Structuring International Cooperative Ventures

Thomas H. Noe
Tulane University

Michael J. Rebello
Georgia State University

Milind M. Shrikhande
Georgia State University and Federal Reserve Bank of Atlanta

We examine the effect of bargaining power and informational asymmetry on the design of international cooperative ventures in the presence of restrictions on equity participation and investment. When the bargaining advantage rests with the multinational, equity participation restrictions can increase the profits to domestic firms and encourage suboptimal investment policies. Overinvestment occurs when the multinational's bargaining advantage is reinforced by an informational advantage, while underinvestment occurs when the domestic firm possesses the informational advantage. In contrast, when the bargaining advantage rests with the domestic firm, equity participation restrictions do not affect investment levels.

More than 20,000 cooperative ventures were formed worldwide between 1996 and 1998. Such ventures now represent at least 20% of the revenue of the 1000 largest U.S. firms [*Economist* (1999)]. Cooperative ventures between foreign and domestic companies are the most common form of foreign direct investment [see Contractor and Lorange (1988)].[1] These cooperative arrangements range from equity joint ventures to franchise agreements, where the firm providing the training receives a fee for the services rendered.

Cooperative ventures have thrived despite numerous obstacles imposed by governments. Among these obstacles are restrictions that limit the multinationals equity participation in cooperative ventures.[2] Examples of coun-

We are grateful to participants at the Atlanta Finance Workshop, 1996 EFMA meetings, 1998 European Finance Meetings, and the INSEAD finance workshop, Jim Bennett, Cheol Eun, Harbir Singh, Briance Mascarenhas, Raman Uppal, Theo Vermaelen, Paulo Fulghieri, and Milton Harris for useful comments. Special thanks are extended to David Hirshleifer, the editor, and an anonymous referee for an insightful critique of an earlier draft of this article. We thank Professor Faiz Al-Khayyal of Georgia Tech and Professor Timothy Van Voorhis of Iowa State University for their help with numerical solutions. The usual disclaimer applies. Address correspondence to Milind M. Shrikhande, Department of Finance, #1221, J. Mack Robinson College of Business, Georgia State University, University Plaza, Atlanta, GA 30303-3083, or e-mail: mshrikhande@gsu.edu.

[1] Estimated foreign direct investment tripled during the period 1980 to 1990 [see Froot (1993)].

[2] Equity participation restrictions (on portfolio investment) by foreign entities are sometimes imposed by domestic firms themselves. Stulz and Wasserfallen (1995) provide an economic rationale for these restrictions. Laws of some countries also restrict domestic firm equity participation. For example, Laotian investment law restricts domestic firm equity particpation in joint ventures to 30%.

The Review of Financial Studies Fall 2002 Vol. 15, No. 4, pp. 1251–1282

tries that impose such restrictions are India, Indonesia, Kenya, South Korea, Nigeria, the Philippines, and Thailand. In many of these countries, foreign firms are restricted to holding minority stakes. These restrictions are frequently binding constraints on the structure of international cooperative ventures and thus may explain why a large percentage of cooperative ventures are characterized by minority ownership by multinationals [see, e.g., Hladik (1985)].[3]

In this article we provide new insights by studying the impact of regulations, financing policies, information asymmetry, and bargaining power on the structuring of international cooperative ventures. We consider a cooperative arrangement between a multinational and a domestic firm. The multinational and the domestic firm together determine the financial structure and scale of the venture. Capital constraints may limit the domestic firm's ability to fund the venture; legal constraints may limit the multinational's ability to hold an equity stake in the venture. In some cases, one of the partners may be replaceable by another equally capable firm. Either party may have private information about the venture's prospects.[4]

Within this framework we consider four possible allocations of information and bargaining power. First, suppose that the multinational has many potential domestic partners. In this case, competition between domestic firms allows the multinational to capture the rents from the venture. Further, suppose that the multinational's bargaining advantage is reinforced by an informational advantage.[5] In this case, the multinational's only problem is to ensure that the fraction of the project that it must cede to the domestic firm, in order to compensate the domestic firm for its contribution, is highly valued. To induce the domestic firm to value its contract highly, the multinational must signal that the venture has favorable prospects. The multinational can signal its positive prospects by taking an all-equity stake in the venture. Restrictions on multinational equity ownership may force the multinational to resort to the costlier signal of overinvesting. Limits on domestic investment in the venture have no impact, as investment is exactly the signal that the multinational wants to use to increase the valuation of the project by the domestic firm.

---

[3] See Gomes-Casseres (1985) for a discussion on the role of equity participation constraints in restricting investment by multinationals. Gomes-Casseres (1988) documents the importance of equity participation restrictions by providing evidence that a larger share of multinational investment was being directed toward countries without equity participation restrictions in the 1970s and 1980s. Eun and Janakiramanan (1986) consider the importance of equity ownership restrictions for investor portfolio construction and asset pricing.

[4] As noted by Sercu and Uppal (1995) among others, the optimal financial structure and scale of a cooperative venture are a by-product of the strategic situation facing the two parties. This situation depends on the degree of competition between potential domestic and multinational participants and the information possessed by the parties.

[5] An example of a scenario that roughly corresponds to this stylized situation is a multinational investing overseas to capture the benefits of commonly observed input-cost differentials with the aim of producing for its home market. The multinational should have more information regarding product demand than its domestic partners. As the domestic partner acts only as a labor contractor, it should face stiff competition for the right to participate in the venture.

Next, consider the case where the multinational has a bargaining advantage but the informational advantage lies with the domestic firm.[6] In this case, the domestic firm has an incentive to "cry wolf," that is, to claim prospects are bleak even when they are good. By crying wolf, the domestic firm may convince the multinational that the domestic firm requires a larger share of the project in order to meet its opportunity costs. To discourage the domestic firm from crying wolf, it is in the multinational's interest to respond to a report of bad prospects by offering the domestic firm a contract that severely restricts project investment, reduces to a minimum domestic firm investment participation, and deprives the domestic firm of upside cash flows. In order to restrict upside participation of the domestic firm, the multinational needs to maximize its equity stake in the project. Thus equity participation restrictions are again binding, and tighter equity participation restrictions on the multinational may induce more severe investment distortions. Again, in this case, restrictions on investment by the domestic firm have little impact as optimal contracting calls for no domestic firm investment participation after a report of poor prospects by the domestic firm.

A third possibility arises when a domestic firm faces many potential multinational partners and its bargaining advantage is supplemented by an informational advantage.[7] In this case, the domestic firm would like to take an all-equity stake in the project to raise the multinational's valuation of the project. Restrictions on multinational equity participation do not act as a hindrance. However, in some instances, when domestic equity ownership alone is not sufficient to signal good prospects, overinvestment may be required. Because the domestic firm can efficiently signal by bearing the costs of increased investment, restrictions on the domestic firm's investment share may both adversely affect the domestic firm and favor the multinational.

A fourth situation occurs when bargaining power rests with the domestic firm, but the multinational firm has an informational advantage.[8] This is a mirror image of the second situation. Thus underinvestment occurs and the domestic firm takes a 100% equity stake when the multinational reports bad prospects for the venture. While restrictions on multinational equity participation have no effect, limits on the domestic firm's investment share may both adversely affect the domestic firm and favor the multinational.

Our analysis complements the existing literature on international cooperative ventures. Much of this literature has focused on the motivation for the

[6] A scenario roughly fitting this description is a multinational initiating the production of a branded good for sale in the host country. The multinational's trademark allows it to extract monopoly rents. At the same time, the domestic firm has an informational advantage resulting from its familiarity with local market conditions.

[7] In this case the multinational acts purely as a financier of the venture. Such a situation is exemplified in ventures requiring a simple technology (e.g., textiles) and production for the host country market.

[8] A situation roughly fitting this description occurs when a large domestic monopolist searches for a multinational partner with technical expertise. Its monopoly gives the domestic firm a bargaining advantage, while the multinational's technical expertise gives it an informational edge.

formation of cooperative ventures [see Teece (1977), Bhattacharya, Glazer, and Sappington (1992), Kamien, Muller, and Zang (1992), and Kamien and Zang (1993)]. An explanation commonly offered in the literature for the formation of cooperative ventures is heterogeneity in tastes and/or complementarities in production [see Porter and Fuller (1986), Ghemawat and Spence (1988), and Kogut (1988)]. However, as noted by Yoffie (1993) among others, economists have shown less interest in the problem of optimally structuring international cooperative ventures. Our analysis helps fill in this gap by providing insights into how heterogeneity between partners in a cooperative venture can affect the venture's structure. Our results are consistent with the evidence in Fagre and Wells (1982) and Contractor (1990), who document that equity ownership by multinationals is an increasing function of their bargaining power. Further, our analysis extends that of Darrough and Stoughton (1989) and Stoughton and Talmor (1994), who examine the effect of bargaining power on transfer pricing in joint ventures. In their analysis, as there is no residual uncertainty conditional on private information, the optimal mechanism need only specify transfer payments between agents. In our analysis, however, the existence of "residual uncertainty" (i.e., private information does not eliminate all uncertainty regarding future cash flows), given limited liability, ensures that optimal mechanisms must specify state-dependent contracts rather than transfer payments.

The intuition underlying the optimality of the specific functional forms of the contracts we identify is similar to the intuition underlying the optimality of using stock as a medium of exchange when target firm shareholders have private information [see Hansen (1987), Fishman (1989), and Eckbo, Giammarino, and Heinkel (1990)]. These models show that a simple transfer payment between raider and target firm in the form of a cash tender payment may not be optimal if the target has private information. Instead, it is optimal for the target firm to receive a firm-value contingent payment. This cash flow contingency can be achieved by means of implementing the takeover through an exchange of stock. Similarly, in our analysis, it is optimal for the venture partner reporting private positive information to receive a firm-value contingent payment.

Our results also lead to a number of empirical implications about financing, investment, and political economy pressures for equity participation constraints depending on the characteristics of the countries and markets involved. For example, they indicate that the tenor of political debate in the domestic country regarding equity participation restrictions is dependent on the locus of bargaining power. When multinationals possess the bargaining advantage, political debate regarding these restrictions may be heated. First, equity participation restrictions have more bite when the bargaining advantage lies with multinationals. Second, because investment distortions can move employment and the domestic partners' profits in opposite directions, participation restrictions can be controversial.

