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 production location, either in the north or south, and its organizational form, either integration or outsourcing. The basic tradeoff between domestic insourcing and foreign outsourcing is that while the labor costs in the north are higher, the productivity in the south is lower, and more importantly, the productivity information about the supplier in the south is private. In the case of outsourcing in the south, the multinational firm is faced with an adverse selection problem. In choosing organizational form in the south, the multinational firm is faced with an adverse selection problem if it outsources to a southern supplier whereas it is faced with a moral hazard problem if it chooses FDI. The moral hazard problem is restricted to the FDI case as, when outsourcing the southern owners of the intermediate goods supplier can monitor the behavior of employees and force them work hard using a relatively lower wage as the compensation.

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 fact 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 trade[1]. In the real world, FDI and intra-firm trade are conducted by MNEs which are playing a key role in international economy today. Some researches report that MNEs-parents 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 goods[2]. In comparing between FDI and outsourcing, Antràs points out, 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 want to explain. In the seminal work of Antràs (2003)[3], he uses the incomplete contract theory to explain this empirical finding[4]. The con-

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[1]According 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)."

[2]Feenstra (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 having documented this phenomenon are Audet (1996), Campa and Goldberg (1997), Hummels et al.(2001) and Yeats (2001).

[3]e.g. Grossman and Hart (1986), Hart and Moore (1990) and Hart (1995)

[4]Similar 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 intermediate goods supplier can make a positive profit. This crucially distinguishes Grossman and Helpman's work from that of Antràs. In my model, the

tracts 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 a new ingredient in the tradeoff, the governance cost, 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 there is a moral hazard problem in the integration case and the MNE must pay a higher wage to the employees to make them work hard.

Turning from the trade literature, I would like to review a classic question in 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 supplier[5]. 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 integrating firm

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intermediate goods supplier can also make a positive profit in the equilibrium, but the reason for this is asymmetric information which is held by the supplier, not the matching process.

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

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

In my model, I use contract theory to explain the economic force behind the multinational firm's choice of production location and form of organization. I will focus on comparison of three types of production: *domestic insourcing, foreign outsourcing* and *vertical FDI*. The obvious tradeoff between domestic insourcing and outsourcing in the south is that while the labor cost in the north is higher, the productivity in the south is lower. More importantly, the information of productivity of the intermediate goods supplier in the south is the supplier's private information. Accordingly, in the case of outsourcing in the south, the multinational firm is faced with an adverse selection problem. In reality, there may be adverse selection problems for the MNE even the 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. There are three reasons for the occurrence of this problem. (1) The system of accounting in the south is often not reliable. (2) The MNE is much more unfamiliar with economic environment in the south compared with southern firms. (3) The information flow is much more difficult between countries than within a country. 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. The reason why the MNE cares about the productivity level of the supplier is related the relationship specific investment. When the MNE and the southern supplier prepare to make a contract on the transfer price of the intermediate goods, some relationship-specific investments have to be made from both sides. It is very costly for the MNE to negotiate with other suppliers when it fails to make a contract with the first one. Accordingly, setting the same unit price for the suppliers which have different productivity is not a profit-maximizing decision for the MNE. In reality, although there is usually a prevailing unit price of the intermediate goods in the market, the MNE has to take into account the cost information of the supplier with which it deals to make

a contract successfully. Due to this, the MNE has to pay the information rent, which offsets at least partially the advantage of lower labor cost in the south.

When comparing between FDI and outsourcing in the south, we have to go into the MNE's affiliate and see what is happening there. The basic tradeoff between them is that although the multinational firm has to pay the information rent when outsourcing, the wage rate in this case is lower compared with the FDI case. This is because the southern owners of the supplier can monitor the *behavior* of southern employees and write wage contracts based on the *behavior* of employees[6]. 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 owners of the MNE to induce southern employees to work hard, however, as the northern owners can not monitor the behavior of southern employees and just can make the wage contracts based on the *results* of the production[7]. One explanation for this assumption is that as the communication and monitoring are much more difficult across border, the northern owners may not want to monitor the *behavior* of southern employees due to the high cost of communication[8]. The hidden action and moral hazard problems therefore arise in the FDI case as the southern employees will shirk under the same wage rate as in the outsourcing case.

The hidden information problem (i.e. adverse selection problem) in the outsourcing in the south case and the hidden action problem (i.e. moral hazard problem) in the FDI case are serious problems in reality, although they have been overlooked by trade economists for many years. In fact, in the field of international management, some researchers take them seriously. In Dunning (1993), "Such cognitive deficiencies give rise to bounded rational-

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[6]In this paper, I assume that the behavior of employees is *observable* only to the owners who come from the same country as the employees. For example, the behavior of employees in the northern intermediate goods supplier is *observable* to the owners of MNE. On the other hand, the behavior of employees in the southern intermediate goods supplier is *unobservable* to the owners of MNE.

