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A Note on Joint Ventures in Which Firms Contribute Complementary Inputs

by Louis Silvia

I. Introduction

The joint venture is a relatively rare type of inter-firm contract.[1] While there is no precise definition of what constitutes a joint venture contract, it is generally recognized in the law that a joint venture is usually formed to undertake a new business opportunity rather than to carry on an existing business. It is also generally recognized that a joint venture contains the following elements: (1) there is either expressed or inferred agreement among the parties, (2) there is a joint contribution of assets to the venture, (3) there is a sharing of profits (and usually losses) and (4) mutual right to control.[2]

Various sorts of efficiencies have been traditionally attributed to joint ventures.[3] It has been argued that joint ventures may allow participating firms to achieve economies of scale[4] or joint ventures may result in risk-spreading efficiencies[5], or that joint ventures may be formed to internalize benefits which firms cannot readily appropriate individually.[6]

Input complementarities between partner firms have also often been stressed as a source of efficiency in joint venturing. For example, Berg, Duncan and Friedman, probably the leading students of the joint venture among economists, stated that "managers point out that most JV's are born out of unique circumstances in which one parent has been able to take advantage of special market positions and/or new technologies of the other parent or parents.[7] Similarly, J. Paul McGrath, former head of antitrust

at the Justice Department, has noted the significance of joint ventures in bringing together complementary skills.[8]

In its simplest form, the notion of joint venture input complementarities refers to a situation where a project requires two inputs and where one partner is relatively efficient in contributing one input while the second partner is more efficient in contributing the other input. The complexity of the relevant inputs might vary greatly from case to case. On the one hand, one might hypothesize a joint venture to produce brass which is supplied by its owners, one a copper producer, the other a producer of zinc.[9] More likely, the relevant inputs will be more complex and might include technological know-how, specialized production or distribution capacity, patents or product designs.[10]

Discussions about the motivations for joint ventures have often overlooked the fact that input complementarities may be present in other types of inter-firm contracts. Moreover, the literature has been sparse in formally comparing the efficiency of the joint venture with other contract types, and it is in this regard that this note seeks to contribute to the understanding of joint ventures. This note, however, does not to attempt provide a complete explanation of why joint ventures occur, and in particular, ignores possible market power incentives for joint venture formation.

In Section II, we examine the profit possibilities in bilateral bargaining between firms having input complementarities. Part A compares a joint venture with a supply contract in which firms negotiate over input prices. Comparison of the profit possibilities for a joint venture and those for royalty agreements is made in Part B. The efficiency comparisons

with supply and royalty agreements are perhaps of particular interest to antitrust policy since these alternatives to joint venturing may be more desirable from a competition perspective since they may reduce concerns about commonality of interest between firms.

As will be shown, the profit possibilities for the contracting firms under a joint venture may be same as those under other kinds of contracts. Consequently, the existence of input complementarities is not a sufficient condition for a joint venture to be efficient relative to other contract types. As Section III concludes, this finding is consistent with relatively recent thinking on joint ventures, most notably by Broadley,[11] that transactions costs considerations are paramount in joint venture formation.

II. Comparison of Profit Possibilities under Joint Venture and Those under Supply, Royalty and Lump Sum Arrangements.

A. Comparison with a Supply Contract. Assume a competitive industry for good q, and that price p_o is the prevailing market price. Assume there is an opportunity to produce q with inputs x_1 and x_2. Firms in the industry already produce q with other inputs. Inputs x_1 and x_2 are not competitively available, but are producible by only two firms, A and B. Furthermore, Firm A is relatively more efficient in producing x_1, while Firm B is relatively more efficient in producing x_2.

The production function for q is given by $q = f(x_1, x_2)$. It is assumed that over the relevant range of input use f_1, f_2, f_{12} and f_{21} are equal to or greater than zero with the concavity requirements of $f_{11} < 0$, $f_{22} < 0$ and $f_{11}f_{22} - f_{12}^2 > 0$. It also assumed that $f(x_1,x_2)$ is subject to

(eventually) decreasing returns to scale and that no output is possible unless both inputs are present.

Both Firms A and B can produce x_1 and x_2 though not with equal efficiency. The firms could undertake the project either independently by relying on internal supply or jointly through some contractual arrangement. Further assume that output under either strategy has no appreciable effect upon market price p_o and that there are no transaction costs. Assume also that Firms A and B have limited capacities in producing x_1 and x_2 such that they are able to supply only one q-producing plant. These conditions imply that neither A or B can dominate or monopolize the industry as a result of their abilities to produce x_1 and x_2, at least within the time frame of the model.[12]

Firm A can produce x_1 at total cost $C_A(x_1)$, with $C_A'(x_1) = c_{A1}$ for x_1 between 0 and capacity. Firm A can produce x_2 at total cost $C_A(x_2)$ with $C_A'(x_2)$ and c_{A2} for x_2 between 0 and capacity. Firm B costs of producing x_1 and x_2 are $C_B(x_1)$ and $C_B(x_2)$ respectively, with $C_B'(x_1) = c_{B1}$ and $C_B'(x_2) = c_{B2}$ for x_1 and x_2 between 0 and capacity. Firm A is more efficient than B in producing x_1: for any x_1, $C_A(x_1)$ is less than $C_B(x_1)$, and further c_{A1} is less than c_{B1}. On the other hand, Firm B is more efficient in x_2: for any x_2, $C_B(x_2)$ is less than $C_A(x_2)$ and c_{B2} is less than c_{A2}.