The conflicts between the interests of domestic firms and their employees are most apparent in instances in which the multinational is at an informational disadvantage and equity participation restrictions result in underinvestment. Because the identity of the party with the bargaining advantage varies across industries, it would appear that political debate on equity participation restrictions would be more intense in countries whose industrial structure ensures that its firms have significant private information but little bargaining power. In contrast, in industries in which the informational advantage also lies with the multinational, both domestic firms and workers stand to benefit from equity participation restrictions. Thus in economies dominated by such industries, equity participation restrictions would receive universal support. In contrast to equity participation restrictions, restrictions on the ability of the domestic partner to provide funding for the joint venture would only be salient when the domestic partner has bargaining leverage. Thus we would expect that, in partnerships in which domestic firms have significant monopoly power over key inputs to the venture, the domestic partner's contribution to the project will be proportional to its access to investment capital. Otherwise we would expect little domestic participation in project funding.

Finally, the greater investment distortions associated with equity participation restrictions imply greater variation in the scale of investment in cooperative ventures. As pointed out by Holmstrom and Weiss (1985), sensitivity of this kind can exacerbate macroeconomic fluctuations. Thus our analysis predicts that countries with equity participation restrictions and domestic capitalists with little bargaining power will experience greater macroeconomic fluctuations.

The rest of the article is organized as follows. In Section 1 we detail the model and determine optimal structures in the absence of informational asymmetries. In Section 2 we describe optimal cooperative structures when bargaining power rests with the multinational firm. In Section 3 we investigate optimal structures when bargaining power rests with the domestic firm. Empirical implications of the analysis are explained in Section 4. Our summary and conclusions comprise Section 5. The appendix contains proofs of all the propositions.

1. The Model

Consider a *multinational* firm that is entering into an international cooperative venture. The venture is to be undertaken with a partner that is domiciled in the country where the fixed assets are to be based. We call this firm the *domestic firm*. The partners have the option of not funding the project. Both the domestic firm and the multinational are risk neutral and the risk-free rate of interest is zero.

1.1 Technology and information

The partners decide on the structure of the venture at the beginning of the period. They determine both the level of investment and the division of the cash flows from the venture. The investment, I, is made at the beginning of the period and the cash flow from the venture is realized at the end of the period.

The random cash flow, $\widetilde{X}$, is dependent on an information signal. This information signal is received at the beginning of the period, prior to the structuring of the venture. The signal is noisy. However, it provides some information regarding the end-of-period cash flows from the venture. The signal takes the values G and B, where G denotes good prospects and B denotes bad prospects. The unconditional probability of the receipt of signal G is given by π. The cash flow has the two-point support $\{L, H\}$, where $0 < L < H$. The probability of realizing cash flow H is given by $P_t(I)$ and the probability of realizing cash flow L is given by $1 - P_t(I)$, where $t = G, B$. We assume that investment in the venture is restricted to $I \in [I_{\min}, I_{\max}]$ and that the domestic firm incurs an opportunity cost of $V_{\min}$ if the venture is undertaken.[9]

To ensure that arrangements exist under which the partners are willing to invest in the venture, we impose the following positive net present value constraint

$$L + P_B(I_{\min})(H - L) - V_{\min} - I_{\min} > 0. \tag{1}$$

This assumption merely ensures that some level of investment exists such that the output from the venture is sufficient to cover the opportunity costs of both the domestic firm and the multinational. To ensure that there exists an internal optimal investment choice, we assume that $P(\cdot)$ is differentiable, monotonically strictly increasing and strictly concave in I. Capital and labor are assumed to complement each other and thus employment is assumed to increase with the scale of the venture. We also impose the standard Inada conditions for an internal optimal investment level, that is, $D_I P_t(I_{\min})(H - L) = \infty$ and $D_I P_t(I_{\max})(H - L) = 0$. The notion that good prospects are likely to result in a higher marginal rate of investment return is formalized by assuming that $P_G(I_{\min}) > P_B(I_{\min})$ and

$$\frac{D_I P_G(I)}{P_G(I)} > \frac{D_I P_B(I)}{P_B(I)}, \quad \text{for all } I \in [I_{\min}, I_{\max}]. \tag{2}$$

This assumption is similar to the standard single-crossing property employed in the signaling literature [see, e.g., Riley (1979)].[10] Note that Equation (2) and our

[9] As will become apparent, allowing for an opportunity cost for the multinational in addition to that of its investment will have little impact on our results. Thus in the interest of minimizing notation, we only assume an opportunity cost for the domestic firm.

[10] By "single-crossing," we mean that the indifference curves (in β–I space) associated with good and bad information cross at, at most, one point.

assumption that $P_G(I_{\min}) > P_B(I_{\min})$ imply that total productivity is higher in the favorable information state, that is,

$$P_G(I) > P_B(I), \quad \text{for all } I \in [I_{\min}, I_{\max}]. \tag{3}$$

1.2 Contracts

Now we describe admissible venture structures. A venture structure must specify the up-front investment expense borne by the two parties and the division of end-of-period cash flows. First consider the division of up-front investment costs. All investment in the project is provided either by the domestic firm or by the multinational. It is therefore possible to specify the up-front investment by specifying the total level of investment and the fractional contribution of the domestic firm. Thus we define investment policy as an ordered pair (I, ϵ), where I represents the total level of investment and ϵ represents the fraction of the initial investment financed by the domestic firm. We restrict attention to the case where the domestic firm is capital constrained. Thus its share of the investment is given by $\epsilon_t \in [0, \bar{\epsilon}]$. To eliminate trivial cases, we assume that the project is not sufficiently profitable to support riskless payments to either party to the venture, that is, we assume "no riskless debt,"

$$L < I_{\min}(1 - \bar{\epsilon}), \quad \text{and} \quad L < V_{\min}. \tag{4}$$

Next consider the division of the end-of-period cash flow. Let $s(x)$ represent the payment made to the multinational in the event that cash flow from the venture is x. Limited liability implies that $0 \leq s(x) \leq x$. Because the cash flow is fully paid out to the two parties, the domestic firm receives $x - s(x)$. Note that, given our assumption that cash flows have a two-point support, $\{H, L\}$, we can provide a simple "slope–intercept" characterization of financial contracts. Define β and γ as follows:

$$\beta \equiv \frac{s(H) - s(L)}{H - L}$$
$$\gamma \equiv s(L)/L.$$

In this expression, β represents the slope of the contract with respect to cash flows. A high slope indicates that payments to the multinational increase with the venture's cash flows. In contrast, γ represents the fraction of the low cash flow that is received by the multinational. Limited liability implies that $\gamma \in [0, 1]$. We also assume that $\beta \in [0, 1]$. Our specification implies that each party receives a combination of debt and equity claims on the end-of-period cash flow. For example, γL and $(1 - \gamma)L$ can be interpreted as the face values of debt claims owned by the multinational and domestic firm, respectively. As β represents the multinational's fractional claim on the difference between the total cash flow and debt payments if cash flow

H is realized, it can be interpreted as the multinational's fractional equity ownership. The term $(1-\beta)$ has a similar interpretation.

Together, the terms representing the division of initial investment expense, I and ϵ, and the terms representing the division of end-of-period cash flows, γ and β, constitute the structure used for the venture. In summary, a *venture structure* is an ordered four-tuple, $(I, \epsilon, \gamma, \beta)$, where $I \in [I_{\min}, I_{\max}]$ represents the overall level of investment in the project; $\epsilon \in [0, \bar{\epsilon}]$ represents the fraction of the project financed by the domestic firm; $\gamma \in [0, 1]$ represents the fraction of the low cash flow allocated to the multinational; and $\beta \in [0, 1]$ represents the slope of the contract used to divide project cash flows. We represent the space of all feasible structures with $\mathcal{S}$. The multinational and the domestic firm are risk neutral. Thus their payoffs are given by their respective shares of expected venture cash flows less their contribution to financing the initial project investment. Therefore, conditional on the signal $t = B,\ G$, and the structure $\mathbf{S} \in \mathcal{S}$, the multinational's payoff can be represented by the function $U_t(S)$, where

$$U_t(S) \equiv \gamma L + \beta(H-L)P_t(I) + \epsilon I - I.$$

Similarly the domestic firm's payoff can be represented as

$$\begin{aligned} V_t(S) &\equiv L + (H-L)P_t(I) - I - U_t(S) \\ &= (1-\gamma)L + (1-\beta)(H-L)P_t(I) - \epsilon I. \end{aligned}$$

We incorporate the equity participation constraint into our analysis by assuming that the partners are restricted to using sharing rules that satisfy the condition that

$$\beta \leq \alpha, \text{ for some } \alpha \in [0, 1].$$

Clearly the smaller the level of α, the tighter the equity participation constraint binds.

The equity participation constraint may restrict contract design in two distinct ways. First, it could restrict the shape of the sharing rule dividing venture cash flows, prohibiting shapes that transfer too much of the upside gains from the project to the multinational. This restriction on contract shape is important in the context of our asymmetric information model because it restricts the use of contract design to mitigate adverse selection costs. Second, equity participation constraints may carve out a fraction of the value for the domestic company. When the domestic company is cash constrained, and thus cannot pay for the value of the carve out by funding an increased share of the venture, the equity participation constraint may force the payments to the domestic partner above the domestic firm's reservation utility level. In this case, even in the absence of contracting frictions such as asymmetric information, the equity participation constraint will affect investment policy by acting as a tax on the multinational paid to the domestic firm.

Because the disincentive effects of taxes on investment are well understood, it is natural for us to concentrate our theoretical investigation on cases where the equity participation affects contract design through its incentive effects. The following constraint ensures that the equity participation constraint only restricts the contract design, and not value division:

$$(1-\alpha)(H-L)P_G(I) < V_{\min}, \qquad I \in [I_{\min}, I_{\max}]. \tag{5}$$

To see why Equation (5) ensures that the equity participation constraint only restricts contract design, note that, by Equation (1), contracts exist that grant the domestic firm more than its reservation. Note also that the contracts set is connected and value is continuous in the contract terms. Thus to ensure that the equity participation constraint does not restrict value division, we need only ensure that a contract exists which provides the domestic firm less than its reservation value. Equation (5), which we call the legal minimum condition, ensures that this is the case.

The legal minimum condition is always satisfied if the equity participation constraint is trivial, that is, if $\alpha = 1$. If this legal minimum condition is not satisfied, the domestic firm would receive payments in excess of its reservation value, regardless of the allocation of bargaining power and information for the obvious reason that the law forces the domestic firm to receive rents. Although this case is not interesting from a theoretical perspective, it is important for empirical specification of the model, because, empirically, it is difficult to determine whether the legal minimum condition, Equation (5), is satisfied. Thus we discuss the empirical implication of violations of this condition in the empirical implications section, Section 4.

1.3 Pareto-optimal contracts

If both parties receive the same information regarding future prospects, the determination of investment in the venture is straightforward. In this setting, both parties have an interest in maximizing total payoffs. Total payoffs are independent of the division of value; the Coase theorem holds: the partners choose the total value maximizing investment policy and the rents from the project are split between the partners based on bargaining power. Total value maximization implies that the level of investment is set so as to equate the marginal total return on investment with its marginal cost.