[7]Usually, the results such as the profit of the firm is *observable* to northern owners.

[8]Even if the northern owners employ southern managers to monitor the behavior of southern employees, there still is moral hazard problem, as the behavior of southern managers is unobservable to northern owners. As a result, wage premium in MNEs-affiliated firms is still needed.

ity, 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). My paper will shed some light on these important issues in international trade theory.

The main result of this paper is that there are two types of equilibrium. One is the IN-OS type equilibrium, which means that in the capital-intensive industry, the firm chooses to undertake domestic insourcing (henceforth IN); for the labor-intensive industry, the firm chooses to outsource in the south (henceforth OS). Firms do not undertake FDI in this equilibrium since, in this equilibrium, the efficiency wage in the FDI case is too high compared with the wage rate in the outsourcing case. Another equilibrium is the IN-FS-OS type equilibrium which indicates that in the most capital-intensive industry, the firm chooses to undertake domestic insourcing (IN); when the capital intensity is in the middle range, the firm will go to the south to undertake FDI (henceforth FS); in the least capital-intensive industry, the firm chooses to outsource in the south (OS). Due to this type of sorting, 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 economic intuition behind this result is that although the adverse selection problem is not related to the capital intensity of production, the moral hazard problem and the wage premium in the FDI case are crucially affected by the capital intensity. In other words, the moral hazard problem hurts less capital intensive (i.e. more labor intensive) firms more as firms do not have to give any incentive to capital.

While the main result of my paper is the same as those of Antràs (2003, 2005), the economic intuition contrasts markedly. In my model, when the parameter of capital intensity is very high (i.e. close to 1), the advantage of a lower wage rate in the south becomes less important, so the MNE will choose to produce at home. When the parameter of capital intensity falls into a middle range, it is profitable for the MNE to go to the south. It is

also profitable engaging in FDI because the MNE will pay relatively small amounts of wage premium to overcome the adverse selection problem. But when the parameter of capital intensity is small (i.e. close to 0), it is very costly for the MNE to overcome the adverse selection problem as it has to pay a relatively large amount of wage premium. As a result, the MNE will choose to not to integrate the intermediate goods supplier in the south.

Two points are highlighted for further discussion. The first one is that the moral hazard problem in the FS case arises from the separation of ownership and control of the firm and the inability of northern owners' monitoring[9]. The northern owners of the MNE own the intermediate goods supplier but can not monitor the behavior of southern employees. The second one 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 OS case and the moral hazard problem in the FS case. Because of this, my 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 benchmark model and calculates the profit or expected profits in all three cases (i.e. IN, OS, FS). Section 3 compares each two of above three (expected) profits and describes the production patterns in the equilibrium. Section 4 concludes. The proofs of main results are relegated to Appendixes.

2   The Benchmark Model

There are two choices for the MNE to make: the location of production and the form of organization. I do not differentiate between the domestic insourcing and outsourcing[10]. Because of this, there are three possible production patterns left: the domestic insourcing (IN)[11], the outsourcing in the south (OS) and the FDI in the south (FS).

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[9]In reality, there may be moral hazard problems in every firm. But here, we stress that the moral hazard problem is more severe in MNEs' affiliates.

[10]Because information is perfect in the north, there is no adverse selection problem in the outsourcing case. On the other hand, because the behavior of the employees of the northern intermediate goods supplier is *observable* to the owners of MNEs, there is no moral hazard problem in the insourcing case. Consequently, there is no difference between domestic insourcing case and domestic outsourcing case.

[11]I use the domestic insourcing case as the production in the north.

2.1 Environment

There are two countries called the north and south. There are two factors—labor and capital. While the labor cannot move between countries, the capital is completely mobile worldwide. Due to this, the capital rental rate should be the same across countries. Because of the technological difficulty, the MNEs only can be located in the north. But the intermediate good suppliers can be located either in the north or south.

Consumer's preferences are such that a producer of good y in industry j faces the following iso-elastic demand function[12]:

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

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 north is Cobb-Douglas type:

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

I assume that the production of final goods requires no further cost:

$$y = x.$$

2.2 Expected Profits

From the production function, we can calculate the cost function of the intermediate goods supplier in the north as

$$c(x) = r_N^{\beta} w_N^{1-\beta} x.$$

As it is the cost function of the final goods also, the optimal pricing for each firm in the monopolistic competitive industry is

$$p = r_N^{\beta} w_N^{1-\beta} / \alpha.$$

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

The expected profit in the IN case is

$$\Pi^N = (1 - \alpha)\lambda_j \left(\frac{\alpha}{r_N^\beta w_N^{1-\beta}} \right)^{\alpha/(1-\alpha)}. \tag{1}$$

Since capital is completely mobile, we can normalize the capital rental rate to one and assume that the wage rate in the north is higher than that in the south (i.e. $w_N > w_S$).

