9-2007

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September 4, 2007

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By

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Abstract

We analyze the formation of an export-oriented international joint venture (IJV) between a multinational corporation (MNC) and a domestic firm under demand uncertainty and in a principal-agent framework. The MNC possesses a superior production technology and is better at predicting foreign market demand. The domestic firm can reduce set-up costs of the IJV with effort levels that is endogenously determined. We examine how the MNC's preference for, and the ownership structure of, a joint venture depend on the efficiency of information gathering and of cost reduction, and on the nature of credit markets. We find, *inter alia*, that when the credit constraint is severe the MNC does not push the domestic firm to its reservation profit level. A relaxation of the credit constraint facing the domestic firm never makes it better off and in fact makes the domestic firm worse off when the credit constraint is severe.

JEL Classification: F23, L24, D86.
Keywords: International joint venture, MNC, demand uncertainty, double-sided moral hazard, set-up costs, exports

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1 Introduction

Foreign direct investment (FDI) takes place for a number of reasons, and it taking the form of an international joint venture (IJV) can have many motives. Similarly, a domestic firm's willingness to join an IJV with a multinational corporation (MNC) has several purposes. In this paper we focus on only a few of these motives for both partners of an IJV. For the domestic firm, better information about a foreign market and access to improved production technology are the two key motives that we consider in this paper. As for the MNC reduced competition and reduction in set-up costs of production are the focus of attention here.[1]

It should be noted one of the key features that distinguished greenfield FDI from other forms of foreign investment is the existence of set-up costs in such an operation, and because of this in the theoretical literature fixed cost has traditionally played an important role (see, for example, Horstmann and Markusen, 1987; and Motta, 1992). IJV also has a greenfield component as IJV agreements are typically followed by significant capacity expansions by the joint entity. Thus, significant reduction in the cost of such capacity expansion can be a driving force in facilitating IJV agreements.

As an empirical fact, IJVs is still a major mode of foreign entry accounting for over a third of FDI in 2003 (see Folta, 2005). This importance of IJVs has led to substantial academic literature on the subject. Das (1999) considers a setting where a risk-neutral MNC and a risk-averse host firm make efforts to produce a good in a competitive market with cost uncertainty. Sinha (2001) considers a dynamic setting where the host government imposes a restriction on foreign equity holdings in the first period but removes the restriction in the second period. Asiedu and Esfahani (2001), Chan and Hoy (1991) and Lin and Saggi (2004) analyze the ownership structure of IJV where a MNC and a domestic firm possess complementary inputs. In Chan and Hoy (1991) and Lin and Saggi (2004), firms cannot directly contract on their inputs, and they provide inputs non-cooperatively based on the profit-

[1] we shall use therms set-up costs and fixed costs interchangeably.

sharing arrangement. Svejnar and Smith (1984) examine the microeconomic behavior of joint ventures established between MNCs and domestic partners in less developed countries, focusing on the role of bargain power, transfer pricing, stock ownership and profit shares of the parties, and the responsiveness of IJVs to national development goals.[2] Darrough and Stoughton (1989) analyze the profit-sharing arrangement in joint ventures as a Bayesian bargaining game between two parents with incomplete information about each other's cost functions. Lee (2004) studies the foreign equity share of international joint ventures in a setting where a MNC and a domestic firm simultaneously decide their respective equity share and the time to exercise an irreversible investment project via Nash-bargaining. Dai and Lahiri (2007) analyze IJV in a principal-agent framework with demand uncertainty, with the domestic firm having advantage in information gathering and the foreign firm having a cost advantage.

In contrast to the above literature, in the present paper the endogeneity of set-up costs in the IJV plays an important role. In particular, we assume that the domestic firm can, with some efforts, reduce set-up costs and the MNC has advantages in costs and in gathering information on demand uncertainty. With this, our principal-agent analysis with double-sided moral hazards allows us to examine conditions under which it is in the interest of both parties to form an IJV and when it is not. To be more specific, we examine how the MNC's preference for, and the ownership structure of, a joint venture depend on the efficiency of information gathering and cost reduction, and the nature of technology transfer. We also examine if credit market conditions can affect the nature of the contract and find, *inter alia*, that under severe credit constraints the principal (the MNC) will not drive the domestic firm's profits to its reservation level (which is also endogenous in our analysis).[3] One of our surprising findings is that a relaxation of the credit constraint facing the domestic firm never

[2]Welfare implications of, and government policies toward, JVs are analyzed in, for example, Farge and Wells, 1982; Katrak, 1983; Al-Saadon and Das, 1996; Roy Chowdhury and Roy Chowdhury, 2002; Das and Katayama, 2003; and Tomoda and Kurata, 2004.

[3]Our analysis also relates to several studies on the value of information in agency problems. See. for example, Sobel (1993), Lewis and Sappington (1994), Lewis and Sappington (1997), Cremer et al. (1998), and Dai et al. (2006).

makes it better off and in fact makes the domestic firm worse off when the credit constraint is severe.

Our framework in which the MNC has an advantage in gathering information on demand uncertainty implicitly assumes that the product of the IJV is mostly sold in a foreign market. In other words, IJV in our paper is an export-oriented (or, export platform) one. This type of FDI is not uncommon in reality.[4] For example, many US firms invest in Ireland and export their product to the rest of European Union member countries (see, for example Barry and Bradly (1997)). Japanese investments in the UK also produce goods mainly for the EU market. According to UNCTAD, foreign affiliate exports now make up about one-third of total world exports (UNCTAD, 1998).

The remainder of the paper is organized as follows. Section 2 describes the central elements of our model. Section 3 discusses the benchmark case of duopoly competition. Whereas section 4 analyzes the IJV equilibrium when the credit market is perfect, in section 5 we allow for credit market imperfections. Some concluding remarks are made in section 6.

2 Technology and Information

In our model, we consider the production of a homogeneous commodity in a country called the host country, and the entire production is sold in a foreign market. There is a domestic and a foreign firm in the host country. We shall call these two firms firm D and the MNC respectively. These two firms either compete as duopolists for the foreign market or they form a joint venture.

The inverse demand function for the product is given by

$$p = \widetilde{a} - bq,$$

[4]see Ekholm et al. (2007) for a recent study of export-platform FDI.

where the demand parameter $\widetilde{a}$ is a binary random variable defined as:

$$\widetilde{a} = \begin{cases} a_0 & \text{with probability } \phi \\ a_1 & \text{with probability } 1-\phi. \end{cases} \tag{1}$$

Without loss of generality, we assume that $a_0 < a_1$.

