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Joint Venture Instability and Monitoring

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Abstract

In this paper we build a theory of joint venture formation and instability based on synergy and monitoring. We find that monitoring problems may prevent the joint venture from forming at all. Moreover, joint venture formation usually involves over-monitoring, and *ex post* could involve cheating by one, or both the firms. It is also possible that joint venture formation leads to zero monitoring by both the firms. We demonstrate that faced with the possibility of over-monitoring, firms may choose to under-invest in improving the input quality. We also develop some testable implications of our theory.

Key words: Joint venture, over-monitoring, under-monitoring, under-investment.
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1 Introduction

For less developed countries (LDCs) pursuing a policy of liberalization, joint ventures are of great interest. This is because for the LDCs joint ventures are an important source of foreign direct investment. Even otherwise, joint ventures have attracted a lot of attention recently. This interest has been sparked by the dramatic increase in the rate of joint venture formation over the last few decades.[1]

Much of the literature, however, focuses on joint venture formation.[2] In this paper, on the other hand, we are interested in the issue of joint venture instability. Typically, joint ventures are quite unstable.[3] Evidence on joint venture instability is well documented. Killing (1982), for example, shows that out of the 37 joint ventures studied by him 36 per cent performed unsatisfactorily. In another study Kogut (1988) finds that out of the 92 joint ventures studied, about half broke up by the sixth year. In the Indian context there are several recent cases of joint venture breakdown, including those between Proctor and Gamble and Godrej, General Electric and Apar, Tata Sons and Unisys, to name a few.

Some salient features of these breakdowns are worth mentioning.

Joint venture breakdowns, for example, are often accompanied by a lack of partner rapport.[4] This lack of rapport can take either of two forms.

[1]For example, Hergert and Morris (1988) demonstrates that the number of US-EEC joint ventures increased from 5 to around 200 between 1979 and 1985. Pekar and Allio (1994) show that since 1985 the rate of alliance formation has increased at an annual rate of more than 25 per cent.

[2]Papers dealing with joint venture formation include, among others, Al-Saadon and Das (1996), D'Aspremont and Jaquemin (1988), Bardhan (1982), Chan and Hoy (1991), Chao and Yu (1996), Choi (1993), Combs (1993), Das (1998, 1999), Katz (1986), Marjit (1991), Purakayastha (1993), Roy Chowdhury (1995), Svejnar and Smith (1986) etc.

[3]We refer the readers to Beamish (1985) and Gomes-Casseres (1987) for surveys on joint venture instability.

[4]In a study of four firms with lots of joint venture experience, Lyles (1987) found that

Often there are allegations of interference in each others activities and even of outright cheating. In fact, even in joint ventures that ultimately succeed such allegations abound. To quote Beamish and Inkpen (1995) "owners of joint ventures ...can and will disagree on just about everything." In a few cases, however, exactly the reverse happens with a severe lack of communication between the partner firms. Littler and Leverick (1995), for example, argues that an important reason behind joint venture failures is the lack of frequent consultations between partners.[5]

While disagreements among partners can be caused by many factors, one oft mentioned point of contention is the supply of inputs by the parent firms to the joint venture. In fact, Shaughnessy (1995) argues that "one of the most serious problems with a partnership arises when one or more parties supply the venture with product or services. There is a tendency for companies entering partnerships to see a special opportunity in becoming a supplier to the new venture." In their study of joint ventures Miller *et al* (1996) also find that the supply of inputs is one of the factors that lead to conflicts among the parent firms. In fact, such opportunistic behavior is an important manifestation of the control problems that make joint ventures problematic to manage.[6]

One way to mitigate such opportunistic behavior would be to monitor the activities of the partner firms. In fact, Devlin and Bleackley (1988) suggest that one of the key features behind joint venture success is to monitor the progress of the alliance on a regular basis. With monitoring of course, it is easy to see why allegations of cheating and interference may arise.

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lack of partner rapport was one of the key reasons behind joint venture conflicts and instability. Managers also state that the potential for disagreement is one of the costs of joint ventures (see Gomes-Casseres (1987)).

[5]Given these problems it is no wonder that several authors, e.g. Cullen *et al* (2000), stress that development of trust is a possible solution to the problem of joint venture instability.