The environment in the OS case is similar to the IN case, whereas one thing is different: the production technology of intermediate goods supplier in the south is

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

where the parameter θ indicates the productivity level of the intermediate goods supplier and is uniformly distributed on $[\theta^*, 1]$ $(0 < \theta^* < 1)$. The productivity of the intermediate goods supplier in the south is always lower than the north. What is more important is that the information about productivity level is the intermediate goods supplier's private information. Due to this, the adverse selection problem occurs. The MNE has to design an incentive compatible contract which makes the intermediate goods supplier report its productivity level (type) truthfully. Because of this, the MNE has to give information rents to intermediate goods suppliers and the suppliers can make positive profits in the equilibrium.

There are two choices for the employees in the supplier to choose. One is to work hard and the other is to shirk. If the employee chooses to work hard, the production of intermediate goods will be completed successfully with probability 1, although (s)he has to burden the disutility d. If the employee chooses to shirk, the production of intermediate goods will be finished successfully only with probability p $(1 > p > 0)$, but (s)he will not burden any disutility. There is an monetary outside option w_O for employees that even they shirk when working in other firms, they still can get w_O. The owners of the intermediate goods supplier have to decide how much they should pay to employees in the case of shirking (i.e. $\underline{w}$) and in the case of hard working (i.e. w_S). Because there is an minimum wage decided by law in developing countries, wages in all cases must be larger than this (i.e. $\underline{w} \geq w_M$ and $w_S \geq w_M$). Obviously, the monetary outside option must

be larger than or equal to the minimum wage (i.e. $w_O \geq w_M$). Because in this case, the behavior of employees is *observable* to southern owners, the optimal wage contract (i.e. $(\underline{w}, w_S)$) should satisfy following conditions:

$$w_M \leq \underline{w};$$
$$\underline{w} - 0 \leq w_S - d;$$
$$w_O \leq w_S - d.$$

Obviously, the minimum wages that satisfy all above conditions are

$$\underline{w} = w_M; \ w_S = w_O + d.$$

The timing of events in the OS case is described as follow. First, the MNE and the intermediate goods supplier in the south write a contract containing a large amount of fine in the case of failure of production[13] and the owners and employees of the intermediate goods supplier make wage contracts based on the behavior of the employees. Second, employees choose their behavior[14]. Then, the production occurs. Finally, the MNE pays money transfer to the intermediate goods supplier for the delivery of intermediate goods and the employees get the wage w_S.

The cost function of intermediate goods is

$$c(x) = w_S^{1-\beta} x/\theta,$$

where we use $r_S = 1$. The MNE's profit (V) and the intermediate goods supplier's profit (U) are (T is the money transfer the MNE has to pay to buy the intermediate goods and we use $y = x$.)

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

$$U = T(y) - \frac{w_S^{1-\beta} y}{\theta}.$$

The objective function of the MNE is

$$\Pi_O^S = \max_{y(.)} \int_{\theta^*}^1 [\lambda_j^{1-\alpha} y(\theta)^\alpha - T(y(\theta))] \frac{d\theta}{1-\theta^*}$$

$$s.t. \quad T(y^*(\theta)) - \frac{w_S^{1-\beta} y^*(\theta)}{\theta} \geq T(y^*(\hat{\theta})) - \frac{w_S^{1-\beta} y^*(\hat{\theta})}{\theta}, \quad \forall \hat{\theta} \neq \theta$$

$$T(y^*(\theta)) - \frac{w_S^{1-\beta} y^*(\theta)}{\theta} \geq 0, \quad \forall \theta$$

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[13]This forces the intermediate goods supplier to induce the employees to work hard.
[14]Because $w_S = w_O + d$, employees will choose to work hard.

where $y^*(\theta)$ is the optimal design of production plan based on the productivity the supplier reports. The principal (the MNE) makes the decision of $y^*(\theta)$ and the agent (the intermediate goods supplier) takes it as given when deciding its own strategy (i.e. the productivity it reports). The first constrait above is the incentive compatible condition that in the equilibrium, the supplier which has the productivity θ does not have the incentive to report its productivity to the MNE untruthfully. The second constrait above is the individual rationality or participation constaint condition that the supplier which has any possible produtivity can earn non-negative profit in the equilibrium. Through some calculation, the above problem can be reduced as follow[15]:

$$\Pi_O^S = \max_{y(.)} \int_{\theta^*}^1 \left[\left(\lambda_j^{1-\alpha} y(\theta)^\alpha - \frac{w_S^{1-\beta} y(\theta)}{\theta} \right) - \frac{w_S^{1-\beta} y(\theta)}{\theta^2}(1-\theta) \right] \frac{d\theta}{1-\theta^*} - U(\theta^*)$$