Both firms are risk neutral. At the beginning of each period, both the MNC and the domestic firm know the distribution of $\widetilde{a}$. However, the MNC has an information advantage in the sense that with efforts it can gather information to update its knowledge on $\widetilde{a}$ before production actually takes place. To be more specific, if the MNC puts in an effort level of e_m, with probability $\mu(e_m) = \alpha e_m$, it discovers the realization of $\widetilde{a}$; but, with probability $1 - \mu(e_m)$, it obtains no further information on $\widetilde{a}$. The parameter α measures the MNC's efficiency in gathering information. The cost of the MNC's information gathering is $e_m^2/2$. The MNC also has a technology advantage in the sense that its constant marginal cost c_m is lower than that of the domestic firm which is denoted by c_d, i.e., $c_m < c_d$.

The MNC's set-up cost of production in the developing country is F. However, in a joint venture, the domestic firm can reduce the set-up cost of production with effort, e_d. Therefore, the set-up cost for a joint venture is $F - \beta e_d$, where β is a parameter measuring the domestic firm's effectiveness in cost reduction. The cost of the domestic firm's effort is $e_d^2/2$.

Each firm's effort is not observable to the other firm and is a private information.

Having described the overall framework in relation to asymmetry in information, we shall now describe the benchmark case of duopoly competition between the two firms, which will materialize if a joint venture arrangement cannot be agreed upon by the two parties.

3 The Benchmark: Duopoly Competition

Suppose the two firms engage in a two-stage Cournot competition. In the first stage, the MNC gathers demand information, and then in the second stage, the two firms compete on outputs, given their information on the demand condition.

In order to obtain a sub-game perfect equilibrium, we work with backward induction, starting with the second stage. In the second stage, the MNC's output strategy depends on its information on the demand parameter. First, when it fails to discover the realization of the demand parameter which has a probability of $1 - \mu(e_m)$, it makes its output decision based upon its prior belief on $\widetilde{a}$ and on the domestic firm's output strategy. In this case, the MNC's optimization problem is the following:

$$\underset{\overline{q}_m}{Max}\ \overline{\pi}_m = \left[\overline{a} - b(\overline{q}_m + \overline{q}_d) - c_m\right] \overline{q}_m - F, \tag{2}$$

where $\overline{a} = E[\widetilde{a}] = \phi a_0 + (1-\phi)a_1$, and $\overline{q}_m$ and $\overline{q}_d$ are the output levels of the MNC and the domestic firm respectively. This optimization problem gives us the MNC's optimal output response function as $\overline{q}_m = (\overline{a} - b\overline{q}_d - c_m)/(2b)$.

Second, when the MNC discovers the realization of $\widetilde{a}$ which has a probability of $\mu(e_m)$, its optimization problem is the following:

$$\underset{q_m^i}{Max}\ \pi_{di} = \left[a_i - b(q_m^i + \overline{q}_d) - c_m\right] q_m^i - F, \tag{3}$$

where $i = 0, 1$ denotes the realization of the demand parameter – a_0 and a_1 respectively. In this case, the domestic firm's optimal output response is $q_m^i = (a_i - bq_d - c_m)/(2b)$ for $i = 0, 1$.

The domestic firm chooses an output level to maximize its expected profits based upon its prior belief on $\widetilde{a}$ and on the MNC's output strategy. In particular, its optimization problem is the following:

$$\underset{\overline{q}_d}{Max}\ \overline{\pi}_d = \{\overline{a} - b[\overline{q}_d + (1-\mu(e_m))\overline{q}_m + \mu(e_m)(\phi q_m^0 + (1-\phi)q_m^1)] - c_d\}\overline{q}_d, \tag{4}$$

where $(1-\mu(e_m))\overline{q}_m + \mu(e_m)(\phi q_m^0 + (1-\phi)q_m^1)$ is the expected value of the MNC's output.

Consequently, the domestic firm's optimal output response is $\overline{q}_d = \{\overline{a} - b[(1-\mu(e_m))\overline{q}_m + \mu(e_m)(\phi q_m^0 + (1-\phi)q_m^1)] - c_d\}/(2b)$.

Therefore, at the equilibrium, both firms' output levels (under different scenarios) are the following:

$$\overline{q}_m = \frac{\overline{a} - 2c_m + c_d}{3b}, \tag{5}$$

$$q_m^0 = \frac{3a_0 - \overline{a} - 4c_m + 2c_d}{6b}, \tag{6}$$

$$q_m^1 = \frac{3a_1 - \overline{a} - 4c_m + 2c_d}{6b}, \text{ and} \tag{7}$$

$$\overline{q}_d = \frac{\overline{a} - 2c_d + c_m}{3b}. \tag{8}$$

At the equilibrium, both firms' outputs increase in (expected) demand condition ($\overline{a}$) and their competitors' marginal costs, but decrease in their own marginal costs. The MNC's output depends on the expected demand condition when it fails to discover the demand condition, but varies with the demand condition when it successfully discovers the demand condition. For simplicity, we assume $c_d \leqslant (\overline{a}+c_m)/2$ and $c_m \leqslant (3a_0 - \overline{a} + 2c_d)/4$ so that both firms will produce positive amounts of the good under all demand conditions. Formally,

Assumption 1 $c_d \leqslant (\overline{a} + c_m)/2$ *and* $c_m \leqslant (3a_0 - \overline{a} + 2c_d)/4$.

The MNC's equilibrium profits depend on its information and the demand conditions. First, when it fails to discover the demand condition, its expected equilibrium profit is

$$\overline{\pi}_m = \frac{(\overline{a} - 2c_m + c_d)^2}{9b} - F. \tag{9}$$

Second, when it discovers the realization of demand parameter to be $\widetilde{a} = a_0$, its profit is

$$\pi_m^0 = \frac{(3a_0 - \overline{a} - 4c_m + 2c_d)^2}{36b} - F, \tag{10}$$

and finally when it discovers the realization of demand parameter to be $\widetilde{a} = a_1$, its profit is:

$$\pi_m^1 = \frac{(3a_1 - \overline{a} - 4c_m + 2c_d)^2}{36b} - F. \tag{11}$$

The expected equilibrium profit for the domestic firm is

$$\overline{\pi}_d = \frac{(\overline{a} - 2c_d + c_m)^2}{9b}. \tag{12}$$

This completes the description of the second stage. In the first stage, the MNC chooses its effort level in information gathering based upon its expectation of equilibrium profits in the second stage.

