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JOINT VENTURE INSTABILITY:

A LIFE CYCLE APPROACH

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Abstract: Joint ventures represent one of the most fascinating developments in international business. In the last few decades, the rate of joint venture formation has accelerated dramatically. Nowadays joint ventures are much more widespread and occur in industries like telecommunications, biotechnology etc. At the same time, however, it must be noted that joint ventures are very unstable. In this paper we survey the phenomenon of joint venture instability. We draw on the relative recent theoretical literature on joint venture instability to provide a unified explanation of joint venture life-cycles, formation, as well as breakdown. Further, we do this for both research oriented, as well as production joint ventures.

Key words: Joint ventures, formation, breakdown, synergy, moral hazard, learning.

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1. Introduction

Joint ventures represent one of the most fascinating developments in international business.

In the last two decades, the rate of joint venture formation has accelerated dramatically.¹ Earlier, joint ventures were concentrated mainly in the extractive industries like mining etc. There has also been a change in the nature of industries where joint ventures are prevalent. Nowadays joint ventures are much more widespread and occur in industries like telecommunications, biotechnology etc.

At the same time, however, it must be noted that joint ventures are very unstable.² Killing (1982) surveyed 37 international joint venture and found that 36 % of them performed unsatisfactorily. Kogut (1989) studied a sample of 92 U.S. based joint ventures and found that by the sixth year about half of them had terminated their relationships. McKinsey did a worldwide survey of more than 200 alliances. Median time span of joint ventures was found to be seven years only. In more than 80% of the cases, it ends up with one partner selling its share to the other. Thus while the rate of joint venture formation is large, so is the rate of breakdown.

In this paper, we make an attempt to understand this phenomenon. While there has been a considerable body of work that examines joint venture formation, joint venture breakdown has received much less theoretical attention.³ Moreover, the existing work largely treats joint venture formation and joint venture breakdown as two separate phenomena.

In this essay we take the viewpoint that joint venture formation and breakdown are driven by the same forces. Thus what is required is a theory of joint venture life-cycles, a framework that is capable of explaining both joint venture formation and breakdown.

The rest of this paper is organized as follows. In the next section we discuss some salient facts regarding joint venture formation. Section 3 discusses some of the empirical features of joint venture instability. In section 4 we develop a life-cycle theory of research joint ventures. Section 5 does the same for production oriented joint ventures. Finally, in section 6 we briefly discuss some non-life cycle theories of joint venture breakdown.

¹ See Hergert and Morris (1988) and Pekar and Allio (1994), among others, for recent studies on joint venture formation.

² See Beamish (1985), and Gomes-casseres (1987), for surveys of prior research on joint venture instability.

³ Studies on joint venture formation include Al-saadon and Das (1996), D'asprenont and Jacquemin (1988), Bardhan (1992), Chao and Yu (1996), Choi (1993), Combs (1993), Das (1998, 1999), Dasgupta (1999), Kabiraj and Marjit (1993), Katz (1986), Marjit (1990, 1991), Purkayastha (1996), Ray Chaudhuri (1995, 1997a, 1997b), Roy Chowdhury (2000), Roy Chowdhury *et al* (1999a), Svejnar and Smith (1986) etc.

2. Some Stylized Facts

We begin by discussing some stylized facts regarding joint ventures. We focus on two classes of joint ventures, R&D based joint ventures and production oriented joint ventures. It appears that while in the developed countries R&D based joint ventures are more common, in LDCs most joint ventures focus on production and marketing.

We begin by considering joint ventures between firms from developed nations.⁴ The majority of these collaborations are between partners from EEC countries. Among the EEC countries, the French firms appear to be the most active. The Japanese firms were comparatively less active in joint ventures. The scenario, however, is changing now, with Japanese firms becoming more active.

Coming to the industries concerned we find that most of the joint ventures are concentrated in high technology fields like aerospace (19%), computers (14 %), motor vehicles (23.7 %), telecommunication (17.2 %), etc. These ventures are characterized by two factors, emphasis on R&D and production for the world market. In most such ventures product development in some form or other seems to be the major objective. Hergert and Morris (1988) find that among joint ventures studied by them 37.7% involve just product development, 16.8 % involve both product development and production, while 23.3 % involve only production.

In contrast joint ventures in less developed countries (either among firms from LDCs, or among an MNC partner and an LDC partner) are mostly involved in production and marketing. There is very little original R&D. Whatever little R&D is done is aimed at modifying existing products to domestic conditions.

We then discuss some of the reasons behind the emergence of joint ventures. We first mention some generic factors leading to joint venture formation, before discussing the reasons that are specific to R&D, or production oriented joint ventures. The generic reasons can be classified under two categories, strategic and government policies.

1. Strategic: Sometimes joint ventures are formed simply to reduce competition. These are known as defensive joint ventures. Joint ventures may also be aimed at increasing the market power of joint ventures firms. This allows the joint venture firm to out-compete the other competing firms. Such ventures are known as offensive joint ventures.

2. Government Policies: Because of government policies penetration of foreign markets often requires joint venture formation with local firms:

- a. Government policies sometimes explicitly require foreign firms to have at least one domestic partner.
- b. Government policies may also dictate that at least some components of a complex good be produced domestically. Since licensing out these technologies to domestic

⁴ This paragraph as well as the subsequent one is based on Hergert and Morris (1988).

firms may involve a possible loss of control over such technologies, foreign firms may prefer to form joint ventures where it can hope to retain greater control of the technology.

Government policy can encourage joint venture formation indirectly as well. One important reason for forming joint ventures is to avoid policy uncertainties like expropriation, sudden tax hikes, reversal of liberalisation policies etc.⁵

We then discuss some reasons that are specific to R&D oriented joint ventures. In fact globally one of the characteristics of joint ventures appear to be their emphasis on research and technological development. {See Mowery and Rosenberg (1989)}.