$$s.t. \quad U(\theta^*) \geq 0,$$

$$y'(\theta) > 0.$$

The term $\lambda_j^{1-\alpha} y^\alpha - \frac{w_S^{1-\beta} y}{\theta}$ is the total surplus created by the MNE and the supplier; the term $\frac{w_S^{(1-\beta)} y}{\theta^2}$ is the information rent. When the intermediate goods supplier is the most productive (i.e. θ=1), it can get information rent most which equals to $\int_{\theta^*}^1 (w_S^{(1-\beta)} y)/\theta^2 d\theta$ as MNE wants to prevent it from mimicking less productive intermediate goods suppliers. On the contrary, when the intermediate goods supplier is the most unproductive (i.e. $\theta = \theta^*$), it cannot get any information rent (i.e. $\int_{\theta^*}^{\theta^*}(w_S^{(1-\beta)} y)/\theta^2 d\theta = 0$). The MNE takes into account the informatioan rents which it has to pay to the more productive supplier while maximizing the total suplurs. Solving the problem, we can get the expected profit in the OS case:

$$\Pi_O^S = \left[(1-\alpha)\lambda_j \left(\frac{\alpha}{w_S^{(1-\beta)}} \right)^{\frac{\alpha}{(1-\alpha)}} \frac{(1-\alpha)(1-\theta^{*\frac{1+\alpha}{1-\alpha}})}{(1+\alpha)(1-\theta^*)} \right]. \qquad (2)$$

Differentiating Π_O^S with respect to θ^*, we find that Π_O^S is a monotonic increasing function of θ^*. There are two effects concerning the increase of

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[15]The problem here is an optimal 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).

θ^*. The first one which I call the efficiency effect is a positive one. Because the realized productivity of the intermediate goods supplier becomes better on average, the MNE will make more expected profits. 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 the MNE has to pay now first-order stochastically dominates the former distribution[16]. As a result, the total effect is positive.

Now, we turn to the FS case. The timing of events in the FDI case is stated as below. First, the MNE and the employees in the intermediate goods supplier write wage contracts based on the results of production. Second, the employees choose the behavior (i.e. hard working or shirking). Then, production occurs. Finally, the result comes forth. If the production is failed, the MNE just has to pay the wage $\underline{w}$; if the production is successful, the supplier has to deliver the intermediate goods to the headquarters of the MNE and the employees get the wage $\tilde{w}_S$. The optimal wage contract (i.e. $(\underline{w}, \tilde{w}_S)$) must satisfy following conditions[17].

$$w_M \leq \underline{w};$$
$$p(\tilde{w}_S - 0) + (1 - p)(\underline{w} - 0) \leq \tilde{w}_S - d;$$
$$w_O \leq \tilde{w}_S - d.$$

Obviously, the minimum wages that satisfy above conditions are

$$\underline{w} = w_M; \ \tilde{w}_S = \max[(w_O + d), w_M + \frac{d}{(1 - p)}].$$

If $(w_O + d) \geq w_M + \frac{d}{(1-p)}$, there is no wage difference between the OS case and the FS case. To make my story more interesting, I make the following assumption[18].

Assumption 1

$$w_M = w_O$$

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

[17]Because $1 > p > 0$, the result of production is not a perfect indicator of the behavior (i.e. Even the employees shirk, the production still can be successfully completed with probability p), so the assumption that in the FS case the behavior is unobservable to the MNE is consistent with this specification of the results.

[18]This assumption can be relaxed to that the difference between w_M and w_O is small.

Under this assumption, The wage rate in the FS case (i.e. $w_M + \frac{d}{(1-p)}$) is higher than the wage rate in the OS case (i.e. $w_O + d$). Accordingly, there is wage premium in the foreign affiliate of MNEs[19]. This is what I call the result of the ineffective monitoring. Because the MNE can not make wage contracts based on the behavior of southern employees and the results of production are not perfect indicators of the behavior, it is more costly for the MNE to induce southern employees to choose hard working (i.e. The incentive compatible condition has been tightened in the FS case.). Now, we can say that the tradeoff between OS and FS is the tradeoff between information and incentives.

The result above can be seen as an explanation for the higher governance cost in the integration case in Antràs and Helpman (2004). If we take the wage difference between FDI and outsourcing ($\tilde{w}_S - w_S$) as the reason of the higher governance cost in the integration case, the assumption of Antràs and Helpman (2004) becomes a result of my model. Another thing I want to stress is that when researching the wage premium puzzle in MNEs-affiliated companies, we must study not only the quantity of the wage, but also the structure of the wage contract. The empirical implication of the above specification is that other than the wage premium in the MNEs-affiliated firms, wages in MNEs-affiliated companies should be more sensitive to the variation of affiliates' profits compared with the domestic firms[20].