The MNC's optimization problem is as follows:

$$\underset{e_m}{Max}\ \pi_m = \mu(e_m)(\phi\pi_m^0 + (1-\phi)\pi_m^1) + (1-\mu(e_m))\overline{\pi}_m - e_m^2/2, \tag{13}$$

where $\overline{\pi}_m,\ \pi_m^0$ and π_m^1 are given in (9), (10) and (11) respectively and $\mu(e_m) = \alpha e_m$.

The solution of the optimal level of effort in the above problem is given by:

$$\begin{aligned} e_m &= \frac{\alpha \mathrm{Var}(\widetilde{a})}{4b}, \quad \text{where} \\ \mathrm{Var}(\widetilde{a}) &= \phi a_0^2 + (1-\phi)a_1^2 - \overline{a}^2. \end{aligned} \tag{14}$$

We define the value of information, V, as the difference between the MNC's profits when information gathering is successful and when it is unsuccessful. Hence,

$$V = (\phi\pi_{m0} + (1-\phi)\pi_{m1}) - \overline{\pi}_m = \mathrm{Var}(\widetilde{a})/(4b). \tag{15}$$

The MNC's maximum profit under duopoly competition, therefore, is

$$\begin{aligned} &\pi_m = \overline{\pi}_m + \alpha^2[\phi a_0^2 + (1-\phi)a_1^2 - \overline{a}^2]^2/(32b^2), \\ \text{or,}\quad &\pi_m = \overline{\pi}_m + \alpha^2 V^2/2. \end{aligned} \tag{16}$$

Therefore, the benefit of the MNC's superior information on demand condition is increasing in α and $\mathrm{Var}(\widetilde{a})$.

Proposition 1 *Under duopoly competition, the MNC's expected profit increases as the demand condition becomes more uncertain or the firm becomes more efficient in gathering information; however, the domestic firm's expected profit depends on neither the demand uncertainty nor the MNC's ability to gather information.*

The intuition is as follows. The MNC's information on demand condition enables it to adjust its output downward when demand is low and upward when demand is high. However, the MNC's gain in profit when the demand is high more than compensates its loss in profit when demand is low because of the volume effect on profits. Therefore, the MNC's expected profit increases as the demand becomes more uncertain. Turning to the effect of efficiency in information gathering, the MNC obtains the demand information more often for any given level of effort as it becomes more efficient in gathering information, and this increases its expected profit. However, the domestic firm's output decision is based purely on its expectation of demand condition and therefore its profits is not affected by the variability of demand condition, but is increasing in the expected value of demand condition.

As for the effect of the MNC's efficiency level in information gathering, it has two opposing effects on the domestic firm's expected profits: the MNC softens the competition by reducing output when demand is low and toughens the competition by raising output when demand is high. These two opposing effects turn out to offset each other. Moreover, as the demand uncertainty increases, so does the magnitude of these two effects. Consequently, the demand uncertainty and the MNC's efficiency in information gathering have no effect on the domestic firm's expected profit.[5]

[5]Basar and Ho (1976), Ponssard (1979), Novshek and Sonnenschein (1982), Vives (1984), and Hwang (1993) study firms' incentives to acquire and disclose information on the demand function in an oligopolistic market. They show that the acquisition of such information is always beneficial to the firms and not disclosing information is a dominant strategy for each firm in Cournot competition when the goods are substitutes.

4 Joint Venture

Having described the benchmark duopoly equilibrium, we are now in a position to develop the international joint venture (IJV) equilibrium. We shall set it up in a principal-agent framework, with the MNC being the principal and the domestic firm as the agent.

As for the technology, we assume that in the joint venture, the marginal cost of production is a linear combination of the MNC's and the domestic firm's original marginal costs, i.e.,

$$c_j = \theta c_m + (1-\theta)c_d,$$

where $\theta \in [0,1]$ measures the efficiency of technology transfer. The set-up cost of the joint venture is $F - \beta e_d$ where e_d is the effort level of the domestic firm in reducing the set-up cost and the positive parameter β represents the efficiency of a given amount of effort in reducing the set-up cost.

The MNC continues, as in the benchmark case, to spend resources in information gathering. Since each firm's effort is unobservable to the other firm, the two firms cannot contract on either the domestic firm's effort in cost reduction or the MNC's effort in information gathering. Consequently, the IJV is subjected to a double-sided moral hazard problem, and the optimal contract must induce both firms' effort supply in the IJV.

The timing of the model is as follows:

1. The MNC offers a contract $\{T, s\}$ to the domestic firm, specifying the domestic firm's lump-sum payment to the MNC T (which can be negative) and the MNC's share of profit s.

2. The domestic firm decides whether to accept or reject the contract.

3. The nature determines the demand condition in the market.

4. The MNC gathers information on demand conditions, and the domestic firm engages in cost reduction.

5. The IJV determines the output level and production takes place.

6. Profits of the IJV are distributed between the two parties based on the contract.

The optimization problem for the IJV depends whether the MNC succeeds or fails to discover the demand condition. When the MNC fails to discover the demand condition, the IJV's optimization problem, at stage 5 of the game, is

$$\underset{\overline{q}_j}{Max}\ \overline{\pi}_j = (\overline{a} - b\overline{q}_j + c_j)\overline{q}_j - (F - \beta e_d), \tag{17}$$

and in this case it can be shown that the join venture's maximum profit is $\overline{\pi}_j = (\overline{a} - c_j)^2/(4b) - (F - \beta e_d)$. The subscript j stands for IJV.

When the MNC discovers the realization of the demand condition, the IJV's optimization problem is

$$\underset{q_j^i}{Max}\ \pi_j^i = \left[a_i - bq_j^i - c_j\right] q_j^i - (F - \beta e_d), \tag{18}$$

where $i = 0, 1$. In this case, the joint venture's maximum profit is $\pi_j^0 = (a_0 - c_j)^2/(4b) - (F - \beta e_d)$ if $\widetilde{a} = a_0$, and $\pi_j^1 = (a_1 - c_j)^2/(4b) - (F - \beta e_d)$ if $\widetilde{a} = a_1$.