[6]See Miller *et al* (1996) for discussions on control problems.

In the light of the above discussion it is of some importance to develop a theory of joint venture instability that could incorporate these features. While there has been some recent work on joint venture breakdowns,[7] the existing literature fails to accomodate these aspects of joint venture instability. In this paper we make a modest beginning in this respect.

To begin with we develop a theory of joint venture formation based on synergy among the partner firms. In international joint ventures between a foreign multinational and a domestic firm, the MNC usually provides the superior technology, management knowhow, capital, access to finance etc., while the domestic firm provides a knowledge of local conditions, access to distribution channels etc.[8] Even in joint ventures among MNC firms synergy is an important reason.[9] Thus if a joint venture forms, then the venture firm can produce much more efficiently compared to either one of the parent firms.

Consider a joint venture where one of the partner firms, say firm 1, can supply a given input, call it capital, and the other firm, say firm 2, can supply another given input, call it labor. Both labor and capital are required for production. Synergy is formally modelled by assuming that firm 1 cannot supply labor and firm 2 cannot supply capital. To begin with, both the partner firms have a given cost of supplying the inputs. The parent firms are re-imbursed their input costs out of the gross joint venture profits. By spending some non-verifiable effort costs (e), however, both the partner firms

[7]Some of the papers to address this issue include Kabiraj (1997), Mukherjee and Sengupta (2001), Roy Chowdhury and Roy Chowdhury (1999, 2001) and Sinha (2001).

[8]See, for example, Miller *et al* (1996). In the Indian alliance between Hewlett and Packard (HP) and HCL in computers, for example, HP hoped for a quick access to the Indian market, while HCL hoped to utilize HP's competence in business processes, production and quality maintenance (Business India (1992)).

[9]The classic example in this context is the joint venture between GM and Toyota in the USA, where GM hoped to access cutting edge technology from Toyota, while Toyota hoped to obtain a quick access to the US labour market, distribution channels, as well as an existing factory cite.

can learn to supply the respective inputs more cheaply. The basic conflict in our model arises because the non-verifiability of the effort costs implies that both the parent firms can claim that the input costs are high (and thus claim a greater amount as input costs), even though these may be actually low. This moral hazard problem creates an incentive to cheat.

Given the fact that both the firms may cheat, both the firms would have an incentive to monitor its partner's activities. The idea of monitoring is formally modeled as follows. Consider the case where the j-th firm have learnt the cheaper technology. Now the i-th firm can spend some non-verifiable amount in monitoring the input costs of firm j, when, with some probability, firm obtains verifiable evidence regarding the actual supply cost of firm j. In case firm i is successful in monitoring, it can ensure that firm j is re-imbursed exactly its input costs from the joint venture. Otherwise, firm j can claim re-imbursements at the higher level, even though its costs are actually lower.

Joint venture formation also requires some fixed investments. We assume that the parent firms have no cash-in-hand so that this amount must be raised from an outside bank, to be repaid later after profits are realized. We say a joint venture is stable if it meets its debt obligations, otherwise we say that it fails. The goal of this paper is to study the links between joint venture instability, financial considerations and monitoring problems.

We now briefly summarize our main results.

We begin by showing that under some parameter values there is a multiplicity of equilibria in the monitoring subgame. One possible equilibrium involves a zero level of monitoring by both the firms, whereas the other equilibrium involves positive levels of monitoring. We then argue that under some parameter configurations monitoring problems may prevent the joint venture from forming at all. There are two possible reasons. First, the positive monitoring equilibrium may involve over-monitoring in the sense that the parent firms make a loss. Second, there may be a problem of under-monitoring in the sense that even under the positive monitoring equilibrium the bank fails to recoup its costs.

For some parameter values of course the joint venture forms. In this case the subgame perfect Nash equilibrium involves a positive level of monitoring. Moreover, there is over-monitoring in the sense that there are lower levels of monitoring such that the bank would make the loan and joint venture formation would be feasible. This formalizes the notion that there is too much interference by the parent firms in each others activities. Moreover, whenever at least one of the parent firms fails to monitor successfully, *ex post* the outcome involves cheating by one or both the parent firms. In that case one or both the parent firms over-charge for the inputs. Also the joint venture fails to meet its debt obligations and is liquidated. Interestingly, even when a joint venture forms there is a basic conflict of interest among the joint venture and the parent firms. The payoffs of the parent firms are greater when the joint venture fails (in the sense that it fails to meet its debt obligations), compared to the case where the joint venture does succeed in meeting its debt obligations.