As there is no adverse selection problem[21], the optimal production decision will be

$$\max_{y(.)} \lambda_j^{1-\alpha} y^\alpha - \tilde{w}_S^{1-\beta} \frac{y}{\theta}.$$

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[19]In the corporate finance theory, the usual specification for the moral hazard problem is that the probabilities of successful production under hard working and shirking are p_H and p_L instead of 1 and p above. In this case, the efficiency wage in the case of successful production is $w_M + d/(p_H - p_L)$. The total expected wage pay is $w_M + dp_H/(p_H - p_L)$, if the wage schedule is based on the results of production. When the difference between w_O and w_M is small, it is still true that this expected wage pay is higher than the wage pay based on the behavior of employees, which equals to $w_O + d$. Accordingly, normalizing p_H as 1 does not change the qualitative result of my model.

[20]Aitken 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. My model can shed some light on these issues.

[21]I 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.

Solving this problem, we get

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

The expected profit in the FS case will be[22]

$$\Pi_F^S = \int_{\theta^*}^1 \left[\left(\lambda_j^{1-\alpha} y^\alpha - \frac{\tilde{w}_S^{1-\beta} y}{\theta} \right) \right] \frac{d\theta}{1-\theta^*}$$

$$= (1-\alpha)^2 \lambda_j \left(\frac{\alpha}{\tilde{w}_S^{1-\beta}} \right)^{\frac{\alpha}{1-\alpha}} \frac{(1 - \theta^{*\frac{1}{1-\alpha}})}{(1-\theta^*)}.$$

It is easy to see Π_F^S is an increasing function of θ^*. The economic intuition is straightforward, because in the FS case, there is no information rent problem. When θ^* goes up, The only effect is the efficiency effect which is positive. Before discussing more, I make an assumption to insure the wage rate in the north is always higher than that in the south.

Assumption 2

$$w_N > \tilde{w}_S$$

3 The Sorting of Production Patterns

There are three types of the production and the comparisons will be made between any two of them. First, the ratio of the expected profit in the OS case over the expected profit in the FDI case is

$$\frac{\Pi_O^S}{\Pi_F^S} = \left(\frac{\tilde{w}_S}{w_S} \right)^{\alpha(1-\beta)/(1-\alpha)} \frac{(1 - \theta^{*\frac{1+\alpha}{1-\alpha}})}{(1+\alpha)(1 - \theta^{*\frac{1}{(1-\alpha)}})}.$$

Here we have lemma 1[23].

Lemma 1

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

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[22]In the FS case, although there is no adverse selection problem in the production process, the ex ante uncertainty about the productivity still exists. The MNE does not know the exact productivity of the supplier which it wants to integrate as the productivity information is a soft information which is not verifiable.

[23]The proof is relegated to Appendix A.

From lemma 1, we have the following result:
If
$$\left(\frac{\tilde{w}_S}{w_S}\right)^{\alpha/(1-\alpha)} \geq \frac{(1+\alpha)(1-\theta^{*\frac{1}{(1-\alpha)}})}{(1-\theta^{*\frac{1+\alpha}{1-\alpha}})},$$
the FS and OS coexist in the equilibrium.
If
$$\left(\frac{\tilde{w}_S}{w_S}\right)^{\alpha/(1-\alpha)} < \frac{(1+\alpha)(1-\theta^{*\frac{1}{(1-\alpha)}})}{(1-\theta^{*\frac{1+\alpha}{1-\alpha}})},$$
the FS (FDI) always dominates the OS for any given value of β.

In the latter case, the cutoff point between OS and FS is negative. To make my story more interesting, I make the following assumption.

Assumption 3

$$\left(\frac{\tilde{w}_S}{w_S}\right)^{\alpha/(1-\alpha)} \geq \frac{(1+\alpha)(1-\theta^{*\frac{1}{(1-\alpha)}})}{(1-\theta^{*\frac{1+\alpha}{1-\alpha}})}$$

3.1 The Comparison between IN and FS

First, we consider the comparison between IN and FS[24]

$$\frac{\Pi^N}{\Pi_F^S} = \left(\frac{\tilde{w}_S}{w_N}\right)^{\alpha(1-\beta)/(1-\alpha)} H(\theta^*)$$

where

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

The assumption below assures that the cutoff point between FS and IN is larger than 0 and smaller than 1.

Assumption 4

$$\left(\frac{w_N}{\tilde{w}_S}\right)^{\alpha/(1-\alpha)} > H(\theta^*)$$

Under assumption 4, we have the following lemma[25].

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[24]Although the constant term λ_j will be changed when many MNEs in the same industry shift their strategies from one to the other, a single MNE can take λ_j as given when deciding the production location and the organizational form.

[25]The proof is straightforward.

