intermediate goods production to the south compared with the FDI.

4 Concluding Remarks

I have presented a simple model using the contract theory to explain the behavior of the multinational firm. The main idea is that if the production of intermediate goods is labor intensive, the MNE will not use integration

²³For proof, see appendix C.

(i.e., FDI) to overcome the adverse selection problem as the problem of the costly monitoring and the relatively higher labor cost for the FDI becomes more severe. On the other hand, when the production of intermediate goods is capital intensive, that problem for the FDI is less severe as the production process needs less labor. Consequently, the MNEs will integrate southern suppliers to produce capital intensive intermediate goods and outsource the labor intensive intermediate goods to stand-alone southern suppliers.

This paper contributes to the theory of multinational firms in the following ways. First, The information problem has been studied in this paper as the disadvantage of engaging in outsourcing, which, I think, has been overlooked by the previous research. Second, this paper gives a new partial explanation²⁴ for the wage premium in the MNE affiliated companies: it is more costly for the MNE to induce southern employees to work hard within the boundary of the firm as the monitoring across border is more costly. Finally, the adverse selection problem in the outsourcing case and the costly monitoring problem in the FDI case are all derived from the cross border transaction. Consequently, the cross border character of economic activities (i.e., outsourcing and FDI) plays a crucial role in this paper's scenario which is different from the story of the economic activities within a country.

This paper has derived many empirical implications. As the south in my model is referred to all developing countries which are heterogenous in various aspects, one should expect without surprise that the outsourcing should be commonly seen from the trade pattern in developing countries which have better accounting systems as better accounting systems will alleviate the uncertainty of the southern supplier's productivity. The fact that for the northern and southern country pair which use the same language, the FDI is commonly seen from the bilateral trade pattern is not surprising either given that the monitoring costs are small in such cases²⁵. I hope future empirical research can support these theoretical predictions.

²⁴The reason why I call this a partial explanation is that in the model above, the wage schedule is derived just based on the profit maximization of the firm. The behavior of employees is overlooked for simplicity.

²⁵In Caves (1996), he writes, "More readily documented, languages and cultures shared between countries reduce MNE's transaction costs, just as neighboring countries reduce their communication and coordination costs" (p.56).

Appendix A: Proof of Lemma 2

Supposing that

$$\frac{(1 - \theta^{*\frac{1+\alpha}{1-\alpha}})}{(1 + \alpha)(1 - \theta^{*\frac{1}{1-\alpha}})} \geq 1,$$

we get

$$T(\theta^*) = (1 - \theta^{*(1+\alpha)/(1-\alpha)}) - (1 + \alpha)(1 - \theta^{*1/(1-\alpha)}) \geq 0.$$

But

$$\frac{dT}{d\theta^*} = \frac{(1 + \alpha)}{(1 - \alpha)}(\theta^{*\alpha/(1-\alpha)} - \theta^{*2\alpha/(1-\alpha)}) > 0.$$

So $T(\theta^*) < T(1) = 0$. A contradiction.

Accordinly, we have lemma 2:

$$0 < \frac{(1 - \theta^{*\frac{1+\alpha}{1-\alpha}})}{(1 + \alpha)(1 - \theta^{*\frac{1}{1-\alpha}})} < 1.$$

Appendix B: Proof of Lemma 3

Differentiating L with respect to θ^* , we get:

$$\begin{aligned} \text{Sign}\left(L'(\theta^*)\right) &= \text{Sign}\left((1 + \alpha)\theta^{*2\alpha/(1-\alpha)}(1 - \theta^{*1/(1-\alpha)}) - \theta^{*\alpha/(1-\alpha)}(1 - \theta^{*(1+\alpha)/(1-\alpha)})\right) \\ &= \text{Sign}\left((1 + \alpha)\theta^{*2\alpha/(1-\alpha)} - \alpha\theta^{*(1+2\alpha)/(1-\alpha)} - \theta^{*\alpha/(1-\alpha)}\right) \end{aligned}$$

Because $y = \theta^{*x}$ ($0 < \theta^* < 1$) is a convex function. By Jensen's inequality, we have:

$$\frac{\alpha}{(1 + \alpha)}\theta^{*(1+2\alpha)/(1-\alpha)} + \frac{1}{(1 + \alpha)}\theta^{*\alpha/(1-\alpha)} > \theta^{*2\alpha/(1-\alpha)}.$$

So, we have:

$$L'(\theta^*) < 0.$$

Appendix C: Proof of Lemma 4

From appendix B, we know that $L(\theta^*)$ is monotonically decreasing in θ^* and the cutoff point between outsourcing and FDI is

$$\beta_{OF} = 1 - \frac{(1 - \alpha) \log L(\theta^*)}{\alpha \log(\tilde{w}_n/\tilde{w}_s)}.$$

Therefore, an increase in θ^* will lead an increase in β_{OF} .

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Figure 1: The Cutoff Point of β_{OF}