Let us also assume that undertaking the project by relying on internal supply would yield zero profits to both firms. However, the project is profitable if the firms exploit their comparative advantage by negotiating a supply contract. Suppose Firm A offers to sell x_1 to Firm B at price r_1 per unit. Since Firm A must cover cost, r_1 must be at least as great as

c_{A1}. On the other hand, r_1 must be less than c_{B1}, since if otherwise Firm B would prefer internal supply.

The relation between the profits of A and B with alternative values of r_1 may be derived as follows. Let Π_B be B's profits in the production of q where

$$\Pi_B = P_0 f(x_1, x_2) - r_1 x_1 - r_2 x_2,$$

with $r_2 = c_{B2}$.

The partial derivative Π_B with respect to r_1 is given by

$$\frac{\partial \Pi_B}{\partial r_1} = P_0 \left(f_1 \frac{\partial x_1}{\partial r_1} + f_2 \frac{\partial x_2}{\partial r_1}\right) - \left(x_1 + r_1 \frac{\partial x_1}{\partial r_1}\right) - \left(r_2 \frac{\partial x_2}{\partial r_1}\right)$$

with $\dfrac{\partial x_1}{\partial r_1} = \dfrac{f_{22}}{P_0(f_{11} f_{22} - f_{12}^2)}$ and $\dfrac{\partial x_2}{\partial r_1} = \dfrac{-f_{12}}{P_0(f_{11} f_{22} - f_{12}^2)}$.[13]

Rearranging terms gives

$$\frac{\partial \Pi_B}{\partial r_1} = \frac{\partial x_1}{\partial r_1}(P_0 f_1 - r_1) + \frac{\partial x_2}{\partial r_2}(P_0 f_2 - r_2) - x_1 .$$

Since profit maximization requires input combination such that $(P_0 f_1 - r_1) = (P_0 f_2 - r_2) = 0$, it follows that

$$\frac{\partial \Pi_B}{\partial r_1} = -x_1 .$$

Firm A's profits as seller of x_1 is given by

$$\Pi_A = r_1 x_1 - C_A(x_1),$$

where $C_A(x_1)$ is the total cost of producing x_1 at A.

Differentiating with respect to r_1 yields

$$\frac{\partial \Pi_A}{\partial r_1} = \left(r_1 \cdot \frac{\partial x_1}{\partial r_1} + x_1\right) - c_{A1} \frac{\partial x_1}{\partial r_1} .$$

Adding $\frac{\partial \Pi_B}{\partial r_1}$ and $\frac{\partial \Pi_A}{\partial r_1}$ yields

$$\frac{\partial \Pi_B}{\partial r_1} + \frac{\partial \Pi_A}{\partial r_1} = \frac{\partial x_1}{\partial r_1} (r_1 - c_{A1}).$$

Given $\frac{\partial x_1}{\partial r_1} < 0$ and since $r_1 \geq c_{A1}$, it follows

$$\frac{\partial \Pi_B}{\partial r_1} + \frac{\partial \Pi_A}{\partial r_1} \leq 0.$$

For values of r_1 where $\frac{\partial \Pi_A}{\partial r_1} > 0$, $\frac{\partial \Pi_B}{\partial r_1} \leq \frac{-\partial \Pi_A}{\partial r_1}$. This implies a differentials ratio of

$$\frac{d\Pi_B}{d\Pi_A} \leq -1.$$

And for values of r_1 where $\frac{\partial \Pi_A}{\partial r_1} \leq 0$, it follows that

$$\frac{d\Pi_B}{d\Pi_A} \geq 0.$$

LMN in Figure one illustrates the relation between Π_A and Π_B over the range of possible r_1 values. At L, r_1 equals c_{A1}. At this point Π_B is a maximum and $d\Pi_B/d\Pi_A$ is equal to -1. Moving down LMN implies increasing r_1. Increasing r_1 reduces Π_B, and increases Π_A up to M, where in this example Π_A reaches a maximum. At N, r_1 equals c_{B1}. Here Π_B equals zero, given our previous assumption that independent entry by Firm B would result in zero profits. Since Π_A in this example reaches a maximum at M, the agreed upon level of r_1 under a supply contract for x_1 must fall between c_{A1} and that value of r_1 which maximizes Π_A. The actual agreed

value of r_1 would depend on factors outside the model such as the bargaining skills of the firms. Segment LM represents the profit possibilities in an agreement in which A supplies x_1 to B.