Lemma 2 *Under Assumption 4, there exists one cutoff point $\beta_{FN} \in (0,1)$, when $\beta > \beta_{FN}$, the home production is more profitable, and when $\beta < \beta_{FN}$, the FDI is more profitable.*

We can use figure 1 to illustrate this lemma. In figure 1, $S_1(\beta)$, which equals to $(w_N/\tilde{w}_S)^{\alpha(1-\beta)/(1-\alpha)}$ is the advantage of lower labor cost of producing in the south using FDI. $H(\theta^*)$ is the disadvantage of producing in the south which is related to the lower productivity of the intermediate goods' production. When the capital intensity of production increases, the advantage of lower labor cost becomes less important, as the production process needs less labor. Consequently, more MNEs will choose home production. Under assumption 4, the cutoff point between FS and IN is

$$\beta_{FN} = 1 - \frac{(1-\alpha)\log H(\theta^*)}{\alpha\log(w_N/\tilde{w}_S)}.$$

3.2 The Comparison between IN and OS

Next, we consider the comparison between IN and OS:

$$\frac{\Pi^N}{\Pi_O^S} = \left(\frac{w_S}{w_N}\right)^{\alpha(1-\beta)/(1-\alpha)} L(\theta^*)$$

where

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

The following assumption assures that the cutoff point between OS and IN is larger than 0 and smaller than 1.

Assumption 5

$$\left(\frac{w_N}{w_S}\right)^{\alpha/(1-\alpha)} > L(\theta^*)^{26}$$

Under assumption 5, we have a cutoff point β_{ON} between IN and OS[27].

In figure 2, $S_2(\beta)$, which euqals to $(w_N/w_S)^{\alpha(1-\beta)/(1-\alpha)}$ is the advantage of lower labor cost of producing in the south using outsourcing. $L(\theta^*)$is the

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[26]This assumption is possible when the wage rate in the north is much higher compared with the wage rate in the south.
[27]See figure 2.

disadvantage of producing in the south because of the lower productivity of the intermediate goods' production and the adverse selection problem. Under assumption 5, the cutoff point between OS and IN is

$$\beta_{ON} = 1 - \frac{(1-\alpha)\log L(\theta^*)}{\alpha \log(w_N/w_S)}.$$

3.3 The Comparison between OS and FS

Finally, we consider the comparison between OS and FS.

$$\frac{\Pi_O^S}{\Pi_F^S} = \left(\frac{\tilde{w}_S}{w_S}\right)^{\alpha(1-\beta)/(1-\alpha)} \frac{1}{M(\theta^*)}$$

where

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

Then we have the following lemma.

Lemma 3

$$M'(\theta^*) < 0^{28}$$

$M(\theta^*)$ is a decreasing function of θ^*. The economic meaning 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[29]. Under assumption 3, we have a cutoff point β_{OF} between OS and FS.[30]

In figure 3, $S_3(\beta)$, which euqals to $(\tilde{w}_S/w_S)^{\alpha(1-\beta)/(1-\alpha)}$ is the advantage of lower labor cost of outsourcing. $M(\theta^*)$ is the disadvantage of outsourcing in the south because of the adverse selection problem. Under assumption 3, the cutoff point between OS and FS is

$$\beta_{OF} = 1 - \frac{(1-\alpha)\log M(\theta^*)}{\alpha \log(\tilde{w}_S/w_S)}.$$

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[28]For proof, see appendix B.
[29]The economic intuition is stated in the next subsection.
[30]See figure 3.

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3.4 The Comparative Statics

We want to see the relationship between θ^* and three cutoff points.

Lemma 4 *When θ^* goes up, the cutoff point between FS and IN (i.e. β_{FN}), the cutoff point between OS and IN (i.e. β_{ON}) and the cutoff point between OS and FS (i.e. β_{OF}) increase.*[31]

It is not difficult to see that the first two cutoff points increase when θ^* goes up, because the expected profits in the OS case and FS case go up while the profit of producing in the north stays unchanged. But the economic intuition of the relationship between β_{OF} and θ^* is not straightforward. It is good news for both types of MNEs which do outsourcing or undertake FDI that θ^* goes up as the average productivity of the supplier in the south increases. It is better news for the MNEs which do outsourcing as the productivity difference narrows which means that the adverse selection problem has been mitigated.

The empirical implication from above lemma is that in the industry which witnesses less uncertainty in intermediate goods suppliers' productivity[32], the probability of choosing outsourcing as the production strategy should be higher as the cutoff point between OS and FS is high. On the other hand, in the industry which witnesses more uncertainty in intermediate goods suppliers' productivity[33], the probability of choosing FDI as the production strategy should be higher as the cutoff point between OS and FS is low.

3.5 Capital Intensity and FDI

There are only two types relationships between above three cutoff points[34]. Based on the discussion above, we have the following important results.

$$\beta_{FN} < \beta_{ON} < \beta_{OF} \ (case \ 1)$$

$$\beta_{FN} > \beta_{ON} > \beta_{OF} \ (case \ 2)$$

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[31]For proof, see appendix C.