1. Increased cost of doing R&D: Cost of doing R&D has escalated dramatically in recent decades, especially in high technology fields like commercial aircraft, telecommunications computers and microelectronics. Let us quote a few figures. The development cost of Douglas DC-3, introduced in the 1930s, was slightly more than 3 million dollars. In contrast, Boeing-747, developed in the 1970s ran to 1 billion dollars, while the development cost of Boeing-767 was around 1.5 billion dollars.

The problem has been exacerbated by the phenomena of technological convergence, whereby different technologies are required for the development of single product. As examples of such technological convergence we can mention the growing importance of bio-technology in pharmaceuticals, interdependence of telecommunications and computer technologies, etc. Such technological convergence forces the firms to develop expertise in all the relevant fields, thus pushing up costs.

2. Decrease in demand: As product demand for high technology goods become more homogeneous, the share of world demand coming to any one particular country has fallen. Moreover, the lifecycle of various products have been shortened dramatically, so that firms have only a short while to exploit a new product before it is replaced by another. This also decreases the demand of any particular product.

Both the above factors imply that profitability in high technology fields is decreasing. A joint venture can help in restoring profitability in two ways. First, it can make an ally out of a potential competitor, and, second, it can spread the costs, as well as the risk of failure among the partners.

We then turn to joint ventures in LDC countries. While most of the reasons are equally applicable to joint ventures between firms from LDCs, and those between an MNC and an LDC firm, for ease of exposition we shall talk mostly of international joint ventures.

For MNCs the most important contributions by its domestic partner is the country specific factors that it can supply, e.g. knowledge of local markets, local legal systems and customs, local reputations, politics, marketing and distribution channels etc. From the LDC partners point of view they treat joint venture as a vehicle of getting access to

⁵ Marjit (1990) provides a theoretical model of this idea.

MNC's superior process and product technology, international reputation, finance, managerial know-how etc.⁶ Thus one of the main reasons behind such joint ventures appear to be the synergistic gains that the parent firms gain from collaborating with each other.

3. Joint Venture Instability

One of the unarguable facts about joint ventures is that they are prone to frequent breakdowns. Let us mention some well-known examples of joint venture instability in the Indian context. The joint venture between DCM and Daewoo was formed to manufacture light commercial vehicles i.e., the Cielo. Initially the project was a success, but then Daewoo decided to buyout DCM. Another well-known example involves the joint venture between Procter and Gamble and Godrej. The objective was to market Cinthol and other Godrej products, as well as the international products of Procter and Gamble. The joint venture, however, has broken up now. Other examples include the breakup between Tata Sons and Unisys. Unisys has set up a wholly owned subsidiary in India and has sold off its 40% holding to Tata sons.⁷

We begin by discussing some general problems associated with joint ventures that may lead to their breakups.

- (i) **Problems related to MNCs:** Business perspectives of a large MNC are likely to be different from that of a family owned business from LDCs.
- (ii) **Export rights :** MNCs do not want the joint venture to export into their own markets, whereas for the LDC partner exporting may be a main reason for going into the joint venture.
- (iii) **Tax issues :** MNCs may use transfer pricing to show less profit in the joint venture if taxes in the domestic country are very high. However, this clearly not in the interest of the domestic partner.
- (iv) **Dividend and investment policies :** MNCs may prefer dividends to reinvestment in the joint venture itself, since it may want the profits for re-investment elsewhere.

⁶ See Miller *et al* (1996).

⁷ For descriptions of these and other cases we refer the reader to Bhandari (1996-1997), Business India (1992, 1996) and Ghosh (1996).

- (v) **Ownership and control problems** : The initial contract may involve sourcing from the MNC partner. However, with time cheaper sources of raw material may become available leading to conflicts.
- (vi) **Technology utilization** : The joint venture may be obliged to buy all its technology from the MNC partner. Again with time alternative sources of technology may become available, leading to conflicts.
- (vii) **Learning** : The worth of the contribution made by the partners may change. For example the MNCs often take LDC partners for their country specific knowledge. With time, however, the value of such contribution may fall as the MNC learns the ropes themselves.

We then mention some reasons for joint venture instability that are specific to India. One contributing factor is that Indian firms are unable, or unwilling to put up their share of the cash when new investment opportunities come up. Debt is very expensive with the Reserve bank of India following a tight money policy. Moreover, during the early 90s many Indian companies had invested in unprofitable ventures due to the easy financial conditions then prevalent. This also created a situation where liquid cash was not available. As a result the foreign partners pressurizes their Indian partners to increase their stake in the joint ventures, leading to instability.

In addition, returns in India are often better than that abroad. For example, while advertising industry is growing by (2-3)% abroad its growing by (25-30)% in India. This would encourage the MNC firms to either buyout their partners, or to open subsidiaries.

Moreover, there is often a clash of objectives between the foreign firms and their Indian partners. While the foreign firms come to India with a long-term vision willing to make initial losses for long term profits, Indian firms in contrast want immediate profits. This leads to a clash in their plans, necessitating the foreign firms either to set up wholly owned subsidiaries, or get controlling stakes in the joint ventures.

Another problem is that in joint ventures Indian partners have a weaker position than is generally thought.

- (i) The main contribution of the Indian partner is a knowledge of Indian conditions. With time, however, the value of such contribution falls as the foreign firm gets to know the local conditions.
- (ii) Indian brands are often thought to be valuable, atleast by the Indian firms themselves. However, these brands are often regional in nature and may not fit with the international plans of the MNC.