Before describing the optimal contract, we shall first of all, describe the first-best solution in which the firms can observe each other's effort levels and thus contract on it.

4.1 The first-best solution

As a reference point, we first consider the optimal solution when the firms can observe and contract on their effort. In this case, the IJV can specify both the domestic firm's effort in cost reduction and the MNC's effort in information gathering in the contract. The MNC's optimization problem is

$$\underset{T,s,e_m,e_d}{Max}\ \Pi_m = s[\mu(e_m)(\phi R_j^0 + (1-\phi)R_j^1) + (1-\mu(e_m))\overline{R}_j - (F - \beta e_d)] + T \tag{19}$$

subject to

$$(1-s)[\mu(e_m)(\phi R_j^0 + (1-\phi)R_j^1) + (1-\mu(e_m))\overline{R}_j - (F - \beta e_d)] - T - e_d^2/2 \geqslant \overline{\pi}_d, \tag{20}$$

where $\overline{R}_j = (\overline{a} - c_j)^2/(4b)$, $R_j^0 = (a_0 - c_j)^2/(4b)$, $R_j^1 = (a_1 - c_j)^2/(4b)$, and $\overline{\pi}_d$ is defined in (12).

Constraint (20), which requires the domestic firm's expected profits in the IJV to be no less than its maximum expected profit under duopoly competition, guarantees the domestic firm's participation in the IJV.

In the optimal solution we must have:

$$e_m^* = \alpha[(\phi R_j^0 + (1-\phi)R_j^1) - \overline{R}_j] = \alpha V, \text{ and} \tag{21}$$

$$e_d^* = \beta. \tag{22}$$

The MNC offers the domestic firm a combination of s and T which drives the latter's profit to its reservation level. Substituting T from (20) (with equality) into (19) and using (21), we can obtain the MNC's maximum profits to be $\overline{R}_j + \mu(e^*)[(\phi R_j^0 + (1-\phi)R_j^1) - \overline{R}_j] + \alpha^2 V^2/2 - (F - \beta^2/2) - \overline{\pi}_d = \overline{R}_j + \alpha^2 V^2/2 - (F - \beta^2/2) - \overline{\pi}_d$. Thus, the domestic firm's and the MNC's profits, respectively, are

$$\Pi_d^* = \overline{\pi}_d, \text{ and} \tag{23}$$

$$\Pi_m^* = \overline{R}_j + \alpha^2 V^2/2 - (F - \beta^2/2) - \overline{\pi}_d. \tag{24}$$

Note that total IJV profit in this case is $\overline{R}_j + \mu(e^*)[(\phi R_j^0 + (1-\phi)R_j^1) - \overline{R}_j] + \alpha^2 V^2/2 - (F - \beta^2/2)$, of which $\alpha^2 V^2/2$ is the contribution of the MNC via information gathering and $\beta^2/2$ is the contribution of the domestic firm via fixed-cost reduction.

4.2 The Optimal Contract

Having described the first best, we now describe the optimal contract when the firms cannot contract on either the domestic firm's effort in cost reduction or the MNC's effort in information gathering. We conduct the analysis again with backward induction.

First, since the firms cannot observe each other's effort supply, each firm chooses its effort level by maximizing its own profit based on its share of profits as specified in the contract.

Given its share of profit, $1-s$, the domestic firm's optimization problem is

$$\underset{e_d}{Max}\ (1-s)[\mu(e_m)(\phi R_j^0 + (1-\phi)R_j^1) + (1-\mu(e_m))\overline{R}_j - (F-\beta e_d)] - T - e_d^2/2. \tag{25}$$

Then the domestic firm's cost-reduction effort given its share is

$$e_d = (1-s)\beta. \tag{26}$$

Given its share of profit, s, the MNC's optimization problem is

$$\underset{e_m}{Max}\ \Pi_m = s[\mu(e_m)(\phi R_j^0 + (1-\phi)R_j^1) + (1-\mu(e_m))\overline{R}_j - (F-\beta e_d)] + T - e_m^2/2. \tag{27}$$

Then the MNC's information gathering effort given its share is

$$e_m = s\alpha V. \tag{28}$$

In the first stage, the MNC chooses a contract $\{T, s\}$ to maximize its profit based on its anticipation of each firm's effort supply in the later stage described above. Therefore, the MNC's optimization problem in the first stage is

$$\underset{s,T}{Max}\ \Pi_m = s[\mu(e_m)(\phi R_j^0 + (1-\phi)R_j^1) + (1-\mu(e_m))\overline{R}_j - (F-\beta e_d)] + T - e_m^2/2. \tag{29}$$

subject to constraints (20), (26), and (28).

Constraint (20) guarantees the domestic firm's participation in the IJV. Constraints (26) and (28) determine the domestic firm's effort in cost reduction and the MNC's effort in information gathering, respectively, for a given contract.

Substituting constraints (26) and(28) into the MNC's optimization problem for e_d and e_m, the MNC's optimization problem can be reduced to:

$$\underset{T,s}{Max}\,\Pi_m = s[\overline{R}_j + s\alpha^2V^2 - (F - (1-s)\beta^2)] + T - s^2\alpha^2V^2/2 \tag{30}$$

subject to

$$(1-s)[\overline{R}_j + s\alpha^2V^2 - (F-(1-s)\beta^2)] - (1-s)^2\beta^2/2 - T \geqslant \overline{\pi}_d. \tag{31}$$

The solution to the MNC's optimization problem is given by

$$s^* = \frac{\alpha^2V^2}{\alpha^2V^2+\beta^2};\text{ and} \tag{32}$$

$$T^* = \frac{\beta^2}{\alpha^2V^2+\beta^2}(\overline{R}_j - F) + \frac{2\alpha^4V^4\beta^2+\beta^6}{2(\alpha^2V^2+\beta^2)^2} - \overline{\pi}_d. \tag{33}$$

Recall that $\alpha^2V^2/2$ and $\beta^2/2$, respectively, are the domestic firm's and the MNC's contributions via their respective effort levels to the joint venture's profit in the first-best solution. Thus, in the optimal contract, each firm's share of profit equals its relative ability to increase the joint venture's profit. Since $0 < s < 1$ in the optimal contract, from constraints (26) and(28) it follows that both firms supply less than their first-best level of efforts. The MNC also charges a lump-sum payment in the optimal contract. Notice that the payment becomes negative as β converges to zero, i.e., as the domestic firm's ability to reduce the set-up cost diminishes. That is, when the domestic firm does not contribute anything to the IJV's profits, it does not receive any share of profits but only a lump-sum transfer from the MNC. This is because in this case the MNC has nothing to gain by giving the domestic firm a higher share of profits and thus inducing it to exert more efforts.