[32]some traditional low-tech industries such as the textile industry and the shoemaking industry

[33]some high-tech industries such as the industry producing chips and CPU of computers

[34]For details, see appendix D.

The economic intuition behind this is that for any MNE which has a capital intensity between 0 and 1, one of the above three choices (i.e. domestic insourcing, outsourcing and FDI) will be optimal. For example, if the ordering is like

$$\beta_{FN} < \beta_{OF} < \beta_{ON},$$

for the MNE which has a capital intensity between β_{OF} and β_{ON}, none of the three choices will be optimal. As a result, mathematically we have six possible orders, but economically we have just two. Having above two types of ordering, we can derive the following two propositions.

Proposition 1 *Under Assumptions* $1-5$ *and in case 1 where* $\beta_{FN} < \beta_{ON} < \beta_{OF}$, *there exists one cutoff point (i.e.* $\beta_{ON} \in (0,1)$*) between the home production and the outsourcing in the south. When* $\beta > \beta_{ON}$, *the home production is optimal; when* $\beta < \beta_{ON}$, *outsourcing in the south is optimal.*

Proposition 2 *Under Assumptions* $1-5$ *and in case 2 where* $\beta_{FN} > \beta_{ON} > \beta_{OF}$, *there exist* $0 < \beta_{OF} < \beta_{ON} < \beta_{FN} < 1$. *When* $\beta > \beta_{FN}$, *the home production is optimal; when* $\beta_{FN} > \beta > \beta_{OF}$, *FDI is optimal. when* $\beta < \beta_{OF}$, *outsourcing in the south is optimal.*

From proposition 2, we have the following main result of this paper.

Proposition 3 *Compared with outsourcing, intra-firm trade (FDI) is heavily concentrated in capital-intensive industries.*

The economic intuition behind this result is that although the adverse selection problem is not related to the capital intensity of production, the moral hazard problem and wage premium in the FDI case are crucially affected by the capital intensity. When the capital intensity goes up, the MNE will pay less wage premium to employees in the FS case, as the production needs less labor. Accordingly, The choice of FDI compared with OS becomes more attractive. As a result, MNEs which have high capital intensities will choose FDI instead of outsourcing!

4 The Concluding Remarks

I present a simple model using contract theory to explain the behavior of the multinational firm. The main ideas are that for the firm which has

high enough capital intensity the option of producing at home is optimal, because it cannot use the advantage of the lower labor cost in the south. For the firm whose capital intensity falls into the middle range, the option of FDI will be optimal, because it can avoid the adverse selection problem by using relatively small amounts of governance cost (i.e. wage premium). For the least capital-intensive firm, the option of outsourcing in the south is optimal. This is because it can use the advantage of lower labor cost and cannot avoid the adverse selection problem by using relatively small amounts of governance cost.

The features of this paper are listed as follow. First, The information problem has been studied in this paper as the disadvantage of engaging in outsourcing, which, I think, has been ignored by the previous research. Second, this paper gives a new explanation for the wage premium in the MNE affiliated companies. The explanation is that it is more costly for the MNE to induce southern employees to work hard within the firm's boundary. Finally, the adverse selection problem in the outsourcing case and the moral hazard 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 integration) plays a crucial role in this paper's scenario which is different from the story of the economic activities within a specific country.

Although this paper is about the theory, many empirical implications can be derived from the above model. As the south in my model is refered 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 and are specialized in the production of low-tech intermediate goods, because better acconting systems and less uncertaity will increase the attractiveness of outsourcing in the south. The fact that for the northern and southern country pair which use the same language, the FDI should be commonly seen from the bilateral trade pattern is not surprising either. I hope future empirical research can support these theoretical predictions.

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Appendix A: Proof of Lemma 1

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 1:

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

Appendix B: Proof of Lemma 3

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

$$Sign\left(M'(\theta^*)\right) = Sign\left((1+\alpha)\theta^{*2\alpha/(1-\alpha)}(1 - \theta^{*1/(1-\alpha)}) - \theta^{*\alpha/(1-\alpha)}(1 - \theta^{*(1+\alpha)/(1-\alpha)})\right)$$

$$= Sign\left((1+\alpha)\theta^{*2\alpha/(1-\alpha)} - \alpha\theta^{*(1+2\alpha)/(1-\alpha)} - \theta^{*\alpha/(1-\alpha)}\right)$$

Because $y = \theta^{*x}$ 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:

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

Appendix C: Proof of Lemma 4

Because an increase in θ^* will lead increases in the expected profits in the FS case and the OS case leaving the profit in the IN case unchanged, β_{FN} and β_{ON} will go up when θ^* increases. From appendix B, we know that $M(\theta^*)$ is monotonically decreasing in θ^*, so an increase in θ^* will lead an increase in β_{OF} also.