Having discussed some of the possible reasons behind joint venture formation as well as breakdown, we then put together some of these elements to develop a theory of joint venture life cycles.

4. Instability in Research Joint Ventures

In this section we develop a simple model of instability in research oriented joint ventures. (This section draws heavily on Roy Chowdhury *et al* (1996)). Following our basic approach we look for an explicitly dynamic story capable of explaining joint venture formation as well as breakdown. The dynamics arises out of the learning-by-doing aspects of R&D activity. (Wright (1936) was the first to observe the learning-by-doing effect in the U.S. airframe industry). We examine a duopoly model of joint product development between two identical firms where the alternative to joint research is competitive R&D. The game consists of an infinite number of periods. At the start of every period the firms decide whether to opt for competitive or cooperative R&D, and then depending on their decisions select their effort levels. The probability of success depends on the current effort levels of the two firms, as well as their experience where the experience level is again a function of the past effort levels. Hence the learning-by-doing effect enters via the experience level which acts as a dynamic link between the various periods.

4.1. The Static Model

We first describe the basic cooperative and non-cooperative games as developed in Ray Chaudhuri (1995).

First consider the case of cooperative R&D. There are two firms, firm 1 and firm 2, jointly trying to develop a product. If they succeed they receive a gross payoff of $2R$, which they share equally. We can interpret the joint venture as a pure research venture, which, in case of success, sells the product for a price of $2R$. In case of failure the firms get nothing despite incurring development costs.

The firms simultaneously decide on their effort levels. The effort levels are non-verifiable and cannot be contracted upon. One basic reason is the difficulty of separating out the individual effort levels under any joint scheme. In the joint research context, an additional complexity arises since the quality of the scientists assigned to a project would be known only to the firm themselves. Thus there is a free-rider problem and we must solve for a Nash equilibrium of the cooperative game.

We then introduce some notations. Let the cost function of the two firms be denoted by $e_i^2/2$, where e_i denotes the effort level of the i -th firm. The probability of success is given by the return function $\min(1, e_1 + e_2)$.⁸

We then solve for the Nash equilibrium of the cooperative game. Clearly, the profit function of the two firms are given by

$$\min(1, e_1 + e_2)R - e_i^2/2, \quad i=1,2. \quad (1)$$

Clearly, the first order condition is given by

$$R = e_i, \quad i=1,2. \quad (2)$$

Clearly this game has a unique equilibrium in effort level. Moreover, the equilibrium profit level of both the firms is given by $3R^2/2$.

We then consider the case where the firms compete in the R&D phase. Assume that the gross payoff of a firm in case it succeeds and the other firm fails is $2R$. Otherwise the payoff of a firm is zero. Clearly, the competitive payoff of the i -th firm is given by

$$\min(1, e_i)(1 - \min(1, e_j))2R - e_i^2/2, \quad i \neq j. \quad (3)$$

Clearly, the first order conditions are given by

$$(1 - \min(1, e_j))2R = e_i, \quad i \neq j. \quad (4)$$

We can again argue that a unique and interior equilibrium exists. The equilibrium profit level of both the firms $D(E) = 2R^2 / (1 + 2R)^2$. The main result from the static analysis is as follows.

Proposition 1. *There exists R' such that whenever $R > R'$, the profit from joint product development exceeds that from competitive R&D.*

Proof. See Ray Chaudhuri (1995).

The result is quite intuitive. For large values of $2R$, free-riding problems are not very severe. The joint venture firms therefore have a sufficient incentive to invest and the probability of success is high. Under competitive R&D, however, a large value of $2R$ implies that both the firms over-invest. Not only does this reduce the individual success probabilities, but increases the cost levels as well. Hence the result follows.

Finally, let us note that we can use this one period model to address some policy issues. Ray Chaudhuri (1999 and 1997a) examine some issues relation to joint ventures between firms from developing and developed countries.

⁸ Note that for expositional purpose we adopt the simplest possible cost and return functions. Both Ray Chaudhuri (1995) and Roy Chowdhury *et al* (1996) allow for more complex cost and return functions.

One important policy question refers to the optimal equity share of the foreign firm in a joint research venture. Ray Chaudhuri (1999) examines this question in the context of a research venture between a domestic firm and a more efficient foreign firm. He shows that the profit share of the foreign firm is increasing in the relative efficiency of the foreign firm, as well as the weight given to consumers' surplus in the social welfare function. Moreover, the first best outcome can be implemented through an appropriate scheme.

Another important policy question refers to the quality of technology transferred by foreign firms under licensing contracts or in joint ventures. It is often argued that foreign firms transfer an inefficient level of technology, either because the domestic market is small, or because of strategic reasons. Ray Chaudhuri (1997a) examines a model of joint product development between firms from developing and developed countries, where, in the first stage the firms endogenously choose their level of technology. If firms from the developed countries are technologically more advanced, then Ray Chaudhuri (1997a) demonstrates that they choose the most advanced technology available to them. In fact it is the firms from developing countries that may have an incentive to choose inefficient technologies. Both these results challenge notions that are well established in the literature.

Roy Chowdhury (1997b) examines the argument that because of dynamic gains from research joint ventures should be treated leniently under anti-trust legislation compared to usual joint ventures or mergers. The treaty of Rome, concerned with the prohibition of collusion, explicitly takes such trade-off into account and offer some exemptions for technology oriented joint ventures. The National Cooperative Research Act of 1984 in the U.S.A. also allows for such preferential treatment. Roy Chowdhury (1997b) demonstrates, however, that the probability of success is lower under a joint venture compared to that under competitive R&D. Moreover, the social surplus under a joint venture may also be lower. These results seriously challenge the conventional wisdom in this respect.