When bargaining power rests with the multinational, the level of investment solves problem MPO-t, defined as follows:

$$\text{MPO-t:} \quad \max_{S \in \mathcal{S}} U_t(S)$$
$$V_{\min} - V_t(S) \leq 0. \tag{6}$$

In problem MPO-t, Equation (6) represents the participation constraint for the domestic firm if it observes $t = B, G$. In the solution to the problem, MPO-t,

the level of investment is set to equal the total value maximizing level, which we represent by I_t^{PO}, and call the *Pareto-optimal investment level.*[11]

The value-maximizing investment level is unique and satisfies the first-order condition for maximizing total value, $D_I P_t(I)(H - L) = 1$. The other terms of the contract are not uniquely determined. Any structure is optimal that provides the domestic firm with a payoff of exactly $V_{\min}$ and specifies the Pareto-optimal investment level. Let U_t^{PO} represent the payoff to the multinational in any such solution to the problem MPO-t.

When the bargaining power is concentrated with the domestic firm, optimal structures solve the problem DPO-t, where DPO-t is defined as follows:

$$\text{DPO-t:} \quad \max_{S \in \mathcal{S}} V_t(S)$$
$$U_t(S) \geq 0. \tag{7}$$

In problem DPO-t, Equation (7) represents the participation constraint for the multinational if it observes $t = B, G$. Just as in problem MPO-t, in any solution, the level of investment satisfies the same first-order condition, $D_I P_t(I_t^{PO})(H - L) = 1$. Thus the overall level of investment is the same as it is when the bargaining power rests with the multinational. All structures featuring this level of investment and producing a zero payoff to the multinational [i.e., satisfying (MPO-t) as an equality] are optimal. Let V_t^{PO} represent the payoff to the domestic firm in the solution to DPO-t.

The solution to MPO-t demonstrates that, in the absence of informational asymmetries between the two parties, optimal structures specify the Pareto-optimal level of investment in the venture. Further, the imposition of equity participation and investment restrictions has no impact on either the desirability of investing in the venture or its profitability. Absent informational asymmetries, whether value is transferred between the partners by means of equity or debt is irrelevant. In the following sections we demonstrate that these irrelevance results no longer hold when informational asymmetries are introduced into the problem.

2. The Bargaining Advantage Rests with the Multinational

In this section we characterize optimal cooperative venture structures when the multinational possesses the bargaining advantage. We examine two cases: (i) the multinational also possesses an informational advantage, and (ii) the domestic firm has the informational advantage.

[11] The Pareto-optimal investment level represents the optimal investment level in the absence of any incentive constraints. When incentive constraints are introduced, they can distort the investment decision. This produces a second-best solution [see Darrough and Stoughton (1989)]. The introduction of limited liability, by limiting the scope of sharing arrangements, can further distort the solution, producing a third-best outcome. Equity participation restrictions add yet constrain the sharing arrangements. Our article shows this produces yet more distortion. We acknowledge that the other sources discussed above also have an important impact on the problem.

2.1 The multinational possesses an informational advantage

When the multinational has the informational advantage, it is faced with the problem of convincing the domestic firm that its contract has a high value. This reduces to a classical signaling problem where, on observing the venture's prospects, the informed multinational proposes a structure to its uninformed domestic partner. The only restrictions on this structure are that it be acceptable to the domestic firm and that it reveal the multinational's private information. We focus on the structures that efficiently solve this signaling problem. These structures require that, if it observes B, the multinational chooses the Pareto-optimal investment level and a contract that allows it to capture all the rents from the venture; if the multinational receives good information, the venture structure solves the problem (P-MB/MI), the optimal contract design problem when the multinational possesses both the bargaining and informational advantage:[12]

$$\text{P-MB/MI} \qquad \max_{S_G \in \mathcal{S}} U_G(S_G)$$

$$U_B(S_G) - U_B^{PO} \leq 0 \tag{8}$$

$$V_{\min} - V_G(S_G) \leq 0. \tag{9}$$

The solution to problem P-MB/MI is the structure that signals favorable information at the lowest cost to the multinational if it observes G. The incentive compatibility constraint, given by Equation (8), is a crucial determinant of the solution. Note that Equation (8) can be rewritten as follows:

$$U_B^{PO} \geq U_B(S_G) = U_G(S_G) - \beta_G(H - L)(P_G(I_G) - P_B(I_B)). \tag{10}$$

From Equation (10), we see that, for contracts that keep $U_G(S_G)$ fixed, increasing multinational equity participation, β_G, relaxes the mimicry constraint. By relaxing the mimicry constraint, the investment can be brought closer to the Pareto-optimal level, thus increasing the total payoff from the venture.[13] Thus the multinational will increase its equity stake to the extent permitted to signal favorable prospects. This implies maximal equity participation consistent with the domestic firm's reservation utility constraint and the equity participation constraint. In other words, either the multinational holds no claim on the low cash flow, $\gamma = 0$, or holds the maximal amount of equity permitted by the equity participation constraint, $\beta = \alpha$.

When the equity participation restriction or the reservation payoff of the domestic firm blocks further equity ownership, costly signaling through investment distortion is required. Our marginal productivity assumption

[12] See Riley (1979) for an analysis of this approach to characterizing signaling equilibria. Cho and Sobel (1990) demonstrate that, under conditions satisfied by our model, these equilibrium outcomes are the only ones supported by the D1 equilibrium refinement.

[13] We would like to thank an anonymous referee for suggesting this argument.

[Equation (2)] implies that investment and information are complements. That is, the better the information, the higher the marginal return from investment. Therefore overinvestment when the multinational has good information is an effective signal because such high levels of investment are even less viable for the multinational if it has unfavorable information. Investment distortion may increase with the severity of equity participation restrictions. Because this increase in severity of participation restrictions further increases the scale of the venture, increasing the severity of the equity participation restriction may result in increased employment. Increased investment distortion also reduces the multinational's profit from the venture. Thus the equity participation constraint distorts investment policy and has a major impact on the payoffs to the partners. Such is not the case with domestic-firm capital constraints. These constraints do not induce distortions because the multinational's incentive, in any case, is to shoulder as much of the project's risk as possible to signal favorable information.

Proposition 1. *When the multinational possesses both bargaining and informational advantages the following results hold.*

- (*i*) *When the multinational has favorable information, it acquires the most equity-like claim consistent with the equity participation constraint.*
- (*ii*) *Investment is distorted in the direction of overinvestment and the magnitude of this distortion may increase with the severity of equity participation restrictions.*
- (*iii*) *Capital constraints preventing domestic participation are not costly to the multinational.*
- (*iv*) *Equity participation restrictions reduce the profitability of the venture to the multinational, leave the domestic firm indifferent, and may result in increased employment.*

The following example illustrates this result; in the example, we assume that the probability of realizing cash flow H is given by the following specific functional form:

$$P_t(I) \equiv P_t^o + \frac{(I-25)^{c_t}}{100}, \qquad t = G, B \quad I \in [25, 33].$$

In the example, the equity participation restriction limits the multinational's equity participation to 90% (i.e., $\beta \leq \alpha = 0.90$) and the domestic firm investment participation constraint specifies that all funds are provided by the multinational, that is, $\bar{\epsilon} = 0$. The numerical parameters used in our example and the results of our search for an optimal contract are presented in Table 1.[14]

[14] The calculations in the example were performed using Mathematica. A Mathematica notebook containing both the calculations and a detailed explanation is available upon request.

Table 1
The optimal contract: multinational possesses both bargaining and informational advantages

Panel A. Venture structure: cash flow sharing

	With restrictions		Without restrictions	
Type	γ^*	β^*	γ^*	β^*
G	0.7812	0.9000	0.0000	0.9719
B	1.0000	0.8179	1.0000	0.8179

Panel B. Investment and payoffs

		With restrictions			Without restrictions		
Type	I^{PO}	I^*	U^*	V^*	I^*	U^*	V^*
G	26.2079	32.3666	177.8573	26.0000	27.0118	180.6915	26.0000
B	25.0028	25.0028	111.7808	26.0000	25.0028	111.7808	26.0000

This table shows the design of the optimal contract between the multinational and the domestic firm forming a venture, when the multinational possesses both bargaining and informational advantages. The multinational firm's equity participation cannot exceed a level of 90%, and all funds for the venture are provided by the multinational. The table presents cash flow sharing between the multinational and the domestic firm in panel A. In panel B the table presents the investment by the multinational firm and payoffs to the multinational firm and the domestic firm when the noisy information signal indicates either good prospects, G, or bad prospects, B, for the venture. These data are presented in the presence of as well as in the absence of equity participation restrictions. In the model, β represents the slope of the contract with respect to cash flows, a higher slope indicating increased payments to the multinational with the venture's cash flows. γ represents the fraction of the low cash flow, L, that is received by the multinational firm. Limited liability implies that $\gamma \in [0, 1]$. I^{PO} represents the Pareto-optimal investment by the multinational firm in the venture. From an initial investment expense, I, in the venture the multinational firm receives the payoff, U, and the domestic firm receives the payoff, V. The assumed parameter values are $\alpha = 0.900$, $H = 300.000$, $L = 20.000$, $V_{\min} = 26.000$, $P_G^o = 0.750$, $P_B^o = 0.500$, $\mathcal{Y}_G = 0.400$, and $c_B = 0.001$.

As the example illustrates, when the multinational is restricted to owning less than 90% of the venture's equity, misrepresentation incentives can be eliminated only by deviating from the Pareto-optimal investment of 26.2079 to an investment of 32.3666 after the receipt of signal G. In the absence of equity participation restrictions, however, a deviation to an investment level of 27.0118 is sufficient to deter mimicry.

Proposition 1 shows that the equity participation restriction can induce overinvestment in the venture when the multinational has both bargaining and informational advantages. As we demonstrate below, this result is reversed when the informational advantage shifts to the domestic firm.

2.2 The domestic firm possesses the informational advantage

In this case the bargaining power of the multinational is counterbalanced by the domestic firm's informational advantage. We employ the mechanism design approach to characterizing optimal structures [see, e.g., Harris and Townsend (1981)]. This requires that the multinational design a menu of structures and choose from this menu a structure based on the domestic firm's report on the venture's prospects. This structure must ensure that the domestic firm does not misreport the prospects, while at the same time ensuring that it remains willing to participate in the venture. More specifically, the multinational picks the structures, $\mathbf{S}_G^*$ and $\mathbf{S}_B^*$, that solve problem P-MB/DI,

stated below:

$$\text{P-MB/DI} \qquad \max_{S_G \in \mathcal{S},\, S_B \in \mathcal{S}} \pi U_G(S_G) + (1-\pi) U_B(S_B)$$

$$V_G(S_B) - V_G(S_G) \leq 0 \tag{11}$$

$$V_B(S_G) - V_B(S_B) \leq 0 \tag{12}$$

$$V_{\min} - V_G(S_G) \leq 0 \tag{13}$$

$$V_{\min} - V_B(S_B) \leq 0. \tag{14}$$

The first two constraints, Equations (11) and (12), ensure that, regardless of the prospects, the domestic firm is better off truthfully reporting its information. The first of the two constraints, Equation (11), ensures that the domestic firm is better off truthfully reporting when it has good information; Equation (12) ensures that the domestic firm is better off truthfully reporting when it has bad information. The next two constraints, Equations (13) and (14), ensure that the domestic firm payoff is never less than its reservation level.