We then demonstrate that if we allow for coordinated equilibria in the monitoring subgame then the zero monitoring outcome can arise as an equilibrium phenomenon. In this case the joint venture is dissolved as it cannot repay its debts. This formalizes the notion that some joint ventures involves too little interaction among the parent firms, leading to dissolution.

We then argue that under some parameter values the outcome can involve under-investment in the sense that faced with the possibility of over-monitoring, only one of the firms invests in e, while the other firm does not. The intuition is simple. The firm that does not invest in e not only saves on e, but also saves on monitoring costs since monitoring costs are lower compared to the case where both the firms invest in e.

Finally, we turn to some comparative statics analysis. We find that joint venture instability increases with the size of the moral hazard effect if the gross return from the project is large. For small values of the project, however, the moral hazard effect does not affect the probability of success. Moreover, an increase in the gross return from the project increases joint venture stability, while an increase in the interest rate increases joint venture instability. This is a testable implication of our theory.

We then relate our paper to the existing literature on joint venture breakdown. In a series of papers Roy Chowdhury and Roy Chowdhury (1999, 2001) provide a theory of joint venture breakdown based on the idea of synergy and organizational learning. With time, organizational learning reduces the value of the synergistic gain, thus leading to breakdown. Kabiraj (1997) shows that a joint venture firm may breakup because a third firm, which is not part of the joint venture, becomes more efficient. Mukherjee and Sengupta (2001) and Sinha (2001), on the other hand, examine the linkages between joint venture breakdown and sequential liberalization. While these papers are clearly important, they fail to account for several of the salient features regarding joint venture breakdowns.

2 The Model

Two firms, firm 1 and firm 2, form a joint venture. Firm 1 supplies one unit of capital and firm 2 supplies 1 unit of labor to the joint venture. Firm 1 cannot supply labor and firm 2 cannot supply capital. We assume that both labor and capital are required for production, so that neither of these two firms can produce by itself. The synergistic effect provides a rationale as to why the joint venture forms at all.[10] The gross revenue from the joint venture is R.

[10]Instead of assuming that firm 1 cannot supply labour, and firm 2 cannot supply capital, we can instead assume that firm 2 can supply labour more cheaply compared to firm 1, and firm 1 can supply capital more cheaply compared to firm 1. This formulation, however, does not lead to any additional insights.

To begin with, firm 1 can supply capital at a cost of r per unit and firm 2 can supply labor at a cost of w per unit. For simplicity we assume that $r = w = a$. Both the firms, however, can spend an amount e with a view to reducing the costs of supplying the inputs. Whether a firm spends e or not is observable, but not verifiable. If firm 1 incurs e, then the cost of supplying capital decreases to r', and if firm 2 incurs this cost, then the cost of supplying labor decreases to w'. For simplicity we again assume that things are symmetric, so that $r' = w' = b$, where $b < a$.

Even though the amount e is spent or not is non-verifiable, the i-th firm can monitor firm j and gather some information regarding the actual input costs of firm j. If firm i decides on a level of monitoring m_i (≤ 1) then, with probability m_i, it obtains verifiable information regarding the input costs of the other firm, i.e. whether it is a, or b. The cost of monitoring at a level m is $f(m)$ for both the firms. The level of monitoring is observable, but non-verifiable.

We assume that $f(m)$ satisfies the following assumption.

Assumption 1.

(i) $f(m)$ is thrice differentiable, increasing and convex, i.e. $f'(m) > 0$ and $f''(m) > 0$.

(ii) $f(0) = f'(0) = 0$.

(iii) $f'(1) > \frac{R-2b-i}{2}$.

(iv) $f'''(m) > 0$.