Finally one may ask if Proposition 1 goes through in a dynamic framework, or if there are cost uncertainties. Ray Chaudhuri (2000a) shows, among other things, that Proposition 1 is robust to a dynamic version of the above model (without any learning-by-doing effects). While Ray Chaudhuri (2000b) examines the robustness of this result if there is some uncertainty with respect to the cost parameters.

4.2. The Dynamic Model

In this sub-section we consider an infinite horizon version of the above model where time is discrete and continues forever so that we can write $t = 1, 2, \dots$. We also assume, for simplicity, that the discount factor of both the firms is zero. This assumption allows us to abstract from the standard repeated games kind of considerations and allows us to focus on the learning-by-doing aspects of the problem.

To begin with we consider the case of joint product development. The learning-by-doing effect enters the analysis via an experience variable E , so that the joint probability of success is given by $\min(1, E+e_1+e_2)$, where e_1 and e_2 represent the present effort level of the two firms. Thus the cooperative profit level in any period is given by

$$P_i(E, e_1, e_2) = \min(1, E+e_1+e_2)R - e_i^2/2, \quad i=1,2. \quad (5)$$

Clearly, the first order condition is given by

$$R = e_i, \quad i=1,2. \quad (6)$$

Thus we can solve for the equilibrium effort levels $e_1 = e_2 = R$. Hence the effective effort level in any period is given by $E+e_1+e_2 = E+2R$.

If $P(E)$ denotes the equilibrium profit levels of both the firms then

$$P(E) = ER + 3R^2/2 \quad (7)$$

is also increasing in E .

If E' denotes the effective effort level in any period, then the experience level in the next period is assumed to be $\mu E'$, where μ lies in the interval $(0,1)$. For $\mu = 0$ there is no learning-by-doing and the firms are effectively playing a new game in every period. For $\mu = 1$ on the other hand there is no loss of memory. We focus on the intermediate case where there is some degree of learning-by-doing, as well as some memory loss. Let the function $f(E)$ denote the next period's experience level as a function of the next period's experience level, where

$$f(E) = \mu(E+2R). \quad (8)$$

It is easy to see that $f(E)$ is increasing in E and has a slope less than 1. Hence it has a unique fixed point

$$E^* = 2\mu R / (1 - \mu). \quad (9)$$

Let us note one important implication of the above results. Consider the case where competitive R&D is ruled out by fiat and only cooperative R&D is allowed. Since $f(E)$ has a slope less than one, the fixed point E^* acts as a global attractor for the experience

level under cooperative R&D. Thus whenever, the experience level is less than E^* , it gradually *increases* towards E^* , where as if it is less than E^* , the experience level *decreases* towards E^* . Actually of course the firms can opt for either form of R&D and we have to check if it is individually rational for firms to opt for cooperative R&D.

We then consider the case of competitive R&D. Assuming that both the firms have the same level of experience E , the payoffs of the firms are

$$D_i(E, e_1, e_2) = \min(1, E+e_i)(1-\min(1, E+e_j))2R - he_i^2, \quad i \neq j. \quad (10)$$

We can again use a reaction function approach to solve for the Nash equilibrium of this game. This yields the equilibrium effort level as a function of the level of experience, i.e. $e' = e'(E)$. Moreover, the equilibrium profit levels

$$D(E) = 2R(1-E)[E+R+ER] / (1+2R)^2. \quad (11)$$

We can then define the function $g(E)$ which yields the next period experience level of both the firms as a function of the common experience level in the current period

$$g(E) = \mu(E+2R) / (1+2R). \quad (12)$$

Again it is straightforward to argue that $g(E)$ is increasing in E and has a fixed point

$$E^{**} = 2\mu R / 1 - \mu + 2R. \quad (13)$$

Again if cooperative ruled out by fiat then E^{**} as a global attractor for the experience level under competitive R&D.

Clearly, $E^{**} < E^*$.

The following proposition is the main result of this section and highlights the essential instability associated with research joint ventures. We require two more notations before we can write down the proposition. Let E_1 and E_2 represent, respectively, the minimum and maximum E such that $D(E) = P(E)$.

Proposition 2. *Let parameter values be such that $P(0) > D(0)$ and $D(E)$ be greater than $P(E)$ for some E . Moreover, let μ be such that $E^{**} < E_1 < E^* < E_2$. Then there is a locally stable cycle of two periods where the firms alternate between joint product development and competitive R&D.*

Proof. See Roy Chowdhury *et al* (1996).

The result can be intuitively explained as follows. Given that $P(0) > D(0)$, initially it is profitable to opt for joint product development. This would generate an experience stream E^1, E^2 etc. whose values gradually *increase* towards E^* . However, given that $E_1 < E^*$, after some periods we have that $E_1 < E^i < E_2$ and competitive R&D becomes more profitable compared to joint product development. Thus there is regime switch and the firms now opt for competitive R&D. Note, however, that now the experience level is greater than E^{**} . Thus the experience level now starts *decreasing* towards E^{**} . Thus after some periods the experience level again falls below E_1 . Hence there is again a regime switch and the firms opt for joint product development. Thus we have an intrinsically unstable system where the firms switch between joint product development and competitive R&D forever. What the proposition demonstrates is that under some conditions this process converges to a limit cycle of period 2.

Our analysis also leads to the following insight regarding the impact of a change in R on the outcome. For low values of R we find that the firms pursue competitive R&D to start with. If, however, success is not forthcoming and the rate of learning is high enough then after a few periods the firms switch to cooperative R&D. Furthermore, the firms continue to pursue cooperative R&D until success occurs. For intermediate values of R however, this pattern is reversed. Here the firms begin by pursuing joint product development, switching over to competitive R&D if success proves elusive. Thus in this case the joint venture breaks up not because it fails, but because the partner firms are too successful in building up relatively high levels of experience. Furthermore, under certain parameter configurations the firms can cycle, and even alternate in successive periods between joint product development and competitive R&D.