The multinational's lack of information prevents it from knowing how large a concession it can extract from the domestic firm. It can always extract larger concessions when the domestic firm has favorable information. Thus the domestic firm has an incentive to conceal favorable information. To limit the gain to the domestic firm from concealing favorable information, the optimal contract calls for the multinational to bear all the investment and take all the equity in response to a report of unfavorable prospects by the domestic firm.[15] Equity participation constraints may restrict this avenue for inducing truthful revelation. In this event, the multinational may have to resort to distorting investment policy to induce truthful revelation. Because lowering investment reduces the benefit to the domestic firm from concealing favorable information, the solution calls for underinvestment in response to a report of unfavorable prospects.

Increasing the severity of equity participation constraints exacerbates underinvestment, thereby resulting in reduced employment in the domestic economy. Further, because these restrictions limit the multinational's ability to use contract design to eliminate the benefits from misreporting, larger payoffs to the domestic firm may be required to elicit correct information. Thus equity participation restrictions may increase the information rents earned by the owners of the domestic firm.

Constraints on the domestic firm's investment have no effect on the optimal venture structure. The reason is straightforward: the binding incentive

[15] Note that Equation (11) can be restated as follows: $V_G(S_G) \geq V_B(S_B) + (H-L)(1-\beta_B)(P_G(I_B) - P_B(I_B))$. From this expression it can be seen that for contacts that hold $V_B(S_B)$ fixed, increasing β_B loosens the incentive constraint.

condition is that the domestic firm, when it has good information, not falsely report bad information. The remedy for this incentive problem is to minimize the domestic firm's stake in the project when it has adverse information. This remedy calls for maximal multinational investment participation. Thus domestic financing is counterproductive. These results are formalized in the next proposition.

Proposition 2. *When the multinational possesses the bargaining power but the domestic firm has the informational advantage, the following results hold*:

- (*i*) *When the domestic firm has unfavorable information, the multinational will acquire the most equity-like claim, consistent with the equity participation constraint.*
- (*ii*) *Investment is distorted in the direction of underinvestment when the domestic firm has adverse information, and not distorted when the domestic firm has favorable information.*
- (*iii*) *Capital constraints preventing domestic participation are not costly to the multinational.*
- (*iv*) *Equity participation restrictions reduce the profitability of the venture to the multinational, may increase the domestic firm's payoff, and can result in decreased employment.*

The following example illustrates this result; in the example, we assume the same general functional form for the probability of realizing cash flow H:

$$P_t(I) \equiv P_t^o + \frac{(I-25)^{c_t}}{100}, \qquad t = G, B \quad I \in [25, 33].$$

As in the previous example, the equity participation restriction limits the multinational's equity participation to 90% (i.e., $\beta \leq \alpha = 0.90$) and the domestic firm investment participation constraint specifies that all funds are provided by the multinational, that is, $\bar{\epsilon} = 0$. In this example, π is assumed to equal 0.50. The numerical parameters used in our example and the results of our search for an optimal contract are presented in Table 2.[16]

Note that when the domestic firm reports positive information, the optimal venture structure always calls for the Pareto-optimal level of investment. When the domestic firm reports negative information, the optimal contract requires that the investment level be reduced below the Pareto-optimal level to 25.0664 in the absence of equity participation constraints. In this case the distortion is caused by the imposition of limited liability. When equity participation constraints are imposed, a further reduction of the investment level to 25.0509 is required. Also note that the domestic firm earns an informational

[16] The calculations in the example were performed using Mathematica. A Mathematica notebook containing both the calculations and a detailed explanation is available upon request.

Table 2
The optimal contract: multinational possesses both bargaining power but the domestic firm has the informational advantage

Panel A. Venture structure: cash flow sharing

	With restrictions		Without restrictions	
Type	γ^*	β^*	γ^*	β^*
G	1.0000	0.8454	1.0000	0.8641
B	0.4128	0.9000	0.0000	0.9579

Panel B. Investment and payoffs

		With restrictions		Without restrictions	
Type	I^{PO}	I^*	V^*	I^*	V^*
G	26.2079	26.2079	32.8585	26.2079	28.8893
B	25.0778	25.0509	26.0000	25.0664	26.0000
		$E[U^*] = 142.735$		$E[U^*] = 144.722$	

This table shows the design of the optimal contract between the multinational and the domestic firm forming a venture, when the multinational possesses bargaining power, but the domestic firm has the informational advantage. The multinational firm's equity participation cannot exceed a level of 90%, and all funds for the venture are provided by the multinational. The table presents cash flow sharing between the multinational and the domestic firm in panel A. In panel B the table presents the investment by the multinational firm and payoffs to the multinational firm and the domestic firm when the noisy information signal, t, indicates either good prospects, G, or bad prospects, B, for the venture. These data are presented in the presence of as well as in the absence of equity participation restrictions. In the model, β represents the slope of the contract with respect to cash flows, a higher slope indicating increased payments to the multinational with the venture's cash flows. γ represents the fraction of the low cash flow, L, that is received by the multinational firm. Limited liability implies that $\gamma \in [0, 1]$. I^{PO} represents the Pareto-optimal investment by the multinational firm in the venture. $E[U^*]$ denotes the expected payoff to the multinational firm from funding the initial investment expense, I, for the venture. The domestic firm receives the payoff, V, from the venture. The assumed parameter values are $\alpha = 0.90$, $H = 300.00$, $L = 20.00$, $V_{\min} = 26.00$, $P_G^o = 0.75$, $P_B^o = 0.50$, $c_G = 0.30$, and $c_B = 0.03$.

rent of $28.8893 - 26.000 = 2.8893$ in the absence of the equity participation restriction. Because of the reduced ability of the contracting menu to force revelation, the informational rent earned by the domestic firm increases to $32.8585 - 26.0000 = 6.8585$ when the equity participation restriction is imposed.

Propositions 1 and 2 demonstrate that when the multinational has the bargaining advantage, equity participation restrictions can exacerbate investment distortions. This increased distortion results because the equity participation restrictions limit contractual flexibility and thus necessitate greater investment distortion to deter mimicry. As we demonstrate in the following section, when the bargaining advantage rests with the domestic firm, equity participation restrictions no longer exert these distortionary effects. The analysis in this section also shows that when the multinational possesses the bargaining power, investment is not distorted by capital constraints preventing domestic-firm investment. This result also reverses when bargaining power rests with the domestic firm.

3. The Bargaining Advantage Rests with the Domestic Firm

In this section we characterize optimal contract-investment pairs in cases where the domestic firm possesses the bargaining advantage. We examine

two cases: (i) the domestic firm also possesses an informational advantage, and (ii) the multinational firm has the informational advantage. In both cases, the equity participation constraint does not distort investment policy.[17]

3.1 The domestic firm possesses an informational advantage

The problem faced by the domestic firm in this setting is similar to that faced by the multinational when it possesses both informational and bargaining advantages, that is, it has to prevent its contract from being undervalued by the multinational firm. Thus we focus on the structure ($\mathbf{S}_G^*$) that solves the signaling problem P-DB/DI stated below:

$$\text{P-DB/DI} \qquad \max_{S_G \in \mathcal{S}} V_G(S_G)$$

$$V_B(S_G) - V_B^{PO} \leq 0 \tag{15}$$

$$U_G(S_G) \geq 0. \tag{16}$$

The solution is the structure that signals favorable information at the lowest cost to the domestic firm if it observes G. If it observes B, the domestic firm chooses the Pareto-optimal investment level and a contract that allows it to capture all the rents from the venture.

Here, higher levels of domestic equity participation, because they involve bearing more of the venture's risk, signal favorable information. When it is not possible to signal through its equity stake alone, the domestic firm will choose the costly alternative of overinvesting. Here, too, greater investment, because it is less profitable if the domestic firm has unfavorable information, signals good prospects. Because the equity participation constraint does not restrict equity ownership by the domestic firm, it has no effect on the terms of the venture.

However, the restriction on the domestic firm's investment share could prevent it from utilizing the most efficient signal, resulting in a transfer of wealth to the multinational.

Proposition 3. *When the domestic firm possesses both bargaining and informational advantages*:

(*i*) *Optimal structures need not involve any multinational equity participation in the venture.*

(*ii*) *Investment is distorted in the direction of overinvestment, but the magnitude of this distortion is unaffected by the severity of equity participation restrictions.*

[17] However, if an upper bound were to be placed on *domestic firm* equity participation, this upper bound would have a distortionary effect on investment. In essence, this distortion occurs for exactly the same reasons that an upper bound on multinational ownership distorts investment when the multinational has the bargaining advantage.

(*iii*) *Capital constraints preventing domestic investment participation are costly to the domestic firm.*

(*iv*) *Equity participation restrictions do not affect the profitability of the venture to the domestic firm, the multinational's payoff, or the level of employment.*

3.2 The multinational firm possesses the informational advantage

In this case, the bargaining power of the domestic firm is counterbalanced by the multinational's informational advantage. We employ the mechanism design problem P-DB/MI to characterize optimal structures:

$$\text{P-DB/MI} \qquad \max_{S_G \in \mathcal{S},\, S_B \in \mathcal{S}} \pi V_G(S_G) + (1-\pi) V_B(S_B)$$

$$U_G(S_B) - U_G(S_G) \leq 0 \tag{17}$$

$$U_B(S_G) - U_B(S_B) \leq 0 \tag{18}$$

$$U_G(S_G) \geq 0 \tag{19}$$

$$U_B(S_B) \geq 0. \tag{20}$$

The first two constraints, Equations (17) and (18), ensure that the multinational firm's contract choice truthfully reveals its information. The next two constraints, Equations (19) and (20), ensure that, regardless of its private information, the multinational has an incentive to participate in the venture.