Note that assumptions 1(i) and 1(ii) are standard. Assumptions 1(iii) and 1(iv) are mainly technical in nature and ensure the existence of interior solutions under various scenarios.[11]

The joint venture requires a fixed investment of 1 dollar. We assume that none of the firms have any cash at hand, so that this amount must be

[11] An example of an $f(m)$ that satisfies assumptions 1(i), 1(ii) and 1(iv) is m^3.

raised from the capital market (for ease of reference called the bank from now on). The rate of interest is i, where $i > 1$.

The bank and the two firms play a four stage game.

Stage 1. The bank decides whether to make the loan of 1 dollar to the joint venture or not.

Stage 2. Both the firms simultaneously decide whether to spend an amount e in effort costs towards reducing its own input supply costs or not.

Stage 3. The firms simultaneously decide on their level of monitoring m_i, where $m_i \in [0, 1]$.

Stage 4. Production takes place and joint venture profits are realized. Out of the gross payoff, R, input costs (i.e. the partner firms) are paid out first, and then the bank is re-paid (to the extent possible). Any remaining profit is equally divided among the two firms.[12]

The gross payoff R is distributed in the following manner. If none of the firms invests in e, then they both spend a on their respective inputs and obtains a as well. Now suppose firm i spends e in effort costs. Then its cost of supplying the input gets reduced to b. If the other firm is successful in its monitoring efforts then firm i obtains b as input costs, otherwise it obtains a.

In order to focus on the interesting case we assume that the parameter values satisfy the following assumption.

Assumption 2.
(i) $1 > R - 2a > 0$.
(ii) $R - 2b - i > 0$.

The assumption that $1 > R - 2a > 0$ implies that if, out of the gross payoff R, both the parent firms are paid a as input costs then the bank

[12] Given the symmetric nature of the model it is natural to assume that the profit sharing rule is symmetric as well.

gets some of its money $(R-2a)$ back, but fails to break even. Whereas the assumption that $R-2b-i>0$ ensures that if both the parent firms are paid b as input costs then the bank is re-paid in full, and the joint venture has a positive level of profits.

We first write down the payoffs of the partner firms in stage 4. There are several cases to consider.

Case 1. First consider the case where both the firms invest in e and both are successful in their monitoring efforts. In that case both the parent firms are re-imbursed the amount b, which is their actual input cost. The net joint venture profit after paying out the input costs and repaying the bank loan is $R-2b-i$. Note that under assumption 1(ii) this is strictly positive. Thus the payoff of the two parent firms (gross of effort costs e and monitoring costs) is

$$\frac{R-2b-i}{2}. \tag{1}$$

Case 2. Next consider the case where both the firms invest in e, but only one of them, say firm i, is successful in its monitoring. In that case firm i obtains a as input costs and firm j obtains b, even though input costs are actually b for both the firms. Thus firm i's gross payoff is

$$(a-b)+\max\{0,\frac{R-a-b-i}{2}\}, \tag{2}$$

and that of firm j is

$$\max\{0,\frac{R-a-b-i}{2}\}. \tag{3}$$

The payoff of the bank is $\min\{i,R-a-b\}$.[13]

Case 3. Next consider the case where both the firms invest in e, but both fail in their monitoring efforts. In that case they both obtain a as re-imbursements of their input costs. The gross payoff of both the firms is

[13]From assumption 2(i) it follows that $R-a-b>R-2a>0$.

given by

$$(a-b)+\max\{0,\frac{R-2a-i}{2}\}, \tag{4}$$

and that of the bank is

$$R-2a.^{14} \tag{5}$$

Case 4. Next consider the case where firm i alone invests in e and firm j succeeds in its monitoring. Then both the firms have a gross payoff of

$$\max\{0,\frac{R-a-b-i}{2}\}, \tag{6}$$

and the payoff of the bank is

$$\min\{i,R-a-b\}. \tag{7}$$

Case 5. Finally consider the case where firm i alone invests in e and firm j fails to monitor. In that case firm i has a gross payoff of

$$(a-b)+\max\{0,\frac{R-2a-i}{2}\}, \tag{8}$$

firm j has a gross payoff of

$$\max\{0,\frac{R-2a-i}{2}\}, \tag{9}$$

and the bank has a payoff of

$$R-2a. \tag{10}$$

3 The Analysis

We solve for the subgame perfect Nash equilibrium of this game. As usual this involves solving the game backwards. We consider the two cases where $R-a-b \leq i$ and $R-a-b > i$, separately.