The impact of a change in μ is also complex. While for low values of the payoff an increase in learning-by-doing effects provide an incentive for joint product development, for intermediate values the effect is just the opposite. In that case joint ventures may break up because they are too successful in acquiring experience via learning-by-doing.

5. A Life-cycle Theory of Production Joint Ventures

We then develop a life cycle theory for production oriented joint ventures. The theory developed here relies on three basic building blocks: *synergy*, *organizational learning* and *moral hazard*.⁹

1. *Synergy* arises out of the complimentary competencies of the two partners firms. As discussed earlier, in case of joint venture involving a foreign multinational (MNC) and a domestic firm (specially from LDC) it appears that usually the MNC provides the superior technology, while the domestic firm provides a knowledge of local conditions, access to local distribution channel etc. In the Indian context, in the alliance between

⁹ This model is a simplified version of Roy Chowdhury *et al* (2001).

Hewlett and Packard (HP) and HCL in computers, HP hoped for a quick access to the Indian market, while HCL hoped to utilize HP's competencies in business processes, production and management (see Business India '92). In this paper synergy is formalized through the assumption that the MNC can supply capital relatively cheaply, while the domestic firm has cheaper access to labor.

2. *Organizational learning*, whereby the partner firms in a joint venture may acquire the other firms' competencies, provides the second building block of our theory. In order to keep things simple we assume learning is both sided and symmetric.¹⁰ Thus after learning occurs, the MNC can supply labor more cheaply than before, while the domestic firm can supply capital more cheaply.

3. *Moral hazard*, whereby we assume that inputs levels are not contractible, forms the third component of this theory. Thus if a joint venture forms, then the partner firms cannot write a contract over the quantities of the inputs to be supplied. Hence, both the firms have an incentive to free ride on the other, leading to a coordination cost for the joint venture.¹¹

Das (1998) also consider the role of moral hazard in joint ventures. He argues that in the presence of policy moral hazard on the part of the host government joint venture formation emerges as the preferred option. Das (1999) examines the choice among alternative modes of foreign investment, wholly owned subsidiary, joint ventures and licensing. The model is driven by moral hazard and difference in risk attitude. He finds that the riskiness of the project is a factor against the joint venture option. Moreover, in the absence of policy intervention the licensing option is dominated by either the joint venture or the subsidiary option, whereas if there is anticipation of policy intervention then licensing may emerge as the preferred option.

We consider a dynamic two period model, consisting of two firms, an MNC and a domestic firm. In every period the firms decide, whether to form a joint venture, or to compete over output levels. If in period 1, a joint venture forms, then the firms learn to internalize each others competencies. Therefore, both the firms become more efficient in the second period. If however, the firms decide to pursue Cournot competition in the first period, then there is no learning.

This game can be solved using the solution concept of subgame perfection, which, in this context, is nothing but backward induction.

We begin by briefly discussing the model.

¹⁰ Roy Chowdhury *et al* (2000b) discuss a model with asymmetric learning.

¹¹ Roy Chowdhury *et al* (1999a) discuss a model with exogenous costs of joint venture formation.

There are two firms, one multinational (denoted by firm 1) and one domestic (denoted by firm 2) who can either form a joint venture or compete (over quantities) in the domestic market. Domestic demand (q) is linear in the level of price (p) :

$$q = a - p. \quad (14)$$

We formulate a two period model, where every period is again sub-divided into two stages.

Stage 1: The firm decides sequentially whether to opt for a joint venture or to compete over quantities (*a la* Cournot). Firm 1 moves first and can either choose one of the two options. This is followed by firm 2, performing the same way. A joint venture forms only when both firms agree, otherwise there is Cournot competition.

Stage 2: If both the firm I and firm 2 opt for joint venture formation, then they simultaneously decide on how much input to supply to the joint venture. In case the two firms opt for Cournot competition, they simultaneously decide on their output levels q_1 and q_2 . Let β denote the common discount factor of the two firms where $0 < \beta < 1$. There are two factors of production capital (K) and labor (L). The production function of both the firms are taken to be identical and of the Cobb-Douglas kind:¹²

$$q = (KL)^{1/2}. \quad (15)$$

Let the per unit wage and rental cost for the MNC be W_m and R_m and that for the domestic firm be W_d and R_d where

$$R_m < R_d \text{ and } W_m > W_d. \quad (16)$$

Equation (3) captures the notion that the MNC is more efficient in supplying capital, whereas the domestic firm is more efficient in supplying labor. Given the production function it is standard to show that the cost function of the I-th firm is of the form $2(W_I R_I)^{1/2} q_i$. Furthermore, we assume that the game is entirely symmetric, so that

$$R_m = W_d = c \text{ and } R_d = W_m = b. \quad (17)$$

Next assume that if a joint venture forms in the first period, then learning takes place, so that the firms internalize some of the skills of their partners. Thus in period 2 the firms can supply the factors of production more cheaply. If β represents the common learning parameter for both the firms, then in the second period the per unit wage cost of the MNC is taken to be βW_d and the per unit rental cost of the domestic firm is taken to be βR_m ,

¹² For expositional purposes we restrict attention to the simplest possible demand and production functions. Roy Chowdhury *et al* (2000a) consider more general demand and cost functions.

where $b/c > \square > I$. Notice that, if $\square = I$, then there is complete learning, whereas if $\square = b/c$, then there is complete learning.