Alternatively, it is possible that Firm A could enter q with B supplying x_2. PQR in Figure 1 represents the profits possibilities under this agreement. Given out previous derivation of LMN, it follows that

$$\frac{\partial \Pi_A}{\partial r_2} + \frac{\partial \Pi_B}{\partial r_2} = \frac{\partial x_2}{\partial r_2} (r_2 - c_{B2})$$

and

$$\frac{\partial \Pi_A}{\partial r_2} + \frac{\partial \Pi_B}{\partial r_2} \leq 0.$$

For values of r_2 where $\frac{\partial \Pi_B}{\partial r_2} > 0$, $\frac{\partial \Pi_A}{\partial r_2} \leq \frac{-\partial \Pi_B}{\partial r_2}$. This implies a differentials ratio of

$$\frac{d\Pi_B}{d\Pi_A} \geq -1.$$

And for values of r_2 where $\frac{\partial \Pi_B}{\partial r_2} \leq 0$, it follows that

$$\frac{d\Pi_A}{d\Pi_B} \geq 0.$$

Furthermore, since q is produced with equal input costs ($r_1 = c_{A1}$, $r_2 = c_{B2}$) at points L and P, it follows that OL equals OP.

In Figure 1 it is assumed that Π_B reaches a maximum at Q. If so, the possible values of r_2 under a per unit supply contract range from c_{B2} to that value which maximizes Π_B.

It is indeterminate whether A will sell x_1 to B or whether B will sell

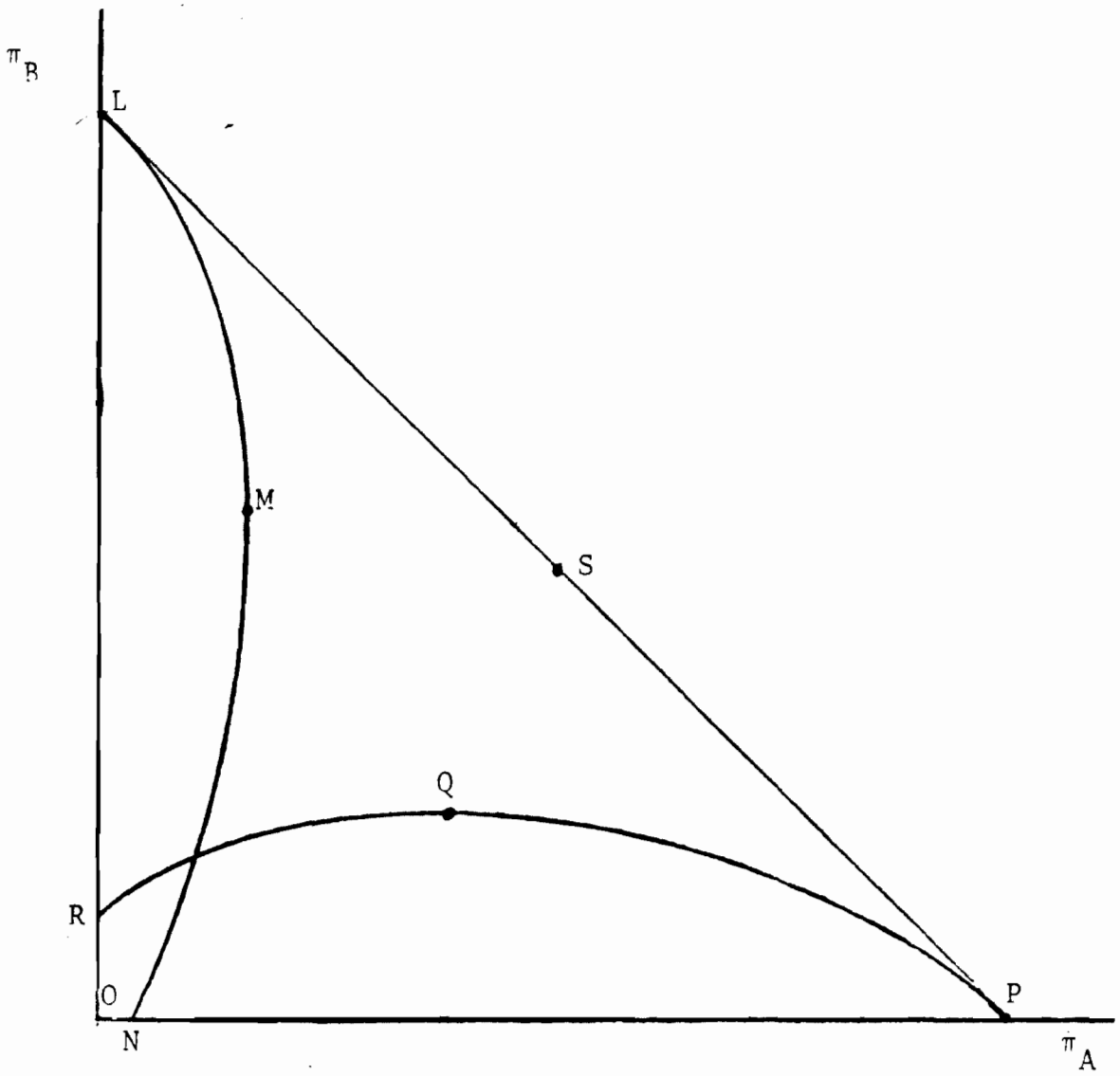
x_2 to A. All that can be said is that the profit possibilities under supply contracts between the firms is given by LM and PQ.