Appendix D: Ordering of Three Cutoff Points

From above, we have:

$$1 - \beta_{ON} = \frac{\log L(\theta^*)}{\log \left(\frac{w_N}{w_S}\right)^{\alpha/(1-\alpha)}} = \frac{\log H(\theta^*) + \log M(\theta^*)}{\log \left(\frac{w_N}{\tilde{w}_S}\right)^{\alpha/(1-\alpha)} + \log \left(\frac{\tilde{w}_S}{w_S}\right)^{\alpha/(1-\alpha)}}.$$

$$1 - \beta_{FN} = \frac{\log H(\theta^*)}{\log \left(\frac{w_N}{\tilde{w}_S}\right)^{\alpha/(1-\alpha)}};$$

$$1 - \beta_{OF} = \frac{\log M(\theta^*)}{\log \left(\frac{\tilde{w}_S}{w_S}\right)^{\alpha/(1-\alpha)}}.$$

From above, we know that the value of $1 - \beta_{ON}$ must be between the value of $1 - \beta_{FN}$ and $1 - \beta_{OF}$. Accordingly, the following result is straightforward.

$$1 - \beta_{FN} < 1 - \beta_{ON} < 1 - \beta_{OF} \text{ or } 1 - \beta_{FN} > 1 - \beta_{ON} > 1 - \beta_{OF}.$$

This is equivalent to

$$\beta_{FN} > \beta_{ON} > \beta_{OF} \text{ or } \beta_{FN} < \beta_{ON} < \beta_{OF}.$$
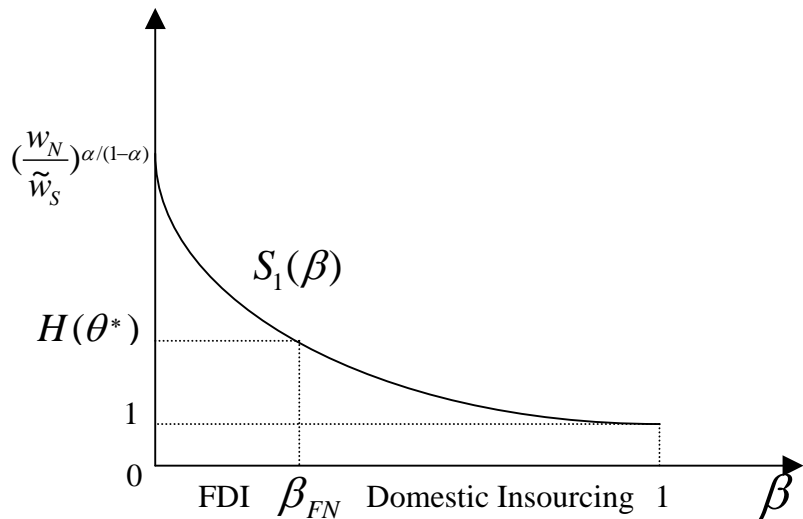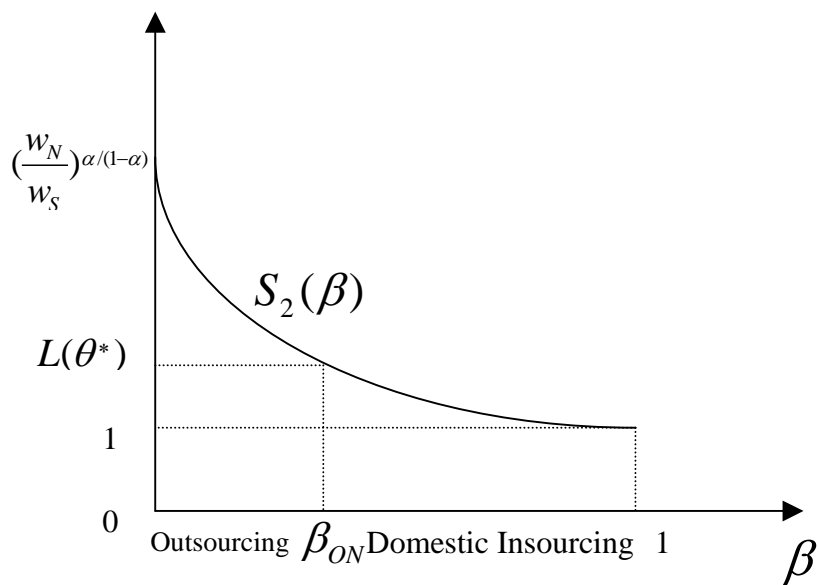
Figure 1: The Cutoff Point of β_{FN}

Figure 2: The Cutoff Point of β_{ON}

Figure 3: The Cutoff Point of β_{OF}

$(\dfrac{\widetilde{w}_S}{w_S})^{\alpha/(1-\alpha)}$

$S_3(\beta)$

$M(\theta^*)$

1

0

Outsourcing β_{OF} FDI 1

β