[14]This follows since from assumption 2(i) we can write $0 < R-2a < 1 < i$. Hence $\min\{i, R-2a\} = R-2a$.

In this sub-section we consider the case where $R - a - b \leq i$.

We begin by solving for the stage 3 monitoring game.

Case 1. First consider the subgame where both the firms have invested in e in stage 2. Recall that m_i denotes the monitoring level of firm i. The net profit of the i-th firm is given by

$$m_i m_j (\frac{R-2b-i}{2}) + m_i(1-m_j)(a-b) + (1-m_i)(1-m_j)(a-b) - f(m_i) - e. \tag{11}$$

Thus the reaction function of the i-th firm is given by

$$f'(m_i) = m_j(\frac{R-2b-i}{2}). \tag{12}$$

Clearly, any equilibrium must be symmetric.[15]

It is easy to see that the monitoring subgame has two different equilibria.

Zero monitoring equilibrium: Given that $f'(0) = 0$ its clear that the strategy vector (m_1, m_2), where $m_1 = m_2 = 0$, constitutes an equilibrium. In that case the net profit of both the firms is

$$a - b - e, \tag{13}$$

and the bank has a payoff of $R - 2a < 1$.

Positive monitoring equilibrium: There is an equilibrium where both the firms monitor at the level $\hat{m}$, where $\hat{m}$ is the unique $m > 0$ satisfying the equation[16]

$$f'(m) = m(\frac{R-2b-i}{2}). \tag{14}$$

It is easy to see that $\hat{m}$ is increasing in R, and decreasing in both b and i.

[15]Suppose to the contrary there is an equilibrium where, say, $m_1 > m_2$. Then

$$m_2(\frac{R-2b-i}{2}) = f'(m_1) > f'(m_2) = m_1(\frac{R-2b-i}{2}).$$

Hence, $m_2 > m_1$, a contradiction.

[16]Note that existence follows since $f'(1) > \frac{R-2b-i}{2} > f'(0) = 0$, and uniqueness follows from the fact that $f'(m)$ is strictly increasing and convex.

In this equilibrium the net profit of both the firms is given by

$$\hat{m}^2(\frac{R-2b-i}{2}) + (1-\hat{m})(a-b) - f(\hat{m}) - e. \tag{15}$$

Next let $B(m)$ denote the expected payoff of the bank under a symmetric equilibrium where both the firms monitor at the level m. Hence

$$B(m) = m^2 i + 2m(1-m)(R-a-b) + (1-m)^2(R-2a) - 1. \tag{16}$$

It is clear that there is an unique m^* such that $B(m^*) = 0$.[17]

Case 2. Next consider the case where only one of the firms, say firm 1, has invested in e in stage 1. Note that firm 2's profit from monitoring is given by

$$m_2 \max\{0, \frac{R-a-b-i}{2}\} + (1-m_2)\max\{0, \frac{R-2a-i}{2}\} - f(m_2) = -f(m_2).^{18} \tag{17}$$

Thus optimally firm 2 does not monitor. Hence in this case firm 1 has a net profit of $a-b-e$, firm 2 has a net profit of 0 and the bank has a payoff of $R-2a-1<0$.

We are now in a position to write down our first proposition.

Proposition 1. *Assume that* $R-a-b \leq i$.

(i) If $\hat{m}^2(\frac{R-2b-i}{2}) + (1-\hat{m})(a-b) - f(\hat{m}) - e < 0$, *then the bank makes no loan and the joint venture does not form at all.*

(ii) If $\hat{m}^2(\frac{R-2b-i}{2}) + (1-\hat{m})(a-b) - f(\hat{m}) - e \geq 0$ *and* $\hat{m} < m^*$, *then the bank makes no loan and the joint venture does not form at all.*

(iii) If $\hat{m}^2(\frac{R-2b-i}{2}) + (1-\hat{m})(a-b) - f(\hat{m}) - e \geq 0$ *and* $\hat{m} \geq m^*$, *then the unique equilibrium involves the bank making the loan, both the firms investing in* e *and monitoring at the level* $\hat{m}$.