What are the profit possibilities for the firms under a joint venture in q in which a contributes x_1 at price of $r_1 = c_{A1}$ and B contributes x_2 at price $r_2 = c_{B2}$? These profit possibilities are given by line LP. With input prices c_{A1} and c_{B2}, the profits of the joint venture, Π_{jv}, must equal Π_A at P and Π_B at L.

Points along LP imply different values of the split in the joint venture profits. Firms A and B's profits from the venture equal $\gamma\Pi_{jv}$ and $(1-\gamma)\ \Pi_{jv}$ respectively, where γ is A's equity share. At L, γ=0, where at P γ=1. At S, which lies midway between L and P, γ=1/2. Clearly for any supply contract profit possibility combination on either LM or QP, there exists some range of joint venture equity shares which would generate higher profits for both parties, ceteris paribus.

Readers familiar with the literature of vertical controls with recognize familiar themes here.[14] In the vertical controls literature, it is assumed that a firm has a monopoly over an input into a competitive industry. Other inputs into the industry are assumed to be competitively available. It has been shown that the input monopolist would have an incentive to integrate downstream if production is subject to variable proportions. Profits under integration will be higher than profits from

FIGURE ONE



selling to downstream firms since inefficient substitution of inputs is prevented. On the other hand, if production is subject to fixed proportions, no input substitution occurs as input price is raised and, as a result, the input monopolist need not integrate to capture all monopoly profits. Similarly in the present analysis, it is clear that the attractiveness of the joint venture arrangement over the supply contract results from the greater efficiency of combining the inputs at the marginal cost.

In our model, however, firms would not be indifferent to a joint venture and the supply contract if production of q is subject to fixed proportions. In the vertical controls literature, the input seller maximizes his return through a monopolistic restriction in the product market. The input monopolist is indifferent to whether profit maximization is achieved directly by equating marginal cost and marginal revenue in the product market with forward integration, or by indirectly achieving the same price and quantity combination in the output market by raising input price to the downstream producers. An input monopolist can achieve the same result in the product market with an output royalty, sales royalty, lump sum payment or tying arrangement or with some combination by these vertical controls.

The important difference in our model here is that possession of inputs x_1 and x_2 confer no market power in q. Since it is assumed the market in q is competitive, profit from the project is maximized when price equals marginal cost in the production q, given that input prices are set at input marginal costs. For example Firm A cannot fully capture this profit by raising r_1 above c_{A1} even if fixed proportions hold, since output would fall. As a result, Firm B would consume less of

x_1. While the absolute value of $\frac{\partial x_1}{\partial r_1}$ becomes smaller as input substitutability is reduced, $\frac{\partial x_1}{\partial r_1}$ is still non-zero negative even if production is subject to fixed proportions. Thus for any value of r_1, the sum of $\frac{\partial \Pi_B}{\partial r_1}$ and $\frac{\partial \Pi_A}{\partial r_1}$ is always less than zero. Consequently, A (or B) cannot fully capture the profit in q production with successive increases in input price without first making production unattractive to B (or A).

It is possible to think of a production function where the total profit in q can be captured in a supply contract, but it is not a fixed proportions function. Instead imagine a function that combines a constant amount of x_1 with variable amounts of x_2, i.e., $q=f(K_1,x_2)$ where $x_1=K_1$. As a result, the cost of x_1 in the production of q is fixed and $\frac{\partial x_1}{\partial r_1} = 0$. In this case, the profit possibilities for a contract in which A supplied B would coincide with the joint venture profit possibilities line. Everything else equal, the firms would be indifferent between the arrangements.[15] Some instances of technology transfer and licensing would appear to correspond to this "fixed" input situation. For example, input x_1 may represent a technological indivisibility such as an invention or new industrial know-how.