Under the optimal contract, the MNC's and the domestic firm's profits in this case are respectively:

$$\Pi_m = \overline{R}_j + \frac{\beta^4 + \alpha^2 V^2 \beta^2 + \alpha^4 V^4}{2(\alpha^2 V^2 + \beta^2)} - F - \overline{\pi}_d, \text{ and} \tag{34}$$

$$\Pi_d = \overline{\pi}_d. \tag{35}$$

Therefore, under the optimal contract, the domestic firm always receives its reservation profits—its profits under duopoly competition. We summarize these properties of the optimal contract in Proposition 2 (the formal proof is given in appendix A).

Proposition 2 *In the optimal contract, each firm receives a share of the joint venture which equals its relative ability to increase the joint venture's profit. Consequently, both firms deliver less than the first-best level of effort. The MNC charges a lump-sum payment (which can be negative), and the domestic firm always receives its reservation profit.*

As the domestic firm's ability to reduce the set-up cost increases, the profit of the joint venture increases but the domestic firm's reservation profit remains the same. Therefore, the MNC's profit increases as the domestic firm becomes more effective in cost reduction. Moreover, the MNC's profit also increases as the MNC's ability to gather information—represented by α—increases. We summarize these results in Proposition 3

Proposition 3 *The MNC's profit in the joint venture increases as either the MNC's ability to gather information or the domestic firm's ability to reduce set-up cost increases.*

The MNC however may not take part in the IJV if its profits under IJV is lower than that under duopoly. On one hand, the formation of a joint venture eliminates competition and reduces set-up costs. On the other hand, the double-sided moral hazard problem in the joint venture leads to inefficient effort supply by both firms. In Proposition 3 we show that, when the technology transfer is perfect, i.e., $\theta = 1$, the the effect of reductions in both competition and set-up cost always dominates the effect of inefficiency of effort supply in the joint venture. Consequently, the MNC would always prefer IJV to duopoly when the technology transfer is perfect (appendix B has the proof). Formally:

Proposition 4 *When the technology transfer is perfect, the MNC always prefers a joint venture to duopoly competition.*

Next we derive a sufficient condition on the domestic firm's ability to reduce set-up cost under which the MNC would still prefer IJV over duopoly even when technology transfer is completely absent, i.e., $\theta = 0$. This sufficient condition also guarantees that IJV is the preferred option for the MNC for all values of θ. However, if this sufficient condition is not satisfied, then there exists a critical value of c_d, say $\tilde{c}_d$, such IJV is preferable to the MNC if $c_d \leq \tilde{c}_d$, and duopoly can be preferable if $\tilde{c}_d \leq c_d$ $(\leq (\overline{a} + c_m)/2)$, because of assumption (1). These results are formally stated in proposition 4 below (the proof is given in appendix C).

Proposition 5 *When the technology transfer is imperfect, there exists a critical value of β, $\widetilde{\beta}$, such that the MNC prefers IJV to duopoly for all values of θ if $\beta > \widetilde{\beta}$. The critical value $\widetilde{\beta}$ is an increasing function of α^2V^2. If $\beta < \widetilde{\beta}$, then there exists a critical value of c_d, $\tilde{c}_d(\leq (\overline{a} + c_m)/2)$, such that the MNC prefers IJV to duopoly when $c_d < \tilde{c}_d$, and duopoly to IJV when $\tilde{c}_d \leq c_d$. Furthermore, the critical value $\tilde{c}_d$ is an increasing function of the technology transfer parameter θ.*

The intuition behind Propositions 4 is as follows. When the technology transfer is imperfect, the MNC faces the trade-off between reductions in both competition and set-up costs on one hand, and the inefficiency in effort supplies and differences in production technology on the other. When the domestic firm's production technology becomes more inefficient (i.e., its marginal cost increases), the MNC's profit under duopoly competition increases, but its profit in the IJV decreases as the IJV's marginal cost of production increases. Consequently, the MNC's benefit from less competition decreases as the domestic firm's production technology becomes less efficient. Therefore, the MNC prefers IJV to duopoly competition only if the domestic firm's ability to reduce set-up cost is sufficiently large relative to the MNC's ability to gather information. When the domestic firm's production technology is sufficiently inferior and its ability to reduce set-up cost is minimal, the MNC prefers duopoly competition to IJV.

Notice that the MNC's original set-up cost of production, F, has no effect the MNC's preference for IJV, as it influences the MNC's profits under both the IJV and duopoly competition equally.

5 Imperfect Credit Market

In the preceding analysis, we implicitly assumed that the domestic firm can finance the *ex ante* payment — which is needed before profits are realized and distributed — by borrowing the amount from the credit market. There is no problem with this if the credit market is perfect. However, in reality credit markets are often imperfect putting restriction on the amount of lump-sum *ex ante* transfer. In this section we assume the existence of such a restriction, and denote by W the maximum amount that the domestic firm can borrow.In this case the MNC may not be able to charge the domestic firm the same amount of *ex ante* payment as in the case of perfect credit market.

When $W \geqslant T^*$ (T^* is the equilibrium level of payment in the previous analysis (defined in equation (33)), i.e., the credit constraint is not binding, then nothing changes and previous analysis holds. However, when $W < T^*$, the domestic firm's *ex ante* payment is constrained by its access to credit, and the MNC can no longer charge the domestic firm the same amount of *ex ante* payment as in the case of perfect credit market. Since the inability to use lump-sum transfer constrains the MNC's ability to extract the domestic firm's profit, it has implications for the participation constraint (31). Consequently two sub-cases arise depending on the extent of the credit constraint. If the credit constraint is binding but not severely so, the MNC would be able to use a combination of the two instruments — a lump-sum *ex ante* transfer T (to the extent allowed) and profit share s — to drive the domestic firm's profits to the reservation level $\overline{\pi}_d$. However, when the credit constraint is severe and the ability of the MNC to charge a lump-sum transfer is very limited, the MNC will choose not to drive the domestic firm's profit to the reservation level. We shall consider these two cases in turn. The critical level of W, $\underline{W}$, at which credit constraint becomes severe from being moderate is given by

$$\underline{W} = \frac{[\beta^2 - \alpha^2 V^2 - (\overline{R}_j - F)][\beta^2 + \alpha^2 V^2 + 3(\overline{R}_j - F)]\beta^2}{2(2\beta^2 - \alpha^2 V^2)^2} - \overline{\pi}_d, \tag{36}$$

and (31) becomes non-binding when $W < \underline{W}$.[6]

For simplicity, in this section we shall assume that the joint venture's profit is nonnegative when neither information gathering nor fixed-cost reduction is feasible, *i.e.*, $\overline{R}_j - F \geqslant 0$.