Under a joint venture the MNC supplies capital and the domestic firm supplies labour to take advantage of the synergistic effects. Because of moral hazard problems, however, the partner firms cannot write a contract over the amounts of labour and capital. The contract can only specify that the gross profit is to be equally divided among the two firms, the input costs being borne by the firm that supplies the input. Thus the profit function of the two firms under a joint venture are as follows:

$$J_1 = \frac{1}{2}[a-(KL)^{1/2}](KL)^{1/2}-R_mK, \quad (18)$$

$$J_2 = \frac{1}{2}[a-(KL)^{1/2}](KL)^{1/2}-W_dL. \quad (19)$$

We can solve for the Nash equilibrium of this game using a reaction function approach. Letting \underline{J} denote the net profit of both the firms in equilibrium

$$\underline{J} = a(a-4c)/8. \quad (20)$$

Cournot Competition. We then consider the outcome under Cournot competition. There are two different cases depending on whether learning has taken place or not.

We first consider the case where learning had not taken place. Clearly the profit functions of the I -th firm is given by

$$P_I = (a-q_1-q_2)q_I-2(bc)^{1/2}q_i, \quad i=1,2. \quad (21)$$

A standard reaction function argument shows that the equilibrium profit level of the two firms are given by

$$\underline{P} = [a-2(bc)^{1/2}]^2 / 9. \quad (22)$$

We then consider the case where there is learning. The profit function of the I -th firm is now given by

$$Q_I = (a-q_1-q_2)q_I-2cq_i, \quad I=1,2. \quad (23)$$

The equilibrium profit level of the two firms in this case

$$Q = [a-2\mu^{1/2}c]^2 / 9. \quad (24)$$

Note that $\underline{P} < Q$, which reflects the fact due to learning marginal costs are lower in the second case. We can now solve for the subgame perfect Nash equilibrium of this game. Clearly, there are three possible cases

- (1) $\underline{P} < \underline{Q} < \underline{J}$
- (2) $\underline{P} < \underline{J} < \underline{Q}$ and
- (3) $\underline{J} < \underline{P} < \underline{Q}$.

We solve for case (2), the arguments for the other two cases are similar. As is usual in finite horizon games, subgame perfection reduces to backwards induction. Consider the game in period 2. Given the parameter values there is going to be Cournot competition if there was joint venture formation in period 1, otherwise a joint venture is going to form in period 2. Let us now consider the game in period 1. Cournot competition in period 1 is going to be followed by joint venture formation in period 2. Thus the expected profits are going to be $\underline{P} + \delta \underline{J}$. Similarly joint venture formation in period 1 is going to be followed by Cournot competition in period 2 when the expected profits are $\underline{J} + \delta \underline{Q}$. Thus in period 1 the firms opt for a joint venture if and only if

$$\underline{J} + \delta \underline{Q} > \underline{P} + \delta \underline{J}. \quad (25)$$

Given the parameter conditions this is always going to be satisfied. Thus in this case there is going to be joint venture formation followed by breakdown. The intuition behind joint venture breakdown is as follows.

Notice that a joint venture enjoys two advantages vis-à-vis Cournot competition. First, it can exploit the synergistic effect. Second, there is no rent dissipation due to quantity competition. On the other hand, a joint venture has the disadvantage that, because of moral hazard problems, both the firms supply less than the optimal amount of inputs. For ease of exposition assume that the discount factor $\delta = 0$. Suppose that initially parameter conditions are such that the advantages of joint venture formation outweigh the moral hazard costs. Then a joint venture forms in the first period. Now organizational learning takes place. Therefore both the firms become more efficient. Hence the value of the synergistic gain declines. It is now possible that the moral hazard cost outweighs the beneficial effects. Hence breakdown takes place.

In case (1) we can similarly argue that the outcome involves stable joint venture formation. Whereas in case (3), depending on the parameter values, there can be either joint venture formation followed by breakdown, or Cournot competition in both the periods.

Summarising the above discussion we obtain the main result of this section.

- Proposition 3.** (i) *If $\underline{P} < \underline{Q} < \underline{J}$, then there is stable joint venture formation.*
(ii) *If $\underline{P} < \underline{J} < \underline{Q}$, then there is joint venture formation followed by breakdown.*
(iii) *If $\underline{J} < \underline{P} < \underline{Q}$ and $\underline{J} + \delta \underline{Q} \geq \underline{P}(1 + \delta)$, then there is joint venture formation followed by breakdown. If, however, $\underline{J} < \underline{P} < \underline{Q}$ but $\underline{J} + \delta \underline{Q} < \underline{P}(1 + \delta)$, then there is Cournot competition in both the periods.*

Thus depending on parameter values the outcome may involve any one of the following: stable joint venture formation, joint venture formation followed by a breakdown, or Cournot competition in both the periods. Thus we provide an integrated theory of joint venture life cycle that seeks to explain both the formation, as well as breakdown of joint venture firms.

Coming to comparative static results we find that greater the demand parameter ' a ', greater are the chances that a joint venture is going to form and that it is going to be stable. Thus if the demand level is very high then a stable joint venture forms. Whereas for intermediate levels of demand, there is joint venture formation followed by breakdown. Finally, for low levels of demand, there is Cournot competition in both the periods.

This provides an econometrically testable implication of our theory. There appears to be very little empirical work that seeks to relate joint venture stability to the demand conditions. The only related work is by Hladik (1985), who does find a positive relation between stability and market demand. We should mention however, that Hladik's (1985) work is in the context of R&D oriented joint ventures and thus may not be directly relevant to our theory.

The above result can be intuitively explained as follows. Straight forward calculations show that the magnitude of the moral hazard problem is independent of demand parameter ' a ', while both the synergistic and rent dissipation effects are increasing in ' a '. Thus an increase in ' a ' increases both the synergistic, and the rent dissipation effect, thus increasing the incentive to form a joint venture, as well for the joint venture to be stable.¹³

Furthermore, we find that greater is the rate of learning (i.e., the smaller is \square) greater are the chances of joint venture breakdown.