This problem is a mirror image of problem P-MB/DI from Section 2. The domestic firm's lack of information prevents it from knowing how large a concession it can extract from the multinational firm. The multinational has an incentive to conceal favorable information from the domestic firm. To induce revelation, the domestic firm chooses a structure that assigns it the maximum equity stake and restricts investment in response to a report of unfavorable information by the multinational firm. To increase its exposure, the domestic firm may have an incentive to increase its investment in the venture. This increase in exposure may be deterred by constraints on its investment share. On the one hand, because the equity participation restriction is not violated by this structure, investment in the venture is not distorted by increasing the severity of equity participation constraints. On the other hand, because the domestic firm would like to limit the multinational's investment participation in the project when the multinational reports adverse information, capital constraints on the domestic firm are costly.

Proposition 4. *When the domestic firm possesses the bargaining advantage but the multinational has the informational advantage*:

(*i*) *Optimal structures need not involve any multinational equity participation.*

(*ii*) *Investment is distorted in the direction of underinvestment, but the magnitude of this distortion is unaffected by the severity of equity participation restrictions.*

(*iii*) *Capital constraints preventing domestic investment participation are costly to the domestic firm.*

(*iv*) *Investment is distorted in the direction of underinvestment. Equity participation restrictions also do not affect the profitability of the venture to the multinational, the domestic firm's payoff, or employment.*

From Propositions 3 and 4 it follows that equity participation restrictions are not binding when the bargaining advantage lies with the domestic partners in cooperative ventures. Thus a shift in bargaining power toward firms operating in emerging economies, which rely heavily on foreign investment, should result in reducing the political salience of equity participation restrictions. The proposition also indicates that shifts in bargaining power toward domestic partners will make capital constraints faced by domestic partners more costly to the domestic partners of multinationals.[18]

4. Empirical Implications

Our results provide a number of insights for future research on international cooperative agreements. In the absence of any guidance from a theoretical treatment of international cooperative ventures, most empirical research has simply attempted to measure the unconditional wealth effects of the announcements of such ventures. Not surprisingly, this research has produced mixed results: Some researchers document positive and others negative wealth effects [see, e.g., Finnerty, Owers, and Rodgers (1986), Lee and Wyatt (1990), Lummer and McConnell (1990), and Crutchley, Guo, and Hansen (1991)]. Our analysis points to conditioning variables that can be used to formulate hypotheses regarding the wealth effects of joint ventures. Some evidence also points to the fact that conditioning announcement effects on these variables may produce more determinate results. For example, Lee and Wyatt (1990) and Frohls et al. (1994) document more positive wealth effects for joint ventures in emerging markets. Because multinationals should have a greater bargaining advantage over firms in emerging economies, this result is consistent with our conclusion that a multinational's bargaining power is positively related to wealth effects of a venture.

Well-specified tests of wealth effects may require (a) controlling for informational and bargaining power effects through incorporating control variables and (b) capturing ex ante investment expectations using the Heckman

[18] See Parasuram (1995) for a discussion by the late U.S. Commerce Secretary, Ron Brown, on the shift in bargaining power toward emerging economies.

methodology [Heckman (1979)]. Examples of control variables for bargaining power are measures of industry concentration in the domestic and international market, and dummy variables for legal restrictions on entry into the industry. Our analysis also indicates that, in the absence of capital controls, investment shares of the partners in a cooperative venture are also correlated with bargaining power. Examples of control variables for the locus of the informational advantage include measures of the complexity of production technology, the market (domestic or international) for the venture's products, the source of the inputs into the production process, and whether the multinational has prior experience in the domestic country. These same variables can be used as dependent variables in the qualitative choice model used to perform the Heckman adjustment.

As well as providing focus for empirical research on the wealth effects of cooperative ventures, our results produce a number of sharp predictions regarding the structure of such ventures. For example, our analysis indicates that

- In industries in which multinationals have a bargaining advantage, equity participation constraints are more likely to bind.
- In industries in which the domestic firms have the bargaining advantage, sharing arrangements in which multinationals obtain fixed payments such as licensing fees should predominate.
- Cooperative ventures in countries with stricter equity participation restrictions will exhibit greater variability in scale.
- The level of investment in cooperative ventures should be higher when the same party holds both the bargaining and informational advantage.
- Domestic political forces will support equity participation restrictions only when multinationals have a bargaining advantage over domestic firms.
- The share of total venture investment costs borne by the multinational is increasing in the multinational's bargaining power.
- Variability in the partners' contributions to the overall project investment will be higher when domestic partners possess the bargaining advantage.

These hypotheses can be tested using qualitative-dependent variable techniques and standard cross-sectional regression methodology. For example, equity participation in cooperative ventures can be predicted using the variables discussed above as inputs to logit-probit models. The other hypotheses can be tested using linear regression analysis.

The results of our theoretical analysis depend on Equation (5), the legal minimum constraint. As discussed in Section 1, if the legal minimum constraint is violated, the equity participation may act not as a restriction on contract design but rather as a simple tax on the joint venture—a tax paid by the multinational to the domestic firm. Because of the taxlike nature of

the equity participation constraint when the legal minimum constraint is violated, analysis of the effect of violations is not difficult. First, note that constraints on the structure of the agreement that force increased payments to the domestic firm are only relevant when the domestic firm does not have the bargaining power. When the domestic firm has the bargaining power it will, in any case, always pick the agreement which maximizes its payoff. Thus even if the legal minimum is violated, the equity participation constraint is still only relevant when the multinational has the bargaining power. When the multinational has the bargaining power, the deadweight impact of the mandated transfers to the domestic firm will lower the incentive for the multinational to invest, regardless of its private information. On the one hand, because our model already predicts underinvestment when the domestic firm has private information, our predictions with or without the legal minimum constraint being satisfied, are qualitatively similar to those when the domestic firm has the private information. On the other hand, because we predict overinvestment when the multinational has private information, our predictions are qualitatively dependent on the legal minimum restriction in this case. When the legal minimum condition is violated, the multinational may underinvest, even when it has both the bargaining power and informational advantage over the domestic firm. Because empirically it is difficult to determine if the legal minimum constraint is satisfied, we need to condition our empirical predictions on the satisfaction of the legal minimum constraint. We predict that when the legal minimum constraint is satisfied, the multinational will overinvest, and when the legal minimum constraint is not satisfied, the multinational will underinvest.

Thus a proxy for the legal minimum constraint is required to test our model predictions. The theory of public choice suggests a possible proxy. When Equation (5) is violated, domestic firms will realize ex ante that participation in joint ventures generates pure economic rents. One would expect, in such a situation, that government officials would have an incentive to extract these rents from domestic firms by restricting access to joint ventures, perhaps by requiring a government license for participation. Thus one proxy for violation of the legal minimum constraint might be regulations imposing licensing requirements on joint venture participation by domestic firms.

5. Conclusion

In this article we determine the relevance and impact of equity participation and investment restrictions imposed on international cooperative ventures. Our results demonstrate that equity participation restrictions bind only when multinational partners in cooperative ventures possess a bargaining advantage and one of the parties to the venture possesses an informational advantage. Conversely, investment restrictions on domestic firms matter only when the

domestic firm possesses a bargaining advantage and the partners are asymmetrically informed.

The existence of differential information results in investment distortions—overinvestment in the venture when the informational advantage is complemented by a bargaining advantage, and underinvestment when the partner with the bargaining advantage is at an informational disadvantage. Equity participation restrictions on the multinational exacerbate these distortions when it has the bargaining edge, while investment restrictions on the domestic firm can exacerbate the investment distortion when it has the bargaining advantage.

Although we consider a number of possible allocations of bargaining power and information between multinational and domestic partners in a cooperative venture, our analysis is not exhaustive. Notably, we focus on extreme cases in which one is allocated all bargaining power and one (perhaps different) party is allocated all information. Our analysis is also limited in that we consider only "stand-alone" cooperative ventures—sharing arrangements that do not involve the commitment of resources from outside the cooperative venture to fund the project. Thus the venture has limited liability. Another simplification used in our analysis was abstracting from the effect of the venture's structure on performance incentives. Extant research demonstrates that the performance incentive of the agents can be improved by providing them with a share of residual claims [see, e.g., Innes (1990)]. This would indicate that allowing a role for performance incentives would lead to less extreme forms of cash flow sharing than characterized in our analysis. Extensions of our analysis that model performance incentives could provide valuable insights into other effects of restrictions on multinational equity ownership. Finally, to simplify the analysis, we only consider ventures with two partners. An extension of our research could model the effects of allowing for coalitions of multinational and domestic firms as venture partners. Such an extension would be valuable because evidence exists that a number of ventures have multiple partners [Porter and Fuller (1986)].

Appendix

In this appendix we present the proofs of all our propositions. To maximize readability we provide the statement of the proposition and we also place beside the name of each constraint the name of the associated Lagrange multiplier.

Proposition 1. *When the multinational possesses both bargaining and informational advantages the following results hold.*

(*i*) *When the multinational has favorable information, it acquires the most equity-like claim consistent with the equity participation constraint.*

(*ii*) *Investment is distorted in the direction of overinvestment and the magnitude of this distortion may increase with the severity of equity participation restrictions.*

(*iii*) *Capital constraints preventing domestic participation are not costly to the multinational.*

(*iv*) *Equity participation restrictions reduce the profitability of the venture to the multinational, leave the domestic firm indifferent, and may result in increased employment.*

Proof. The structure design problem, P-MB/MI, can be expressed as follows.

$$\max_{S_G} U_G(S_G)$$

$$\text{s.t. } U_B(S_G) - U_B^{PO} \leq 0 \tag{A1}$$

$$V_{\min} - V_G(S_G) \leq 0 \tag{A2}$$

$$I_G \in [I_{\min}, I_{\max}] \quad \gamma_G \in [0,1] \quad \beta_G \in [0,\alpha] \quad \epsilon_G \in [0,\bar{\epsilon}].$$

The derivatives of the associated Lagrangian are given as follows:

$$\frac{\partial \mathcal{L}}{\partial \gamma_G} = L[(1-\lambda_2) - \lambda_1] \tag{A3}$$

$$\frac{\partial \mathcal{L}}{\partial \epsilon_G} = (1-\lambda_2) - \lambda_1 \tag{A4}$$

$$\frac{\partial \mathcal{L}}{\partial \beta_G} = P_B(I_G)(H-L)\left[\frac{P_G(I_G)}{P_B(I_G)}(1-\lambda_2) - \lambda_1\right] \tag{A5}$$

$$\frac{\partial \mathcal{L}}{\partial I_G} = \beta_G(H-L)[(1-\lambda_2)P_G'(I_G) - \lambda_1 P_B'(I_G)] + \lambda_2(P_G'(I_G)(H-L)-1) - (1-\lambda_2-\lambda_1). \tag{A6}$$

To prove the proposition we first establish (i) and (ii). The other results then follow. First, note that maximal equity participation (i) requires either that the multinational owns only an equity claim on the firm's cash flows and the domestic partner therefore holds a senior debt claim, that is, $\gamma_G^* = 0$, or that the multinational and the domestic firm share both the high and low cash flows and the equity participation constraint binds, that is, $\beta_G^* = \alpha$.[19] Distortion requires that the investment level exceeds the Pareto-optimal level. Since the Pareto-optimal level is characterized by marginal return on investment equaling one plus the rate of return on capital, and the assumed interest rate is zero, the Pareto-optimal level of investment is implicitly defined by the condition that $P_G'(I_G)(H-L) = 1$. Overinvestment (ii) occurs when $P_G'(I_G^*)(H-L) < 1$. Therefore we need to show that

$$\text{(i) } \beta_G^* = \alpha \text{ or } \gamma_G^* = 0$$

$$\text{(ii) } P_G'(I_G^*)(H-L) \leq 1.$$

We will first prove that (i) holds. Then we will use (i) to prove (ii). To initiate the proof of (i), first note that the multinational must receive something. Thus it must be the case that either $\beta_G^* > 0$ or $\gamma_G^* > 0$. This implies that the partial derivative associated with at least one of these partials must be nonnegative. This implies, because $P_G(I_G) > P_B(I_G)$ [by Equation (3)] that

$$\max\left\{\frac{\partial \mathcal{L}^*}{\partial \beta_G}, \frac{\partial \mathcal{L}^*}{\partial \gamma_G}\right\} \geq 0.$$

[19] We use "*" to denote values of the variable that solve the optimization problem and we use "$\partial \mathcal{L}^*$" to represent the evaluation of the derivative of the Lagrangian at a solution to the optimization problem.