5.1 The case of moderate credit constraint: $T^* > W > \underline{W}$

In this case, the domestic firm's access to moderate amount of credit allows the MNC to drive the domestic firm's profit to its reservation level. Under the optimal contract,

$$T = W, \tag{37}$$

and the MNC's share of profit, S, is determined by

$$(1 - s)[\overline{R}_j + s\alpha^2 V^2 - F + (1 - s)\beta^2/2] - W = \overline{\pi}_d. \tag{38}$$

From equation (38) it can be derived that $ds/dW = -1/[\overline{R}_j + (2s - 1)\alpha^2 V^2 - F + (1 - s)\beta^2]$, and this can be shown to be negative using (38). That is, the domestic firm's share of profit increases as its access to credit increases, when $\overline{R}_j > F$.

[6]Note that the critical value of W depends on β among other things, and if the value of β relatively small so that $\beta^2 < \alpha^2 V^2 + (\overline{R}_j - F)$, the critical value of W is negative and the case of severe credit constraint cannot arise.

When the domestic firm's ability to deliver the lump sum payment T is limited by its credit constraint, the MNC has to rely on the share of profits S to extract the domestic firm's profit, which dilutes the domestic firm's incentive to provide cost-reduction effort. Therefore, the MNC faces a tradeoff between profit extraction and incentive provision. As the domestic firm's access to credit increases, the MNC can charge a larger *ex ante* payment, so the MNC is willing to offer the domestic firm a larger share to induce its effort supply. Consequently, the joint venture's profit and the MNC's profit in the joint venture both increase as the domestic firm's access to credit increases. We summarize the properties of optimal contract in this case in Proposition 6.

Proposition 6 *When $T^* > W \geqslant \underline{W}$ and $\overline{R}_j > F$, the domestic firm's share of profit increases as its access to credit increases. Moreover, the joint venture's and the MNC's profit both increase as the domestic firm's access to credit increases. However, the domestic firm always receives its reservation profit.*

When the credit market is imperfect, the MNC receives a smaller profit than that in a perfect credit market. However, when the technology transfer is perfect, i.e., $\theta = 1$, it can be shown that the reduction in both the competition and set-up costs still dominates the inefficiency of effort supply in the joint venture. Consequently, the MNC always prefers IJV to duopoly when the technology transfer is perfect (appendix F has the proof).

Proposition 7 *When the technology transfer is perfect, the MNC always prefers a joint venture to duopoly competition even if the credit market is imperfect.*

5.2 The case of severe credit constraint: $W < \underline{W}$

In this case, the domestic firm's ability to make the *ex ante* payment is severely constrained by its access to credit, and therefore the participation constraint (31) is not binding. The optimal contract is given by

$$s = \frac{\overline{R}_j - F + \beta^2}{2\beta^2 - \alpha^2 V^2}; \text{ and} \tag{39}$$

$$T = W. \tag{40}$$

Note that this case arises only if $\beta^2 > \alpha^2 V^2 + \overline{R}_j - F$, i.e., the domestic firm is sufficiently efficient in cost reduction. Given the domestic firm's high efficiency in cost reduction, in the optimal contract the MNC offers the domestic firm a large share of profit to induce its effort supply in cost reduction. The share optimally balances the MNC's share of profit and the domestic firm's incentive to reduce set-up cost. Constrained by the domestic firm's access to credit, the *ex ante* payment is too small to limit the domestic firm's profit to its reservation level. Consequently, the domestic firm receives a profit above its reservation level.

From equation (39), $ds/d\alpha^2 > 0$, i.e., the MNC's share of profits increases as its ability to gather information increases. Moreover,

$$\frac{ds}{d\beta^2} = -\frac{2(\overline{R}_j + \frac{\alpha^2 V^2}{2} - F)}{2\beta^2 - \alpha^2 V^2}, \tag{41}$$

which suggests $ds/d\beta^2 < 0$ when $\overline{R}_j > F$. Therefore, the domestic firm's share of profit increases as its ability to reduce set-up cost increases.

As the domestic firm's access to credit W increases, on one hand, the lump sum payment T increases; on the other hand, the domestic firm's share of profit does not change as indicated by equation (39). Consequently, the MNC's profit increases but the domestic firm's profit surprisingly decreases as the domestic firm's access to credit increases.

We summarize the properties of optimal contract in this case in Proposition 8.

Proposition 8 *When $W < \underline{W}^*$ and $\overline{R}_j > F$, the MNC's share of profit increases as its ability to gather information increases, and the domestic firm's share profit increases as its* *ability to reduce set-up cost increases. The MNC's profit increases but the domestic firm's profit decreases as the domestic firm's access to credit increases. Moreover, the domestic firm's profit in the joint venture is always above its reservation level.*

6 Conclusion

Foreign direct investment (FDI) in general, and international joint venture (IJV) in particular, can take place for a variety of reasons and the nature of the contract between the partners in an IJV is likely to reflect the underlying incentives and motives. Set-up costs are thought to be an integral part of all type of FDI, and in this paper reducing these costs — which the domestic partner can do with some efforts — is an important motivation for a multinational corporation (MNC) to prefer IJV over purely greenfield investments.