Turning to the welfare analysis we demonstrate that if the parameter values are such that the outcome involves joint venture breakdown, then such breakdown is not only profitable for the firms concerned, but is welfare improving for the consumers also. Thus joint venture breakdown welfare dominates stable joint venture formation. This result is interesting because joint venture breakdown is often presumed to be socially undesirable. The result is important from a policy viewpoint, especially for less developed countries interested fostering foreign investment via joint ventures.

We then discuss the robustness of our results to the underlying assumptions.

We begin by relaxing the assumption that the cost of joint venture formation is of the moral hazard kind. Roy Chowdhury *et al* (1999) relaxes this assumption to consider the case where joint venture formation involves an exogenous cost. Such costs may arise out

¹³ Marjit and Roy Chowdhury (2000), however, provide a theory of joint venture breakdown based on asymmetric capacity costs where they find that an increase in the demand level may lead to joint venture breakdown. See section 6 for a more detailed discussion of Marjit and Roy Chowdhury (2000).

of the different cultures of the two parent organizations. Alternatively, such costs could be attributed to the administrative costs of running a joint venture headquarter.¹⁴ An indirect evidence that costs of joint venture formation are high is provided by Hergert and Morris (1988) who find that 81% of all joint ventures involve only two firms. Joint ventures involving three or more firms are quite rare.

Roy Chowdhury *et al* (1999) find that the two main results in Roy Chowdhury *et al* (2001) go through in this model as well. First, that joint venture breakdown can be explained endogenously, and second, that an increase in the demand parameter increases joint venture stability. Thus both these results are robust to the assumption that costs of joint venture formation are of the moral hazard kind.

We then apply our theory to examine some aspects of the liberalisation process being carried out in several less developed countries including India. We consider a scenario where the less developed country is following a policy of sequential liberalisation. In India, for example, the lubricant sector has been liberalized early, while the other segments of the petroleum industry are yet to be liberalized.

We find that such a policy of sequential liberalisation can create additional incentives for joint venture formation. In fact, the lubricant industry in India provides an example where MNC firms appear to persist in doing joint ventures though the immediate prospect does not appear too alluring. This sector witnessed a lot of joint venture activity, for example those between Indian Oil and Mobil Oil, HPCL and Exxon, BPCL and Royal Dutch Shell etc. While some of these ventures have been reasonably successful (e.g. Tide Water Oil), the majority does not appear to be doing that well. In fact, some of these joint ventures have been completely marginalised in the market. Despite this joint venture breakdown has not been significant.

In the light of our theory such behavior is easily explained. In these joint ventures the partner MNC firms are also active in related industries like refining, production and marketing of diesel, petroleum etc. These segments have not yet been liberalized though further liberalization's are expected. Thus the MNCs are treating these joint ventures are mainly learning vehicles, the expectation being that the knowledge acquired through such joint ventures is going to prove useful if and when further liberalisation takes place.

The next assumption that we examine is that of a symmetric rate of learning. Roy Chowdhury *et al* (2000) relax this assumption to examine a model with differential rates of learning. In fact we assume that only the MNC partner can learn, while the domestic partner does not learn at all. Such one-sided learning may arise because the MNC technology is often patent protected, so that imitating such a technology may not be possible.¹⁵ Such differences in learning ability can also be traced to the differences in the cultures of the two firms. Kumar and Nti (1998) argue that the ability of firms to learn is related to the quality of employees, knowledge base and the incentive of the firms.

¹⁴ Dymsha (1988) suggest that such costs may be important.

¹⁵ Beamish and Inkpen (1995) also argue that learning by the local partner is much less common. See footnote 17 in Beamish and Inkpen (1995).

Moreover, the sharing rule is assumed to be exogenously given by the government. The results derived in this paper are qualitatively similar to those in Roy Chowdhury *et al* (2001). We find that the possibility of joint venture breakdown emerges endogenously. Moreover, we find that an increase in the demand parameter increases joint venture stability. Thus both these results are similar to that in Roy Chowdhury *et al* (2001) and suggests that our results are robust to the assumption that learning is symmetric.

The formulation with asymmetric learning also throws up the possibility that the outcome may involve delayed joint venture formation. The intuition is as follows. Suppose that there is joint venture formation in period 1. Under our assumption the MNC will learn at a greater rate compared to the domestic firm. Next suppose that there is joint venture breakdown in period 2 leading to Cournot competition. Since the MNC, because of differential learning, is more efficient compared to the domestic firm, the profit of the domestic firm is going to be low in this period. This is something that the domestic firm wants to avoid. Thus there will be delayed joint venture formation, with a joint venture forming only when the threat from asymmetric learning is not that large. This is an interesting result, and emerges only because of the asymmetric nature of learning process.

Ray Chaudhuri (2000) examines the incentive for joint venture formation among exporting firms. It shows that an increase in domestic demand increases the incentive for joint venture formation. An increase in world price, however, can either increase or decrease the incentive for joint venture formation.

We then briefly discuss some other theories of joint venture breakdown. The papers closest to our own are those by Kabiraj (1999), Kabiraj and Lee (2000) and Lin and Saggi (1998).

Kabiraj (1999) argues that a joint venture may break up because a third firm, not part of this joint venture, may become more efficient. This increases the competitive pressures in this industry, leading to breakdown. This paper also determines the optimal timing of breakdown. Thus the results are driven by exogenous gains in efficiency, rather than by learning.¹⁶

Kabiraj and Lee (2000), on the other hand, studies the evolution of an industry with three firms, two domestic and one foreign. They show that depending on the synergic effects various different industrial pattern may emerge. One interesting possibility is that though a joint venture forms, the composition of the joint venture changes over time.