Using the definitions of the partials of the Lagrange multipliers provided by Equations (A3) and (A5), we see that

$$\max\left\{\left[\frac{P_G(I_G^*)}{P_B(I_G^*)}(1-\lambda_2^*)-\lambda_1^*\right],\left[(1-\lambda_2^*)-\lambda_1^*\right]\right\}\geq 0.$$

This inequality, combined with the total productivity assumption of Equation (3), implies that

$$\frac{P_G(I_G^*)}{P_B(I_G^*)}(1-\lambda_2^*)-\lambda_1^*\geq 0.$$

Thus

$$\frac{\partial \mathcal{L}^*}{\partial \beta_G}\geq 0,$$

which implies, by Equation (A5), that

$$P_G(I_G^*)(1-\lambda_2^*)-P_B(I_G^*)\lambda_1^*\geq 0. \tag{A7}$$

If, on the one hand, $\frac{\partial \mathcal{L}^*}{\partial \beta_G}=0$ then it would have to be the case by Equation (A5) that

$$\frac{P_G(I_G^*)}{P_B(I_G^*)}(1-\lambda_2^*)-\lambda_1^*=0.$$

Equation (3) then implies that $(1-\lambda_2^*)-\lambda_1^*<0$. By Equation (A4), this fact implies that $\frac{\partial \mathcal{L}^*}{\partial \gamma_G}<0$, which by the Kuhn–Tucker (K-T) conditions implies that $\gamma_G^*=0$. If, on the other hand, $\frac{\partial \mathcal{L}^*}{\partial \beta_G}>0$, then the K-T conditions imply that $\beta_G^*=\alpha$. Thus we have shown that either $\beta_G^*=\alpha$ or $\gamma_G^*=0$, that is, we have established (i).

Next, note for future reference that, by the legal minimum assumption, Equation (5), the domestic firm must capture more than the legal minimum in the optimal solution, that is, either $\gamma<1$ or $\beta<\alpha$. Thus it must be the case that

$$\min\left\{\frac{\partial \mathcal{L}^*}{\partial \beta_G},\frac{\partial \mathcal{L}^*}{\partial \gamma_G}\right\}\leq 0.$$

This expression, and the derivative definitions of Equations (A3) and (A5) imply that

$$\min\left\{\frac{P_G(I_G^*)}{P_B(I_G^*)}(1-\lambda_2^*)-\lambda_1^*,(1-\lambda_2^*)-\lambda_1^*\right\}\leq 0. \tag{A8}$$

This expression implies, because, by Equation (3), $P_G(I_G^*)/P_B(I_B^*)>1$, that

$$(1-\lambda_2^*)-\lambda_1^*\leq 0. \tag{A9}$$

To prove (ii) note first that, because marginal product of investment varies between zero and infinity over the feasible range of investment, we must have an interior level of investment. That is, it must be the case that

$$\frac{\partial \mathcal{L}^*}{\partial I_G}=0. \tag{A10}$$

Now note that Equation (A7) implies that

$$\frac{P_G(I_G^*)}{P_B(I_G^*)}\geq\frac{\lambda_1^*}{(1-\lambda_2^*)}\quad\text{and}\quad(1-\lambda_2^*)\geq 0. \tag{A11}$$

Thus

$$P'_G(I^*_G)(1-\lambda^*_2) - P'_B(I^*_G)\lambda^*_1 = (1-\lambda^*_2)P'_B(I^*_G)\left[\frac{P'_G(I^*_G)}{P'_B(I^*_G)} - \frac{\lambda^*_1}{1-\lambda^*_2}\right]$$
$$\geq (1-\lambda^*_2)P'_B(I^*_G)\left[\frac{P'_G(I^*_G)}{P'_B(I^*_G)} - \frac{P_G(I^*_G)}{P_B(I^*_G)}\right] \geq 0. \tag{A12}$$

where the last inequality follows from the marginal productivity Equation (2). Because of Equations (A6), (A10), (A11), and (A12), it must be the case that $(P'_G(I^*_G)(H-L)-1) \leq 0$, that is, (ii) holds.

Showing that (iii) holds is simple. Note that Equations (A4) and (A7) imply that $\frac{\partial \mathcal{L}^*}{\partial \epsilon_G} \leq 0$. Thus relaxing the upper bound on domestic investment never increases the welfare of the multinational. To prove the final result, (iv), first note that $\lambda^*_2 > 0$, regardless of the tightness of the equity participation constraint. This follows from Equations (A6), (A7), (A10), and (A12). Thus the reservation constraint of Equation (A4) always binds. This implies that, in any optimal solution, the domestic firm always receives its reservation payoff, $V_{\min}$, and thus is not affected by equity participation constraints. Since the equity participation constraint reduces the feasible space for the multinational's optimization problem, it must (weakly) lower the multinational's payoff. Thus we have established (iv). This completes the proof of Proposition 1. ■

Proposition 2. *When the multinational possesses the bargaining power but the domestic firm has the informational advantages the following results hold*:

(*i*) *When the domestic firm has unfavorable information, the multinational will acquire the most equity-like claim consistent with the equity participation constraint.*

(*ii*) *Investment is distorted in the direction of underinvestment when the domestic firm has adverse information and is not distorted when the domestic firm has favorable information.*

(*iii*) *Capital constraints preventing domestic participation are not costly to the multinational.*

(*iv*) *Equity participation restrictions reduce the profitability of the venture to the multinational may increase the domestic firm's payoff and can result in decreased employment.*

Proof. The mechanism design problem P-MB/DI can be expressed as follows:

$$\max_{S_G, S_B} \pi U_G(S_G) + (1-\pi)U_B(S_B)$$
$$V_G(S_B) - V_G(S_G) \leq 0 \tag{A13}$$
$$V_B(S_G) - V_B(S_B) \leq 0 \tag{A14}$$
$$V_{\min} - V_G(S_G) \leq 0 \tag{A15}$$
$$V_{\min} - V_B(S_B) \leq 0 \tag{A16}$$
$$I_G \in [I_{\min}, I_{\max}] \qquad I_B \in [I_{\min}, I_{\max}]$$
$$\beta_G \in [0, \alpha] \qquad \beta_B \in [0, \alpha]$$
$$\gamma_G \in [0, 1] \qquad \gamma_B \in [0, 1]$$
$$\epsilon_G \in [0, \bar{\epsilon}] \qquad \epsilon_B \in [0, \bar{\epsilon}].$$

This venture structure design problem has four constraints and six unknowns. Obtaining an analytical result requires us to determine which constraints are binding. We follow a standard approach to the identification of the binding constraints and progressively eliminate constraints from consideration starting with the "easiest" eliminations. First, consider Equation (A15), the

reservation constraint for the G-type domestic firm. First-order stochastic dominance of type G's cash flows, together with the fact that Equation (A13) is satisfied, ensures that

$$V_G(S_G^*) \geq V_G(S_B^*) > V_B(S_B^*) \geq V_{\min}.$$

Thus Equation (A15) never binds. So the Kuhn–Tucker (K-T) conditions imply that the Lagrange multiplier associated with this constraint, λ_3^*, equals 0. This fact is recorded below:

$$\lambda_3^* = 0. \tag{A17}$$

Having determined that the domestic participation constraint under positive information, Equation (A15), never binds, we now show that the mimicry constraint associated with positive information, Equation (A13), always binds. To accomplish this task we need to consider the signs of the derivatives of the Lagrangian with respect to β, ϵ, and γ. These derivatives are given below:[20]

$$\frac{\partial \mathcal{L}}{\partial \gamma_G} \overset{\text{ss}}{=} \pi - \lambda_1^* + \lambda_2^* \tag{A18}$$

$$\frac{\partial \mathcal{L}}{\partial \epsilon_G} \overset{\text{ss}}{=} \pi - \lambda_1^* + \lambda_2^* \tag{A19}$$

$$\frac{\partial \mathcal{L}}{\partial \beta_G} \overset{\text{ss}}{=} \pi - \lambda_1^* + \lambda_2^* \frac{P_B(I_G^*)}{P_G(I_G^*)} \tag{A20}$$

$$\frac{\partial \mathcal{L}}{\partial \gamma_B} \overset{\text{ss}}{=} (1-\pi) + \lambda_1^* - \lambda_4^* - \lambda_2^* \tag{A21}$$

$$\frac{\partial \mathcal{L}}{\partial \epsilon_B} \overset{\text{ss}}{=} (1-\pi) + \lambda_1^* - \lambda_4^* - \lambda_2^* \tag{A22}$$

$$\frac{\partial \mathcal{L}}{\partial \beta_B} \overset{\text{ss}}{=} (1-\pi) + \lambda_1^* \frac{P_G(I_B^*)}{P_B(I_B^*)} - \lambda_2^* - \lambda_4^*. \tag{A23}$$