B. Comparison with Royalty Agreements

A royalty arrangement would be preferred to a supply contract, everything else equal, to the extent that inefficient input combination is avoided. However, royalty arrangements may still tend to reduce output in q relative to a joint venture. Suppose that A offers supply of x_1 at marginal cost to B in exchange for a t dollars per unit royalty on q.[16] Although not necessary to the result, suppose A retains ownership of the x_1

producing assets and also charges B to cover marginal cost.[17] Firm A's profits are given by

$$\Pi_A = tq + r_1x_1 - C_A(x_1) \text{ with}$$

$$\frac{\partial \Pi A}{\partial t} = \frac{t\partial q}{dt} + q + r_1 \frac{\partial x_1}{\partial t_1} - c_A(x_1) \frac{\partial x_1}{\partial t_1}$$

Since $r_1 = c_{A1}$, it follows that

$$\frac{\partial \Pi_A}{\partial t} = \{\frac{t\partial q}{\partial t} + q\}.$$

Firm B's profits are given by

$$\Pi_B = (P_o - t)q - h(q) \text{ with}$$

$$\frac{\partial \Pi_B}{\partial t} = P_o \frac{\partial q}{\partial t} - \frac{t\partial q}{\partial t} + q - h'(q)\frac{\partial q}{\partial t}$$

where h(q) is cost of producing q. It follows that

$$\frac{\partial \Pi_A}{\partial t} + \frac{\partial \Pi_B}{\partial t} = \{P_o - h'(q)\}\frac{\partial q}{\partial t}$$

Since $\frac{\partial q}{\partial t} < 0$ and $P > h'(q)$ it follows that

$$\frac{\partial \Pi_A}{\partial t} + \frac{\partial \Pi_B}{\partial t} < 0$$

Therefore, the decrease in output in response to an increase in t makes it impossible for a to capture fully the profit earned by B in q. Similarly, B would be unable to capture all the profit in q should it supply x_2 to A at marginal cost in exchange for a per unit royalty on q. As in the case of the supply contract in which firms negotiate over input price, the profit possibilities curves for A and B under an output royalty agreement will tend to lie in the region under the joint venture profit possibilities. Consequently, there will be some value of γ such that both

firms would prefer a joint venture over an output royalty agreement, everything else equal.

An exception would be if $\frac{\partial q}{\partial t} = 0$, which would be true if marginal cost in q were perfectly inelastic. If so, the firms would be indifferent in negotiating an output royalty agreement and a joint venture, everything else equal.[18]

If, however, the royalty rate is applied to profit, rather than output or revenue, the profit possibilities under a royalty arrangement will always be the same as those under joint venture. In this case, the royalty rate and γ play the same role in allocating the project's profits to the two input-contributing firms.

C. Comparison with a Lump Sum Payment

Now suppose that a lump sum payment, L, is offered by one firm to another to secure input supply at marginal cost. A lump sum agreement may take the form of a merger between the firms an asset acquisition, or a license paid by a one-time royalty. Possible values of L lie between 0 and Π_{jv}. A lump sum agreement has identical profit possibilities for negotiating parties as a joint venture since for any possible value of L there is a value of γ such that $\gamma\Pi_{jv} = L$. Consequently, firms having input complementarities would be indifferent between a lump sum agreement and a joint venture, everything else equal.

III. Why Then Joint Ventures?

In a world of certainty and no transactions costs, input complementarities would not be a sufficient condition for firms to prefer a joint venture over other kinds of contracts. As we have seen the profit possibilities in bilateral bargaining for a joint venture are always the

same as those with lump sum arrangements, and depending on the production function, may in some instances be the same as those with output or sales royalty agreements.

Input complementarities, therefore, are by themselves incidental to joint venture formation and, as we noted earlier, much the same can be said of scale economies as an explanation of joint venturing.[19] What all efficiency-driven joint ventures have in common is that they are a response to some underlying transactional cost problem. Broadley appears to have been the first joint venture analyst to recognize the importance of transactions costs.[20]

Generally, the underlying transactional problem will be related to the costs of writing and monitoring complete contracts, sometimes additionally compounded by the possibility of opportunistic behavior when two vertically-related stages of production are separately owned. More specifically, arguments that joint ventures can result in risk-spreading efficiencies must ultimately invoke transactional explanations such as bankruptcy costs or principal-agent models which deal with the possibly persistent divergence of managerial behavior and stockholders' interests with respect to risk-taking.[21] Joint ventures that are formed to internalize benefits not readily appropriable, such as in R&D, obviously have a transactions cost basis.