[17] Existence follows since $B(1) = i-1 > 0$ and $B(0) = R-2a-1 < 0$, and uniqueness follows since $B'(m) = 2[m(i-R+2b)+a-b] > 0$.

[18] Note that here we use the fact that $R-a-b \leq i$, to conclude that $R-2a < R-a-b \leq i$ so that the first two terms in the L.H.S. of equation (17) equal zero.

The formal proof can be found in the appendix.

The intuition is as follows. Note that the bank breaks even (i.e. joint venture formation is feasible) only if both the firms invest in e and they both monitor at the level $\hat{m}$. In all other cases the bank fails to break even and does not make the loan at all.

If $\hat{m}^2(\frac{R-2b-i}{2}) + (1-\hat{m})(a-b) - f(\hat{m}) - e < 0$, then monitoring is too costly in the sense that the firms make losses under the positive monitoring equilibrium. Thus the equilibrium cannot involve a positive level of monitoring and the joint venture cannot form.

If $\hat{m}^2(\frac{R-2b-i}{2}) + (1-\hat{m})(a-b) - f(\hat{m}) - e \geq 0$, then the firms break even when they both monitor at the level $\hat{m}$. However, if $\hat{m} < m^*$ then even at the positive monitoring equilibrium the bank makes a loss, i.e. $B(\hat{m}) < 0$. Thus in this case also joint venture formation is not feasible.

Finally, if $\hat{m}^2(\frac{R-2b-i}{2}) + (1-\hat{m})(a-b) - f(\hat{m}) - e \geq 0$ and $\hat{m} \geq m^*$, then at the level $\hat{m}$ the bank, as well as the firms break even. Thus joint venture formation is feasible. Note that in this case there is over-monitoring in the sense that the equilibrium level of monitoring is greater than what is required to ensure that the banks break even.

Note that conditional on a joint venture forming, the probability that the joint venture succeeds in meeting its debt obligations is given by $\hat{m}^2$. Thus the probability of joint venture success is increasing in R and decreasing in both b and i. Thus joint venture breakdowns are more likely if the interest rate is high. This is interesting because there is some anecdotal evidence that during the mid-1990s, a tighter money policy led to greater joint venture instability in India.[19] Interestingly for this range of parameter values, the size of the moral hazard effect i.e. $a-b$ does not seem to affect the degree of joint venture stability. Moreover, greater is a, i.e. greater the moral hazard effect, greater are the chances that a joint venture is going to form.

[19] See Ghosh (1996).

Let us now examine the *ex post* payoffs of the two firms under Proposition 1(iii). Note that in case both the parent firms are successful in monitoring the joint venture succeeds in repaying its loans in full and has a positive net payoff. In all other cases the joint venture fails to meet its debt obligations. Thus one would say that the joint venture succeeds if and only if both the parent firms succeed in monitoring. A look at the net profits of the parent firms, however, tell a different story. If both the firms succeed in monitoring then both their payoffs is $\frac{R-2b-i}{2} - f(m) - e$. Whereas if, firm i, say, fails then firm j's payoff is $a - b - f(m) - e$. Clearly, $\frac{R-2b-i}{2} - f(m) - e > a - b - f(m) - e$. Thus the parent firms' payoffs are larger in the states where the joint venture fails to meet its debt repayment obligations. Hence it appears that even when the joint venture forms there is a basic conflict of interest between the joint venture and the parent firms.

We then provide an example to show that Proposition 1 is not vacuous.

Example 1. (i) Let $R = 6, a = 3, b = 1, i = 2$, $e = 1$ and $f(m) = \frac{m^3}{3}$. In this case $\hat{m} = 1$, so that $\hat{m}^2(\frac{R-2b-i}{2}) + (1-\hat{m})(a-b) - f(\hat{m}) - e = -1/3 < 0$. Thus this example satisfies the hypotheses of Proposition 1(i).[20]

(ii) Let $R = 4, a = 2, b = 1, i = 2$, $e = 0.5$ and $f(m) = \frac{m^3}{3}$. In this case $\hat{m} = 0$, so that $\hat{m} < m^* = 1/2$. Moreover, $\hat{m}^2(\frac{R-2b-i}{2}) + (1-\hat{m})(a-b) - f(\hat{m}) - e = 0.5 > 0$. Thus the hypotheses of Proposition 1(ii) is satisfied.