Next, note that our total productivity assumption, Equation (3), that $P_B(\cdot) < P_G(\cdot)$, implies that, at any solution to the problem,

$$\begin{aligned} \lambda_2^* = 0 &\Longrightarrow \frac{\partial \mathcal{L}^*}{\partial \gamma_G} = \frac{\partial \mathcal{L}^*}{\partial \epsilon_G} = \frac{\partial \mathcal{L}^*}{\partial \beta_G} \qquad \lambda_2^* > 0 \Longrightarrow \frac{\partial \mathcal{L}^*}{\partial \gamma_G} = \frac{\partial \mathcal{L}^*}{\partial \epsilon_G} > \frac{\partial \mathcal{L}^*}{\partial \beta_G}, \\ \lambda_1^* = 0 &\Longrightarrow \frac{\partial \mathcal{L}^*}{\partial \gamma_B} = \frac{\partial \mathcal{L}^*}{\partial \epsilon_B} = \frac{\partial \mathcal{L}^*}{\partial \beta_B} \qquad \lambda_1^* > 0 \Longrightarrow \frac{\partial \mathcal{L}^*}{\partial \gamma_B} = \frac{\partial \mathcal{L}^*}{\partial \epsilon_B} < \frac{\partial \mathcal{L}^*}{\partial \beta_B}. \end{aligned} \tag{A24}$$

Next, note that $\lambda_1^* > 0$, otherwise, by Equations (A18), (A19), and (A20) and the K-T conditions, it would have to be the case that $\beta_G^* = \alpha$, $\gamma_G^* = 1, \epsilon_G^* = \bar{\epsilon}$. Such a contract would specify a zero payment to the domestic firm and thus contradict the participation constraint of Equation (A15). Because, $\lambda_1^* > 0$, the associated constraint must be satisfied as an equality. Thus we have established that

$$V_G(S_G^*) = V_G(S_B^*) \quad \text{and} \quad \lambda_1^* > 0. \tag{A25}$$

Our next step is to show that Equation (A14) never binds, that is, that $\lambda_2^* = 0$. Our first step in this direction is to show that

Result 1. *If S^* is optimal, $\gamma_G^* + \epsilon_G^* > 0$.*

[20] The notation " $\overset{\text{ss}}{=}$ " indicates that the two expressions have the same sign.

Proof of Result 1. If Result 1 did not hold, we would have $\gamma_G^* = \epsilon_G^* = 0$. By the K-T conditions, this would imply that

$$\frac{\partial \mathcal{L}^*}{\partial \epsilon_G} \left(= \frac{\partial \mathcal{L}^*}{\partial \gamma_G} \right) \leq 0.$$

By Equation (A24) this implies that $\frac{\partial \mathcal{L}^*}{\partial \beta_G} < 0$. The fact that $\frac{\partial \mathcal{L}^*}{\partial \beta_G} < 0$ implies that it is also the case that $\beta_G^* = 0$. Thus the optimal contract would have to offer the entire cash flow to the domestic firm on a report of G. Thus the payoff to the multinational, given the true state is G, would be $-I_G^*$. Now the total payoff when the true state is B is never greater than the payoff at the Pareto-optimal investment level. Moreover, in order for the domestic firm's reservation constraint to be satisfied, the domestic firm must receive at least $V_{\min}$. Thus the highest possible payoff for the multinational when the true state is B is $(H-L)P_B(I_B^{PO}) - I_B^{PO} - V_{\min}$. Therefore the payoff to the multinational under S^* is no greater than

$$\pi(-I_G^*) + (1-\pi)((H-L)P_B(I_B^{PO}) - I_B^{PO} - V_{\min}). \tag{A26}$$

By simply having the domestic firm always invest at the Pareto-optimal level when information is B, I_B^{PO}, and setting contract terms (for both a report of B and G) to satisfy the reservation constraint when information is B, the multinational could earn a payoff of at least

$$(H-L)P_B(I_B^{PO}) - I_B^{PO} - V_{\min}. \tag{A27}$$

Inspection shows that Equation (A27) exceeds Equation (A26), contradicting the optimality of the policy involving $\gamma_G^* + \epsilon_G^* = 0$ and thus proving Result 1. ■

Next we require the following result.

Result 2. *If Equation* (A14) *binds, then* $I_G^* \geq I_B^*$.

Proof of Result 2. Suppose, to obtain a contradiction, that Equation (A14) binds and that $I_G^* < I_B^*$. Because, by Equation (A25), Equation (A13) also binds, it must be the case that both mimicry constraints bind. Both constraints binding implies that the structure, S^o, that involves "switching contracts," that is, setting $S_B^o = S_G^*$, $S_G^o = S_B^*$, would clearly satisfy the constraints of the mechanism design problem. Moreover, by Equation (2), output would be higher under S^o. The multinational's payoff equals total payoff less the domestic firm's payoff. Because both mimicry constraints bind, the payoff to the domestic firm would be the same under S^* and S^o. Thus the multinational's payoff would be higher under the feasible structure S^o, contradicting the optimality of S^*. ■

We now use Result 1 and Result 2 to establish Result 3.

Result 3. $\frac{\partial \mathcal{L}^*}{\partial \beta_B} \leq 0 \Rightarrow$ *(DB) is not binding.*

Proof of Result 3. As shown by Equation (A25), Equation (A13) is always binding. Thus if Equation (A14) were binding, then both Equations (A14) and (A13) would be binding. Note that $\frac{\partial \mathcal{L}^*}{\partial \beta_B} \leq 0$ implies, by Equation (A24), that $\frac{\partial \mathcal{L}^*}{\partial \gamma_B} = \frac{\partial \mathcal{L}^*}{\partial \epsilon_B} < 0$. This fact implies that $\gamma_B^* = \epsilon_B^* = 0$. Using the definitions of the payoffs to the agents, we see that (DB) being binding implies that

$$L + (1-\beta_B^*)(H-L)P_B(I_B^*) = (1-\gamma_G^*)L + (1-\beta_G^*)(H-L)P_B(I_G^*) - \epsilon_G^* I_G^*. \tag{A28}$$

Next, let $R = \gamma_G^* L + \epsilon_G^* I_G^*$. Using this notation we can rewrite Equation (A28) as follows:

$$R + (1-\beta_B^*)(H-L)P_B(I_B^*) = (1-\beta_G^*)(H-L)P_B(I_G^*). \tag{A29}$$

Similarly, if Equation (A13) were also binding, we would have

$$R+(1-\beta_B^*)(H-L)P_G(I_B^*)=(1-\beta_G^*)(H-L)P_G(I_G^*). \tag{A30}$$

Rearranging, and dividing Equation (A29) by Equation (A30), we see that

$$\frac{R+(1-\beta_B^*)(H-L)P_B(I_B^*)}{R+(1-\beta_B^*)(H-L)P_G(I_B^*)}=\frac{(1-\beta_G^*)(H-L)P_B(I_G^*)}{(1-\beta_G^*)(H-L)P_G(I_G^*)}=\frac{P_B(I_G^*)}{P_G(I_G^*)}. \tag{A31}$$

Next, note that the function q, defined by

$$q(R)=\frac{R+(1-\beta_B^*)(H-L)P_B(I_B^*)}{R+(1-\beta_B^*)(H-L)P_G(I_B^*)}=1-\frac{[P_G(I_B^*)-P_B(I_B^*)](1-\beta_B^*)(H-L)}{R+(1-\beta_B^*)(H-L)P_G(I_B^*)}$$

is increasing when $R\geq 0$. By Result 1, $R>0$; thus

$$\frac{R+(1-\beta_B^*)(H-L)P_B(I_B^*)}{R+(1-\beta_B^*)(H-L)P_G(I_B^*)}=q(R)>q(0)=\frac{P_B(I_B^*)}{P_G(I_B^*)}. \tag{A32}$$

Thus Equations (A31) and (A32) imply that

$$\frac{P_B(I_B^*)}{P_G(I_B^*)}<\frac{P_B(I_G^*)}{P_G(I_G^*)}. \tag{A33}$$

However, basic calculus shows that our marginal productivity condition, Equation (3), implies that the function $I\rightarrow P_B(I)/P_G(I)$ is decreasing. By Result 2, $I_G^*\geq I_B^*$. Thus

$$\frac{P_B(I_B^*)}{P_G(I_B^*)}\geq\frac{P_B(I_G^*)}{P_G(I_G^*)}. \tag{A34}$$

This contradiction between Equation (A33) and Equation (A34) shows that both constraints cannot bind. We have already shown that Equation (A13) must bind. Thus it must be the case that Equation (A14) does not bind. ■

Next, we establish the following result.

Result 4. *When* $\frac{\partial\mathcal{F}^*}{\partial\beta_B}>0\Rightarrow$ *Equation* (A14) *is not binding.*

Proof of Result 4. The definition of the payoff function for the domestic firm implies that

$$V_G(S)=V_B(S)-(1-\beta)(P_G(I)-P_B(I)). \tag{A35}$$

Because $\frac{\partial\mathcal{F}^*}{\partial\beta_B}>0$, $\beta_B^*=\alpha$. Because we have already shown that Equation (A13) binds, if Equation (A14) was also binding we would have $V_G(S_B^*)-V_B(S_B^*)=V_G(S_G^*)-V_B(S_G^*)$, which implies, by Equation (A35) and the fact that $\beta_B^*=\alpha$, that

$$(1-\beta_G^*)(P_G(I_G^*)-P_B(I_G^*))-(1-\alpha)(P_G(I_B^*)-P_B(I_B^*))=0. \tag{A36}$$

By the marginal productivity Equation (2), $P_G'>P_B'$. Thus the function

$$I\longrightarrow P_G(I)-P_B(I)$$

is increasing. By Result 2, $I_G^*\geq I_B^*$. Thus $P_G(I_G^*)-P_B(I_G^*)\geq P_G(I_B^*)-P_B(I_G^*)$ and the inequality is strict whenever $I_G^*>I_B^*$. Because α is the upper bound on the slope of the contract, $1-\beta_G^*\geq 1-\alpha$, and the inequality is strict whenever $\beta_G^*<\alpha$. Thus Equation (A36) can only hold if $\beta_G^*=\alpha=\beta_B^*$ and $I_G^*=I_B^*$. However, $\beta_G^*=\alpha$ implies that $\frac{\partial\mathcal{F}^*}{\partial\beta_G}\geq 0$, which implies by Equation (A24)

that $\frac{\partial \mathcal{L}^*}{\partial \gamma_G} = \frac{\partial \mathcal{L}^*}{\partial \epsilon_G} > 0$. This implies, by the K-T conditions, that $\gamma_G^* = 1$ and $\epsilon_G^* = 1$. However, this fact, combined with $\beta_G^* = \alpha$ and our Equation (5) (the worst possible contract does not meet the domestic firm's reservation constraint) implies that $\gamma_G^* = 1$ and $\epsilon_G^* = 1$, and $\beta_G^* = \alpha$ is not feasible. This contradiction establishes Result 4. ■