Putting aside risk-spreading and appropriability, let us conclude by focusing on the perhaps more typical transactional considerations that might arise in joint venture formation. The important element to recognize is the difference in the dispersion of managerial control between a joint venture and other contracts.[22] Managerial control is significant because

it allows influence over strategic decisions affecting a project and accords inspection rights of all records pertaining to the project. There are three managerial control alternatives in which the inputs of two firms may be combined to undertake a project. First, with a supply, royalty or lump sum agreement (excepting merger), managerial control over the project could be vested in one firm, although that firm's decision-making would be constrained by whatever contractual arrangements it had with the second firm. The second alternative is sharing managerial control of the project through a joint venture. Merger of the two firms is the third alternative. Merger brings all the firms' assets and inputs, including those unrelated to the project, under common, undivided control.

Consider the first alternative, a non-merger arrangement of some sort with one-sided managerial control. A firm may tend to reject arrangements in which they contribute inputs to a project absent managerial control for several reasons. A firm's managers may believe that its return on its contributed input is too vulnerable to mistakes or cheating by the firm which will have control of the project. Negotiating contract provisions that might safeguard against these possibilities, and act as a substitute for managerial control, may be very costly or only partially effective. Furthermore, a firm may also be reluctant forego managerial control if opportunistic behavior poses a threat to the value of other inputs or assets that the firm retains. For example, suppose Firm A's contribution to a proposed project with Firm B was to be a plant which presently manufactures components that are then shipped to other plants owned by Firm A, and that the component plant was expected to continue this supplier role after being contributed to the project. Since the value of other assets

are dependent on the component plant, Firm A may insist on retaining managerial control. Similar considerations might arise if the contributed asset were a trademark or brandname.

These factors create a demand for managerial control. The demand for managerial control on the part of two negotiating parties need not be equal. Joint venture formation, however, would appear most likely in cases where both negotiating parties have relatively strong demands for managerial control, thus preventing one party from profitability "buying" complete managerial control under some non-merger alternative. Relatively one-sided demand for managerial control would appear to favor joint venture alternatives. The possible transactions costs savings (relative to non-merger alternatives) in a joint venture appear two-fold. First, sharing managerial control may economize on contract writing costs. Second, sharing managerial control may make it easier for a firm to monitor an input-contributing partner's fulfillment of obligations.

On the other hand, the joint venture has important transactional disadvantages in that it is an "incomplete" contract and, as Broadley writes, is saddled with the problem of "two masters."[23] Costly disagreements may arise once the venture is underway, and these may involve no clear breach of contract. In this regard, the joint venture suffers from the same disadvantage as short-term contracts under conditions of long-lived, contract-specific investments with small numbers bargaining.[24] Indeed, disputes between joint venture partners are not uncommon and lead to the early termination of many joint ventures. The possibility of costly disputes with a partner probably discourages many firms from

entering joint ventures and may account for rarity of joint ventures relative to other contracts.

Potential joint venture partners often try to reduce the expected cost of later disputes, although this behavior itself is costly and reduces the net advantage in forming a joint venture relative to other contractual arrangements. Joint venture negotiations are often long. In part, these negotiations can be interpreted as search costs for a compatible partner. A firm's managers must be convinced that a possible joint venture partner would not only be an efficient supplier of some input, but would also likely be in agreement on future strategic and managerial issues affecting the joint venture. In addition, despite the fact that they are incomplete (in that many contingencies are left to managerial discretion), joint venture contracts are often lengthy and detailed, typically including provisions on the geographic and product scope of the venture, financing and capitalization, the obligations of the partners as well as various accompanying operating and technology agreements. Having such a detailed contract reduces the number of unspecified contingencies that may later become points of dispute.

The third managerial control alternative is merger. A merger may economize on contract writing and monitoring costs relative to both joint ventures and "one-sided" control arrangements such as licensing or supply agreements. Second, merger, unlike a joint venture, does not suffer from the two masters problem.

Weighing against merger, however, are the incremental costs of internal organization. As Coase argued in his classic article on transactions costs, "as a firm gets larger, there may be decreasing returns to the

entrepreneur function, that is, the costs of organizing additional transactions within the firm may rise."[25] Generally, we would expect that the merger of two large firms to have greater incremental costs of internal organization than the merger of two small firms or of small firm with a big one. There may be a bias in favor of joint ventures and away from mergers among negotiating firms that are both large, since the incremental costs of internal organization are more likely to swamp the gains from undertaking a project. The findings that most joint ventures are small relative to the parent firms and that joint venture participation increases with firm size,[26] may be evidence of a bias by large firms toward joint ventures, although it is possible that the antitrust laws may also have tended to discourage mergers in favor of joint ventures.

Notes

1. FTC data, based on publicly available sources, found that 9,744 mergers and asset acquisitions occurred in the U.S. between 1973 and 1979, while only 608 joint ventures were counted in the U.S. over the same period. Presumably other kinds of inter-firm contracts such as supply and royalty agreements are also much more common than joint ventures.