Another related paper is by Lin and Saggi (1998). They assume that after a joint venture forms the partners decide on the type of investment. If it is complementary then synergy increases and the joint venture is stable, whereas if it is competitive then synergy decreases and there is breakdown. However, they do not allow for either organisational learning, or moral hazard problems.

¹⁶ Technically speaking the result follows from the theory of Cournot competition developed by Salant, Switzer and Reynolds (1983).

6. Other Theories of Joint venture Breakdown

Finally, for the sake of completeness, we discuss some theories of joint venture breakdown that do not adopt a life-cycle approach. Given that in this survey we do not focus on such theories, this section is selective, rather than comprehensive. We apologise to all authors whose works we fail to discuss in this section.

Marjit and Roy Chowdhury (2000) build a simple theory of joint venture breakdown based on asymmetric access to capital and an increase in the level of demand.¹⁷ Consider a situation where a joint venture between an MNC and a domestic firm from a LDC already exists. The MNC has access to cheap capital while the domestic firm has no access to capital and thus cannot open a subsidiary at all. Marjit and Roy Chowdhury (2000) then goes on to examine whether a buyout occurs or not. Whether a buyout occurs or not depends on whether the threat of opening a subsidiary is credible or not. If this threat is credible, then a buyout always occurs. For a large enough demand level the threat of opening a subsidiary is always credible, thus a buyout necessarily occurs. The key to this result lies in the asymmetric access to capital of the two firms. While opening a subsidiary firm 1 will invest the whole of the new capital in the subsidiary, thus obtaining the whole of the market profits via the subsidiary, while the joint venture only obtains a small fraction of the profits. Hence the result. Thus, in contrast to the learning based theories, this model generates the result that an increase in demand increases joint venture instability.

Kabiraj and Roy Chowdhury (2000) develop a theory of joint venture breakdown where the result is driven by the different time preferences of the partner firms regarding future payoffs. Such different time preferences among partner firms is an attempt at capturing an element of joint venture instability that is well accepted in the management literature, viz. cultural differences among an MNC and its LDC partner.¹⁸ They examine a situation where a new project becomes available to the joint venture. Because of different time preferences, however, the two parent firms value the project differently. The MNC partner, having the larger time preference, values the project more and is eager to adopt it, while the domestic partner is not willing to adopt it. In such a situation the only way to resolve this problem may be for the MNC firm to open a subsidiary, leading to joint venture breakdown.

Mukherjee and Sengupta (2000) examine a scenario with sequential liberalisation whereby a less developed country allows foreign firms to open fully owned subsidiaries. In such a situation the MNC may then bid to raise their stake in the joint venture, or failing that threaten to compete with them. They examine the incentive for opening a subsidiary vis-à-vis continuing with the joint venture. The analysis is carried out under different assumptions regarding the intensity of competition and the mode of control.

¹⁷ Empirically also both Bhandari (1996-97) and Ghosh (1996) suggest that in the context of joint venture instability a major area of dispute was that of capacity expansion.

¹⁸ Another paper that deals with this issue is Kabiraj, Lee and Marjit (2000).

They examine the cases both when investment is sunk, as well as the case when it is reversible.

Finally, Sinha (2000) also examines a model of sequential liberalisation. In the context of a developing country Sinha (2000) examines a two period model with uncertainty about government policy, as well as the possibility of imitation. The joint venture forms in response to government restrictions on subsidiary formation. It is also argued that uncertainty about government policy is an important reason why a joint venture forms in the first place. He argues uncertainty about government policy, as well as successful imitation by the domestic firm, are responsible for joint venture instability, where instability is interpreted as payoff renegotiations.

Clearly, all these papers have interesting insights to offer. All of these, however, take the existence of a joint venture as given, and then goes on to analyze joint venture instability. Hence these are all theories of joint venture breakdown, rather than joint venture life cycles.

Finally, let us briefly discuss some open questions in this area. Clearly, over the last few years considerable theoretical progress has been made. The basic idea in most models seems to be the following: Initially joint ventures are formed under certain parameter conditions. With time, however, these conditions change, either exogenously, due to demand shocks, changes in government policy etc., or endogenously, through organisational learning. It is these changes that lead to joint venture instability. Clearly, there is scope for more research in this area that examines other ways that the initial conditions may change. In fact in section 3 we identify some potential areas of conflict, namely changes in technology utilization and sourcing of raw materials. Models formalising these conflicts should prove interesting.

One important issue that has been left out from most of the theoretical literature, however, is that of control. In most papers the assumption is that the joint venture manager acts in the interest of the joint venture, rather than either of the parent firms. It may be argued, however, that depending on equity shares, the composition of the board of directors etc. the manager may give greater importance to one of the parent firms. It is generally accepted that one of the main reasons for joint venture instability is that the partner firms tries to control joint venture policies in their favour. Kabiraj and Chaudhuri (2000) make a beginning in this respect. However, even here the control structure is exogenously given. Thus a theory of joint venture instability, based on endogenously determined control structure is clearly wanted.

In conclusion we find that the phenomenon of joint venture instability is slowly beginning to attract the kind of theoretical attention that it deserves. However, till now most of the literature has failed to develop a theory of joint venture life cycles. While ignoring the issue of joint venture formation undoubtedly simplifies the analysis, we feel that by doing so many insights of interest are lost. To paraphrase Marx, it is our contention that "joint ventures contain the seeds of their own destruction." This essay has been a modest attempt at analyzing some of the reasons why that may be the case.

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