We develop a principal-agent model of IJV in which the MNC is the principal and it has an advantage over its domestic partner in gathering information on uncertain demand. The principal offers a contract to its potential domestic partner, making sure that the latter receives at least as much income from the IJV as it can if it competes with the MNC in a duopoly competition. We find that there are circumstances where the MNC may prefer duopoly to IJV. This possibility arises only when the IJV technology is inferior to the MNC technology, or in other words technology transfer in the IJV is imperfect. We also find that the the contract involves a positive share of IJV profits for both parties as long as the domestic firm has some advantage in fixed-cost reduction. It also involves an *ex ante* lump-sum transfer from the domestic firm to the MNC if the domestic firm is sufficiently efficient in reducing set-up costs. In the latter situation, the domestic firm can receive an income which is higher than its reservation income if imperfections in credit market are severe. In other words, the domestic firm is worse off when the credit constraint facing it improves from being severe to moderate or no constraint. We also find that a relaxation of the credit constraint facing the domestic firm never makes it better off and in fact makes the domestic firm worse off when the credit constraint is severe.

Our contribution to this expanding literature can shed some light on some stylished facts. For example, in 1995 IJVs accounted for 70.45% of total FDI. This figure has gone down to 35.8% in 2003. Some of this fall can be explained by changes in policy toward FDI in countries such as China and India. However, some of it can also be explained by the fact that globalization has also resulted in advances in information technology, and therefore the specific advantages of joining on IJV such as cost-reducing advantage, information gathering advantage etc. are no longer as significant as it used to be. Furthermore, advances in credit facilities can also, according to our analysis, dampen the enthusiasm of the potential domestic partners of an IJV.

Appendix A: Proof of Proposition 2

The Lagrangian of the MNC's problem is the following:

$$\begin{aligned} \pounds &= s[\overline{R}_j + s\alpha^2V^2 - (F-(1-s)\beta^2)] + T - s^2\alpha^2V^2/2 + \\ &\quad \lambda_1\{(1-s)[\overline{R}_j + s\alpha^2V^2 - (F-(1-s)\beta^2)] - (1-s)^2\beta^2/2 - T - \overline{\pi}_d\}, \end{aligned} \tag{A.1}$$

where λ_1 is the Lagrangian multiplier for constraint (31). Then the first order conditions are the following:

$$\pounds_s = [\overline{R}_j + s\alpha^2V^2 - F + (1-2s)\beta^2)] + \lambda_1[(1-2s)\alpha^2V^2 - \overline{R}_j + F - (1-s)\beta^2)] = 0, \text{ and} \tag{A.2}$$

$$\pounds_T = 1 - \lambda_1 = 0. \tag{A.3}$$

Equation (A.3) indicates that $\lambda_1 = 1$. Then solving (A.2) we get

$$s = \frac{\alpha^2V^2}{\alpha^2V^2 + \beta^2}. \tag{A.4}$$

From constraint (31), we also find that

$$T = \frac{\beta^2}{\alpha^2V^2+\beta^2}(\overline{R}_j - F) + \frac{2\alpha^4V^4\beta^2 + \beta^6}{2(\alpha^2V^2+\beta^2)^2} - \overline{\pi}_d. \tag{A.5}$$

.

Appendix B: Proof of Proposition 3

The MNC strictly prefers joint venture to duopoly competition if

$$\Pi_m > \pi_m, \text{ or} \tag{B.1}$$

$$\frac{(\overline{a}-c_j)^2}{4b} + \frac{2\alpha^4V^4\beta^2 + \beta^6 - \beta^4\alpha^2V^2}{2(\alpha^2V^2+\beta^2)^2} > \frac{(\overline{a}-2c_m+c_d)^2}{9b} + \frac{(\overline{a}-2c_d+c_m)^2}{9b}. \tag{B.2}$$

Since

$$\frac{2\alpha^4V^4\beta^2+\beta^6-\beta^4\alpha^2V^2}{2(\alpha^2V^2+\beta^2)^2} = \frac{\beta^2\left[(\beta^2-\sqrt{2}\alpha^2V^2)^2+(2\sqrt{2}-1)\beta^2\alpha^2V^2\right]}{2(\alpha^2V^2+\beta^2)^2} \tag{B.3}$$

$$> 0, \tag{B.4}$$

a sufficient condition for condition (B.6) is

$$\frac{(\overline{a}-c_j)^2}{4b} > \frac{(\overline{a}-2c_m+c_d)^2}{9b} + \frac{(\overline{a}-2c_d+c_m)^2}{9b}. \tag{B.5}$$

When the technology transfer is perfect, $c_j = c_m$ and the above condition simplifies to

$$\frac{(\overline{a}-c_m)^2}{4} > \frac{(\overline{a}-2c_m+c_d)^2+(\overline{a}-2c_d+c_m)^2}{9}. \tag{B.6}$$

Define $\varphi(c_d) \equiv [(\overline{a}-2c_m+c_d)^2+(\overline{a}-2c_d+c_m)^2]/9$. Since $\varphi'(c_d) = (10c_d-2\overline{a}-8c_m)/9$ and $\varphi''(c_d) \equiv 10/9 > 0$, $\varphi(c_d)$ is strictly convex in c_d and is U-shaped. Furthermore, $\varphi'|_{c_d=c_m} = 2(c_d-\overline{a})/9 < 0$ and $\varphi|_{c_d=c_m} = 2(\overline{a}-c_m)^2/9 < (\overline{a}-c_m)^2/4$. Thus, the inequality (B.6) is satisfied at $c_d = c_m$.

It can also be shown that, $\varphi'|_{c_d=(\overline{a}+c_m)/2} = (\overline{a}-c_m)/3 > 0$ and $\varphi|_{c_d=(\overline{a}+c_m)/2} = (\overline{a}-c_m)^2/4$, which is the left hand side of (B.6). However, from assumption 1 , we have $c_m < c_d < (\overline{a}+c_m)/2$. Thus from the shape of the $\varphi(c_d)$ function it follows that $\varphi < (\overline{a}-c_m)^2/4$ for all $c_d \in [c_m, (\overline{a}+c_m)/2]$. □

Appendix C: Proof of Proposition 4

Define $\phi(c_d) \equiv (\overline{a}-2c_m+c_d)^2/9+(\overline{a}-2c_d+c_m)^2/9-(\overline{a}-c_j)^2/4-\beta^4/2(\alpha^2V^2+\beta^2)$. Following the proof of proposition 3, it follows from (B.5) that the MNC would prefer IJV to duopoly competition if and only if $\phi(c_d) < 0$.