2. H.G. Hann and J.R. Alexander, Laws of Corporations and Other Business Enterprises (St. Paul, Minnesota: West Publishing Co., 1983), pp. 105-106.

3. Various institutional, non-efficiency factors have also been said to be important in encouraging joint ventures. First, firms that want to do business abroad are sometimes required by local laws to share equity and management with local firms. Foreign governments may also offer low interest loans, loan guarantees or tax breaks to joint ventures formed by local firms and firms based outside the country. Second, U.S. tax laws may have tended to favor joint ventures over other kinds of inter-firm contracts. For example, it has been argued that firms may reduce tax payments by paying capital gains tax on the sale of stock of a joint venture to which it had contributed technology rather than paying taxes on licensing royalties which are based on the corporate income tax rate. Third financial reporting regulations have also been said to encourage joint venturing. For example, borrowing by a joint venture in which a firm has a 50 percent or less interest need not be reflected in the firm's consolidated balance statement, thus resulting in no change in the firm's reported debt-equity ratio. Fourth, unlike a wholly-owned subsidiary, legal liabilities of a incorporated joint venture do not carry over to the parent firms. On the first point see A.R. Janger, Organization of International Joint Ventures, Conference Board Research Report No. 787., 1980, pp. 1-2. On the last three points see S.V. Berg, J. Duncan and P. Friedman, Joint Venture Strategies and Corporate Innovation (Cambridge, MA: Oelgeschlager, Gunn and Hain, 1982), pp. 73-74.

4. These might be called "natural monopoly" joint ventures. For example, there are significant scale economies in petroleum pipelines. Frequently, a pipeline is joint owned by the owners of the references served by the pipeline. The efficiency of a joint venture agreement in this setting, however, is not due to scale economies per se, but rather comes from reducing the possibility of opportunities behavior relative to separate ownership of vertically-related assets. On this point, see Benjamin Klein, Robert G. Crawford and Armen A. Alchian, "Vertical Integration, Appropriable Rents and the Competitive Contracting Process," Journal of Law and Economics, October 1978, pp. 297-326.

5. While it is beyond the scope of this paper to analyze the issue fully, the notion of risk-sharing efficiencies in joint ventures deserves some comment since, on the one hand, risk-sharing is frequently advanced as a motivation for joint venture formation, while on the other hand, theoretical support for such a motivation is unsettled.

There are two basic variants of the risk-sharing argument. The

first is the financial variant, viz., risk-sharing by joint venturing firms results in cost of capital savings relative to independent undertaking of a project. If one believes, a la CAPM, that only systematic risk matters in the pricing of a firm's equity (and that managers believe this too) no cost of capital savings result from joint venturing. In this view, the price of a firm's equity would rise whenever a project's expected rate of return more than compensated the project's systematic risk. A project with an inadequate rate of return relative to its systematic risk would be rejected since acceptance would tend to lower the price of the firm's equity. The same decision would be made no matter whether the whole project were considered or some joint venture share of it. Forming a joint venture would result in no additional cost of capital advantages for firms but would merely have the effect of spreading any equity appreciation (or depreciation if firms unwisely accepted a project whose rate to return was inadequate relative to systematic risk) between the partner firms.

Some analysts remain skeptical of the CAPM model and maintain that, because of bankruptcy and transactional costs of diversifying investor portfolios, firm non-systematic, own-risk may also be important to the cost of capital. Clearly, doing a project in a joint venture will tend to have a smaller impact on a firm's overall own risk profile than doing the project independently, suggesting that stock price/cost of capital considerations might favor one alternative over the other. It seems doubtful, however, that this effect will be generally significant. Projects which are small or even average-sized relative to the firm may have no significant impact on the firm's overall risk profile. Indeed, financial texts treating the capital budgeting problem usually assume that the present cost of equity can be used as an exogenous benchmark in accepting or rejecting projects. Consequently, it appears that a cost of capital argument for joint ventures should be limited to relatively large projects that pose significant bankruptcy threats to individual firms. For such projects, firm cost of capital might rise with increased participation in the project, and as a result, a joint venture share in a project might be acceptable while unilateral undertaking of the project might not.

The second variant of the joint venture risk-sharing argument is based on managerial risk aversion. There is considerable support in the literature that managerial risk aversion is a factor which affects firm behavior. A propensity to form conglomerate mergers that reduce firm own-risk or tendencies to underinvest in risky projects have been pointed to as being symptomatic of managerial risk-aversion. (See, for example, Y. Amihud and B. Lev, "Risk Reduction as a Managerial Motive for Conglomerate Mergers," Bell Journal Economics, Autumn, 1981; and A.J. Marcus, "Risk Sharing and the Theory of the Firm," same Journal, Autumn, 1982). In their study of joint ventures, Berg, Duncan and Friedman argue that managerial risk aversion is an important motivation in joint venture formation. Berg, et. al., found some evidence of an inverse relationship between propensity to form joint ventures and firm rate of return, and concluded that this finding may be the result of managers trading off profits for reduced firm-own risk through joint venture formation. See Berg, et. al., Joint Venture Strategies and Corporate Innovation, op. cit., chp. 12.