(iii) Let $R = 6, a = 3, b = 1, i = 2$, $e = 1/3$ and $f(m) = \frac{m^3}{3}$. In this case $\hat{m} = 1$. Since $m^* < 1$, $\hat{m} > m^*$. Moreover, $\hat{m}^2(\frac{R-2b-i}{2}) + (1-\hat{m})(a-b) - f(\hat{m}) - e = 1/3 > 0$. Thus this example satisfies the hypotheses of Proposition 1(iii).

From Proposition 1 we find that the zero monitoring case does not arise in any subgame perfect equilibrium. We now argue that if we allow the

[20]In this example, as well as in the later ones, assumptions 1(ii) and 2 are sometimes satisfied weakly, rather than with a strict inequality. It is straightforward to modify the examples to make them conform to the assumptions exactly.

monitoring strategies to be coordinated, then the zero monitoring case can also arise as an equilibrium phenomenon.

Suppose the parameter values are such that $\hat{m}^2(\frac{R-2b-i}{2}) + (1-\hat{m})(a-b) - f(\hat{m}) - e \geq 0$ and $\hat{m} \geq m^*$. Let the parent firms use some coordinating device to coordinate their strategies so that they play the positive monitoring equilibrium with probability μ, and the zero monitoring equilibrium with probability $1-\mu$. For μ close to 1, we can use Proposition 1(iii) and continuity to argue that these strategies constitute an equilibrium.

In this sub-section we consider the case where $R-a-b>i$. We show that in this case there may be an under-investment problem in the sense that there may be an equilibrium where only one of the firms invests in e.

We again use backwards induction to solve for the equilibrium. Consider the monitoring subgame where only one of the firms, say firm i, has invested in e in stage 2. Clearly, firm j's payoff is given by

$$m_j(\frac{R-a-b-i}{2}) - f(m_j). \tag{18}$$

Thus the first order condition is

$$\frac{R-a-b-i}{2} = f'(m_j). \tag{19}$$

Letting $\tilde{m}$ denote the solution of the above equation we can write down the payoffs of firm i and firm j respectively as follows:

$$\begin{aligned} I(\tilde{m}) &= \frac{\tilde{m}(R-a-b-i)}{2} + (1-\tilde{m})(a-b) - e, \quad (20)\\ X(\tilde{m}) &= \frac{\tilde{m}(R-a-b-i)}{2} - f(\tilde{m}). \quad (21)\end{aligned}$$

Next consider the payoff of the bank. Clearly, if firm j monitors at the level m, then the payoff of the bank is

$$B(m) = im + (1-m)(R-2a) - 1. \tag{22}$$

Given that $R-2a-i<0$, $B(m)$ increasing in m. Moreover, $B(m'')=0$, where $m'' = \frac{1-R+2a}{i-R+2a} < 1$.

We then consider the monitoring subgame where both the firms have invested in e in stage 2. Then in the monitoring subgame firm i's net profit is given by

$$m_i m_j(\tfrac{R-a-b-i}{2}) + m_i(1-m_j)[a-b+\tfrac{R-a-b-i}{2}]$$
$$+(1-m_i)(1-m_j)(a-b) + (1-m_i)m_j\tfrac{R-a-b-i}{2} - f(m_i) - e. \quad (23)$$

Clearly the first order condition is that $(1-m_j)\frac{R-a-b-i}{2} = f'(m_i)$. Assuming a symmetric solution, the first order condition can be written as

$$(1-m)\frac{R-a-b-i}{2} = f'(m). \quad (24)$$

Note that in this case no zero monitoring equilibrium exists. Let the equilibrium level of monitoring be m''' and the net profit of both the firms be $Y(m''')$.

Comparing equations (19) and (24) it is easy to see that $m''' > \tilde{m}$. Thus monitoring costs are higher if both the firms invest in e.

We can now write down conditions under which there is an under-investment equilibrium that involves only one of the firms investing in e.