It is easy to verify that

$$\phi(c_d)|_{c_d=c_m} = -(\overline{a}-c_m)^2/36 - [2\alpha^4V^4\beta^2+\beta^6-\beta^2\alpha^2V^2]/2(\alpha^2V^2+\beta^2)^2 < 0.$$

Moreover, the function also has the following property:

$$18\phi'(c_d) = [-4+9(1-\theta)]\overline{a} - [16+9\theta(1-\theta)]c_m + [20-9(1-\theta)]c_d, \tag{C.1}$$

$$18\phi''(c_d) = [20-9(1-\theta)] > 0. \tag{C.2}$$

Thus, the function $\phi(c_d)$ is strictly convex and is either monotonically increasing or U-shaped. Moreover, since the maximum possible value for c_d is $(3a_0 - \overline{a} + 2c_m)/4$ and an increase in the value of θ decreases the value of $\phi(c_d)$ for every level of c_d, if we can show that $\phi(c_d)|_{c_d=(3a_0-\overline{a}+2c_m)/4,\ \theta=0} < 0$, then $\phi < 0$ for all admissible values of θ and c_d and we can say that the MNC will always prefer IJV to duopoly competition. In fact, we have

$$\phi(c_d)|_{c_d=(\overline{a}+c_m)/2,\ \theta=0} = \frac{3(\overline{a}-c_m)^2}{16} - \frac{\beta^4}{2(\alpha^2V^2+\beta^2)} \tag{C.3}$$

From equation (C.3), there exists a value of β, $\widetilde{\beta}$, such that $\phi(c_d)|_{c_d=(\overline{a}+c_m)/2,\ \theta=0} < 0$ when $\beta > \widetilde{\beta}$ but $\phi(c_d)|_{c_d=(\overline{a}+c_m)/2,\ \theta=0} > 0$ when $\beta < \widetilde{\beta}$. Further, $\widetilde{\beta}$ is increasing in $3(\overline{a}-c_m)^2/16$ and α^2V^2. Therefore, the condition $\beta > \widetilde{\beta}$ is a sufficient condition for the MNC to prefer IJV over duopoly competition always. If $\beta < \widetilde{\beta}$, then by continuity, there must a critical value of c_d, $\tilde{c}_d$, such that IJV is preferable to the MNC if $c_d \leq \tilde{c}_d$, and duopoly is preferable if $\tilde{c}_d \leq c_d \leq (\overline{a}+c_m)/2$. Moreover, since $\phi(c_d)$ decreases with θ for every c_d, $\tilde{c}_d$ increases with θ and as θ is sufficiently large $\tilde{c}_d$ becomes inadmissible (greater than $(\overline{a}+c_m)/2$). $\square$

7 Appendix D: Proof of Proposition 6

The MNC's maximization problem is (30) subject to constraints (31) and the credit constraint, $T < W$. Therefore, the Lagrangian of the MNC's problem is the following:

$$\begin{aligned}\pounds &= s[\overline{R}_j + s\alpha^2V^2 - (F-(1-s)\beta^2)] + T - s^2\alpha^2V^2/2 + \lambda_2\{W-T\} \\ &\quad \lambda_1\{(1-s)[\overline{R}_j + s\alpha^2V^2 - (F-(1-s)\beta^2)] - (1-s)^2\beta^2/2 - T - \overline{\pi}_d\},\end{aligned} \tag{D.1}$$

where λ_2 is the Lagrangian multiplier for the credit constraint. Then the first order conditions are the following:

$$\pounds_s = [\overline{R}_j + s\alpha^2V^2 - F + (1-2s)\beta^2)] + \lambda_1[(1-2s)\alpha^2V^2 - \overline{R}_j + F - (1-s)\beta^2)] = 0, \text{ and} \tag{D.2}$$

$$\pounds_T = 1 - \lambda_1 - \lambda_2 = 0. \tag{D.3}$$

When $\lambda_1 = 0$, $\lambda_2 = 1$ from equation (D.3), which implies $T = W$. From equation (D.2),

$$s = \frac{\overline{R}_j - F + \beta^2}{2\beta^2 - \alpha^2V^2}. \tag{D.4}$$

From equation (D.4), $s \leqslant 1$ requires $\beta^2 > \alpha^2V^2 + \overline{R}_j - F$. From constraint (31), $\lambda_1 = 0$ requires $W < \underline{W}$. Further, $d\pounds/dW = \lambda_2 = 1$ suggests that the MNC's profit increases as W increases.

8 Appendix E: Proof of Proposition 7

From Appendix D, when $\lambda_1 > 0$ and $\lambda_2 > 0$, both the credit constraint and constraint (31) are binding binding, i.e., $T = W$ and

$$(1-s)[\overline{R}_j + s\alpha^2V^2 - (F - (1-s)\beta^2)] - (1-s)^2\beta^2/2 - W = \overline{\pi}_d. \tag{E.1}$$

Equation (E.1) determines the MNC's optimal share of profit in this case. The fact $\lambda_1 > 0$ and $\lambda_2 > 0$ requires $T^* > W > \underline{W}$.

Differentiation of equation (E.1) provides

$$\frac{ds}{dW} = -\frac{1}{\overline{R}_j + (2s-1)\alpha^2V^2 - F + (1-s)\beta^2}. \tag{E.2}$$

It can shown that $ds/dW > 0$ when $s = \alpha^2V^2/(\beta^2 + \alpha^2V^2)$ and $s = (\overline{R}_j - F + \beta^2)/(2\beta^2 - \alpha^2V^2)$. Further, $\overline{R}_j + (2s-1)\alpha^2V^2 - F + (1-s)\beta^2$ is monotone in s. Therefore, $ds/dW > 0$ always holds.

9 Appendix F: Proof of Proposition 8

We consider the MNC's preference for IJV for a given contract–$\{s = 1, T = -\overline{\pi}_d\}$. It can be easily verified that the proposed contract satisfies all constraints. Notice that the proposed contract provides a lower bound of the MNC's profit from the joint venture, because it is implementable but may not be optimal.

The MNC prefers the proposed contract to duopoly competition if

$$[\overline{R}_j + \alpha^2 V^2 - F] - \alpha^2 V^2/2 - \overline{\pi}_d \geqslant \pi_m, \text{ or} \tag{F.1}$$

$$\overline{R}_j \geqslant R_m + \overline{R}_d.. \tag{F.2}$$

Since $\overline{R}_j \geqslant R_m + \overline{R}_d$ as shown in Appendix D, the MNC always prefers the proposed joint venture contract to duopoly competition. Therefore, we can conclude that the MNC always prefers a joint venture to duopoly competition even when the credit market is imperfect.

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