It should also be noted that in discussion of risk-spreading and joint ventures, the generally stated or implied alternative is the firm's risk situation given that the project is undertaken unilaterally. However, the

joint venture contract is not unique in having risk-spreading as an attribute. Royalty and supply agreements also have some implicit division of risk and return between contracting parties. One could construct contract curves for each type of agreement which show the risk/return possibilities for the bargaining parties for varying levels of the negotiated parameter (i.e. input price, royalty rate or joint venture share). This analysis would be similar to that found in the labor economics literature on implicit contracts. From a theoretical perspective, it does not appear that a joint venture would always prevail over other kinds of contracts in which there is also risk-spreading.

6. See G. Stigler, "Free Riders and Collective Action: An Appendix to the Theories of Economic Regulation," Bell Journal of Economics, Autumn, 1974, pp. 359-365.

7. Berg, Duncan, and Friedman, op. cit., p. 37.

8. J. Paul McGrath, Remarks at the 18th Annual New England Antitrust Conference, November 2, 1984, p. 1. See also, Steffan Gullander, "Joint Ventures and Corporate Policy," Columbia Journal of World Business, Spring 1976, p. 104; J. Backman, "Joint Ventures in the Light of Recent Antitrust Developments: Joint Ventures in the Chemical Industry," Antitrust Bulletin, January-April 1965, p. 14, 15; J.D. Hlavacek, B.H. Dovey and J.J. Biondo," Tie Small Business Technology to Marketing Power," Harvard Business Review, January-February 1977, pp. 106-116.

9. Cournot proposed this setting for his analysis of complementary monopolies. See Researches into the Mathematical Principles of the Theory of Wealth (Homewood, Ill.: Richard D. Irwin, Inc., 1963) chp. IX.

10. In addition, there may be instances of more complex production functions where output is possible with zero amount of one input. Such output, however, would be more costly compared to having both inputs present.

11. J. F. Broadley, "Joint Ventures and Antitrust Policy," Harvard Law Review, May 1982, pp. 1527-1529.

12. These assumptions are made to rule out any market power incentives for forming a joint venture.

13. J.M. Henderson and R.E. Quandt, Microeconomic Theory: A Mathematical Approach, 2nd edition, (McGraw-Hill, 1971), pp. 67-70.

14. For a comprehensive treatment of the vertical controls literature see R.D. Blair and D.L. Kaserman, Law and Economics of Vertical Integration Control, (Academic Press, New York, 1983).

15. The firms would still prefer either arrangement, ceteris paribus, over contract in which B supplied x_2 to A since $\frac{\partial x_2}{\partial r_2}$ remains negative.

16. Essentially identical results obtain if A offered supply at marginal cost in return sales revenue royalty of sp per unit where $0 > s > 1$.

17. In other words, Firm B pays a two-part tariff.

18. R.H. Scott makes a similar point in his discussion of share-cropping leases. See "A Note on Rents, Royalties, Leases, and Cost-Plus Contracts," Journal of Economics and Business, Winter 1979, pp. 145-148.

19. See n. 3.

20. (Broadley, op. cit., pp. 1527-1529.)

21. See n. 4.

22. References to the significance of managerial control can be often found in the business literature on joint ventures. One study of international joint ventures noted that while supply and licensing agreements may allow U.S. firms to participate in overseas markets with limited risk, these arrangements "are bought only at some loss of control over technology, product quality and trademarks," and that "local reputation is put into the hands of others." Firms may also be concerned that without continued managerial influence, their contributed inputs may be under-utilized, especially in a possibly fast-growing market. See Allen R. Janger, Organization of International Joint Ventures, op. cit., p. 4; Hlavacek, Dovey and Biondo also make the point about underutilized inputs in writing about domestic high tech-joint ventures. See, "Tie Small Business Technology to Marketing Power," Harvard Business Review, op. cit., p. 108.

23. Broadley, op. cit., p. 1529.

24. The fact that joint venture partners owe fiduciary obligations to each other may imply a recognition of this problem in the law.

25. R.H. Coase, "The Nature of the Firm," Economica, November 1937, reprinted in Readings in Price Theory, G.J. Stigler and Kenneth Boulding, eds., (Homewood, Ill: Richard D. Irwin, Inc., 1952), p. 340.

26. S.E. Boyle, "An Estimate of the Number and Size Distribution of Domestic Joint Subsidiaries," Antitrust Law and Economics Review, Spring 1968, pp. 81-92; Berg, Duncan and Friedman op. cit., p. 156.