Proposition 2. *Suppose that $I(\tilde{m}) \geq 0$, $X(\tilde{m}) \geq \max\{0, Y(m''')\}$ and $\tilde{m} \geq m''$. The unique equilibrium leads to an outcome where the bank makes the loan, only one of the firms invests in e and the other firm monitors at the level $\tilde{m}$.*

It is sufficient to note that under these parameter conditions the firms as well as the bank have non-negative payoffs. Moreover, the condition that $X(\tilde{m}) \geq Y(m''')$ ensures that firm j has no incentive to invest in e in stage 2. This condition also ensures that the outcome where both the firms invests in e cannot be an equilibrium.

The intuition is simple. Compared to the outcome where both the firms invest in e, firm j has two advantages. First, of course it can save on the effort cost e. Second, the monitoring level is also lower so that firm j can save on monitoring costs as well. Thus we can say that if both the firms invest in e there is over-monitoring, leading to under-investment in the first place.

In this case the probability that the joint venture succeeds in meeting its debt obligations is given by $\tilde{m}$. Hence the probability of joint venture success is increasing in R and decreasing in a, b and i. Thus in this case also joint venture breakdowns are more likely if the interest rate is high. For this range of parameter values, however, an increase in the moral hazard effect i.e. $a - b$ increases joint venture instability. The effect of an increase in $a - b$ on the incentive for joint venture formation is, however, ambiguous.

We then provide an example to show that Proposition 2 is not vacuous.

Example 2. Suppose that $R = 6, a = 2.5, b = 1.5, i = 1,$[21] $e = 0.64$ and $f(m) = \frac{m^3}{3}$. In this case $\tilde{m} = 0.7071$ so that $I(\tilde{m}) = 0.006$ and $X(\tilde{m}) = 0.2323$. Moreover, $m'' = 0$, so that $\tilde{m} \geq m''$. Finally, $m''' = 0.5$, hence $Y(m''') = 0.19 < X(\tilde{m})$. Thus the hypotheses of Proposition 2 are satisfied.

4 Conclusion

In this paper we build a theory of joint venture instability that seeks to formalize the informal stories regarding interference and cheating in joint ventures.

We find that monitoring problems may prevent the joint venture from forming at all. Moreover, joint venture formation usually involves over-monitoring, and could involve cheating by one, or both the partner firms. We can interpret this over-monitoring as formalizing the idea that there is too much interference by the partner firms in each others activities. Joint venture formation could also involve zero monitoring by both the firms, so

[21] To be precise we should write $i = 1 + \epsilon$, where ϵ is very small.

that there is too little communication among the partner firms. We then demonstrate that faced with the possibility of over-monitoring, firms may choose to under-invest in improving the input quality. Finally, we develop the testable hypothesis that while an increase in the interest rate increases joint venture instability an increase in the gross return from the joint venture decreases it.

5 Appendix

Proof of Proposition 1. We begin by arguing that making the loan is only feasible when both the firms invest in e.

First consider the case where only one of the firms invest in e. Then, from the argument in case (2) in sub-section 3.1, we know that there is no monitoring and the bank fails to break even.

Also, if none of the firms invest in e then the bank has a payoff of $R - 2a - 1 < 0$. Thus in neither of these two cases can the bank break even.

(i) Suppose that the bank makes the loan. If both the firms invest in e then, given the condition that $\hat{m}^2(\frac{R-2b-i}{2}) + (1-\hat{m})(a-b) - f(\hat{m}) - e < 0$, the monitoring subgame cannot involve the positive monitoring equilibrium. Thus there is no monitoring and the bank fails to break even.

Hence it is optimal for the bank not to make the loan at all.

(ii) Again suppose that the bank makes the loan. Then there is under-monitoring in the sense that whenever both the firms invest in e the bank makes a loss even if the monitoring level is $\hat{m}$. This follows since $\hat{m} < \tilde{m}$.

Hence it is optimal for the bank not to make the loan at all.

(iii) Suppose that the bank makes the loan. Then the outcome where both the firms invests in e, and monitors at the level $\hat{m}$ constitutes an equilibrium. Since $\hat{m}^2(\frac{R-2b-i}{2}) + (1-\hat{m})(a-b) - f(\hat{m}) - e \geq 0$, the firms make a positive level of profits. Moreover, since $\hat{m} \geq m'$, the bank also breaks even.

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