Together, Results 3 and 4 show that Equation (A14) is not binding. The K-T conditions thus imply that the multiplier associated with Equation (A14) equals 0, that is,

$$\lambda_2^* = 0. \tag{A37}$$

Because of Equations (A37) and (A18)–(A20), $\frac{\partial \mathcal{L}^*}{\partial \beta_G} = \frac{\partial \mathcal{L}^*}{\partial \epsilon_G} = \frac{\partial \mathcal{L}^*}{\partial \gamma_G}$. As we have shown earlier, the multinational cannot receive all cash flows (as she would if $\frac{\partial \mathcal{L}^*}{\partial \beta_G} = \frac{\partial \mathcal{L}^*}{\partial \epsilon_G} = \frac{\partial \mathcal{L}^*}{\partial \gamma_G}$ were positive); nor can the multinational receive zero cash flows (as she would if $\frac{\partial \mathcal{L}^*}{\partial \beta_G} = \frac{\partial \mathcal{L}^*}{\partial \epsilon_G} = \frac{\partial \mathcal{L}^*}{\partial \gamma_G}$ were negative). Thus $\frac{\partial \mathcal{L}^*}{\partial \beta_G} = \frac{\partial \mathcal{L}^*}{\partial \epsilon_G} = \frac{\partial \mathcal{L}^*}{\partial \gamma_G} = 0$, which implies by Equation (A18) that

$$\lambda_1^* = \pi. \tag{A38}$$

Next note that Equations (A25) and (A24) imply that $\frac{\partial \mathcal{L}^*}{\partial \beta_B} > \frac{\partial \mathcal{L}^*}{\partial \gamma_B}$. Thus in order for the domestic firm to receive a positive payoff it must be the case, by the K-T conditions, that $\frac{\partial \mathcal{L}^*}{\partial \gamma_B} \leq 0$. If $\frac{\partial \mathcal{L}^*}{\partial \gamma_B} < 0$, then $\gamma_B^* = 0$. If $\frac{\partial \mathcal{L}^*}{\partial \gamma_B} = 0$, then because $\frac{\partial \mathcal{L}^*}{\partial \beta_B} > \frac{\partial \mathcal{L}^*}{\partial \gamma_B}$, $\frac{\partial \mathcal{L}^*}{\partial \beta_B} > 0$ and $\beta_B^* = \alpha$. In either case, the multinational makes the most equity-like stake feasible. This proves (i).

Next we establish (ii). Imposing the condition $\lambda_2^* = \lambda_3^* = 0$ and $\lambda_1^* = \pi$, and taking the derivatives of the Lagrangian with respect to investment levels, yields

$$\frac{\partial \mathcal{L}^*}{\partial I_G} = \pi(P'(I_G^*)(H-L) - 1), \tag{A39}$$

$$\begin{aligned} \frac{\partial \mathcal{L}^*}{\partial I_B} = {} & (1-\pi)(\beta_B^* P_B'(I_B^*)(H-L) + \epsilon_B^* - 1) \\ & - \pi((1-\beta_B^*)P_G'(I_B^*)(H-L) - \epsilon_B^*) \\ & + \lambda_4^*((1-\beta_B^*)P_B'(I_B^*)(H-L) - \epsilon_B^*). \end{aligned} \tag{A40}$$

If on the one hand, $I_B^* = I_{\min}$, then underinvestment clearly occurs and (ii) is established. If on the other hand, $I_B^* > I_{\min}$, then $\frac{\partial \mathcal{L}^*}{\partial I_B} \geq 0$. Thus henceforth we assume that $\frac{\partial \mathcal{L}^*}{\partial I_B} \geq 0$. This implies that $\frac{\partial \mathcal{L}^*}{\partial \beta_B} \geq 0$, for if $\frac{\partial \mathcal{L}^*}{\partial \beta_B} < 0$, then, by Equations (A24) and (A25), and the K-T conditions, $\beta_B^* = \epsilon_B^* = \gamma_B^* = 0$. By the positive net present value assumption, Equation (1), these contract terms imply that payment to the domestic firm exceeds the reservation value and thus the multiplier for the reservation constraint, λ_4^*, would be zero. Because $\beta_B^* = \epsilon_B^* = \gamma_G^* = 0$ and $\lambda_4^* = 0$, Equation (A40) reduces to $\frac{\partial \mathcal{L}^*}{\partial I_B} = -(1-\pi) - \pi P_G'(I_B^*)(H-L) < 0$.

Thus when $I_B^* > I_{\min}$, $\frac{\partial \mathcal{L}^*}{\partial \beta_B} \geq 0$. Because $\frac{\partial \mathcal{L}^*}{\partial \beta_B} \geq 0$ and $\lambda_2^* = \lambda_3^* = 0$, and $\lambda_1^* = \pi$,

$$\lambda_4^* \leq (1-\pi) + \pi \frac{P_G(I_B^*)}{P_B(I_B^*)}. \tag{A41}$$

Substituting Equation (A41) into Equation (A40) and using the fact that $\frac{\partial \mathcal{L}^*}{\partial I_B} \geq 0$ yields

$$0 \leq \frac{\partial \mathcal{L}^*}{\partial I_B} \leq (1-\pi)(\beta_B^* P_B'(I_B^*)(H-L) + \epsilon_B^* - 1) \tag{A42}$$

$$- \pi((1-\beta_B^*)P_G'(I_B^*)(H-L) - \epsilon_B^*) \tag{A43}$$

$$+ (1-\pi)((1-\beta_B^*)P_B'(I_B^*)(H-L) - \epsilon_B^*) \tag{A44}$$

$$+ \pi \frac{P_G(I_B^*)}{P_B(I_B^*)}((1-\beta_B^*)P_B'(I_B^*)(H-L) - \epsilon_B^*). \tag{A45}$$

Combining Equations (A42) and (A44) and combining Equations (A43) and (A45) yields

$$0 \leq (1-\pi)(P'_B(I^*_B)(H-L)-1) \tag{A46}$$

$$+\pi P_G(I^*_G)\left(\left[\frac{P'_B(I^*_B)}{P_B(I^*_B)}-\frac{P'_G(I^*_B)}{P_G(I^*_B)}\right]+\left[\frac{\epsilon^*_B}{P_G(I^*_B)}-\frac{\epsilon^*_B}{P_B(I^*_B)}\right]\right). \tag{A47}$$

By Equations (2) and (3), the terms in Equation (A47) are negative. Thus the only way for the sum of the three terms to be nonnegative, as required by the inequality, is for Equation (A46) to be positive. In other words,

$$(1-\pi)(P'_B(I^*_B)(H-L)-1) > 0. \tag{A48}$$

This implies that the type B firm must underinvest. Equations (A39) and (A48) together establish result (ii). Result (iii) follows from Equations (A19) and (A22) after substituting in the conditions $\lambda^*_2 = \lambda^*_3 = 0$ and $\lambda^*_1 = \pi$. Given results (i), (ii), and (iii), result (iv) is straightforward. Because equity participation constraints restrict the multinational's mechanism design problem they must, at least weakly, lower the multinational's profits. Because investment is distorted in the direction of underinvestment, decreased employment can be produced by the participation restrictions. Thus (iv) is established. This completes the proof of Proposition 2. ■

Proposition 3. *When the domestic firm possesses both bargaining and informational advantages*:

(*i*) *Optimal structures need not involve any multinational equity participation in the venture.*
(*ii*) *Investment is distorted in the direction of overinvestment, but the magnitude of this distortion is unaffected by the severity of equity participation restrictions.*
(*iii*) *Capital constraints preventing domestic investment participation are costly to the domestic firm.*
(*iv*) *Equity participation restrictions do not affect the profitability of the venture to the domestic firm, the multinational's payoff, or the level of employment.*

Proof. The proof is virtually identical to the proof of Proposition 1 and thus is omitted.

Proposition 4. *When the domestic firm possesses the bargaining advantage, but the multinational has the informational advantage*:

(*i*) *Optimal structures need not involve any multinational equity participation.*
(*ii*) *Investment is distorted in the direction of underinvestment but the magnitude of this distortion is unaffected by the severity of equity participation restrictions.*
(*iii*) *Capital constraints preventing domestic investment participation are costly to the domestic firm.*
(*iv*) *Investment is distorted in the direction of underinvestment. Equity participation restrictions also do not affect the profitability of the venture to the multinational, the domestic firm's payoff, or employment.*

Proof. The proof is virtually identical to the proof of Proposition 2 and thus is omitted.

References

Bhattacharya, S., J. Glazer, and D. Sappington, 1992, "Licensing and the Sharing of Knowledge in Research Joint Ventures," *Journal of Economic Theory*, 56, 43–69.

Cho, I., and J. Sobel, 1990, "Strategic Stability and Uniqueness in Signaling Games," *Journal of Economic Theory*, 50, 381–414.

Contractor, F., 1990, "Ownership Patterns of U.S. Joint Ventures Abroad and the Liberalization of Foreign Government Regulations in the 1980s: Evidence from the Benchmark Surveys," *Journal of International Business Studies*, 1, 55–73.

Contractor, F., and P. Lorange, 1988, "Why Should Firms Cooperate? The Strategy and Economic Basis for Cooperative Ventures," in F. Contractor and P. Lorange (eds.), *Cooperative Strategies in International Business*, Lexington Books, Lexington, MA.

Crutchley, C., E. Guo, and R. Hansen, 1991, "Stockholder Benefits from Japanese-U.S. Joint Ventures," *Financial Management*, 20, 22–30.

Darrough, M., and N. Stoughton, 1989, "A Bargaining Approach to Profit Sharing in Joint Ventures," *Journal of Business*, 62, 237–270.

Eckbo, E., R. Giammarino, and R. Heinkel, 1990, "Asymmetric Information and the Medium of Exchange in Takeovers: Theory and Tests," *Review of Financial Studies*, 3, 651–675.

Economist, 1999, "Hold My Hand," *Economist*, May 15, 73–74.

Eun, C., and S. Janakiramanan, 1986, "A Model of International Asset Pricing with a Constraint on the Foreign Equity Ownership," *Journal of Finance*, 41, 897–914.

Fagre, N., and L. Wells, 1982, "Bargaining Power of Multinationals and Host Government," *Journal of International Business Studies*, 9–23.

Finnerty, J., J. Owers, and R. Rodgers, 1986, "The Valuation Impact of Joint Ventures," *Management International Review*, 26, 14–26.

Fishman, M., 1989, "Preemptive Bidding and the Role of the Medium of Exchange in Acquisitions," *Journal of Finance*, 44, 41–57.

Frohls, M., A. Keown, M. McNabb, and J. Martin, 1994, "Growth Opportunities, Corporate Governance, and the Market Value of Multinational Joint Ventures," working paper, University of Texas at Austin.

Froot, K., 1993, Introduction, in K. Froot (ed.), *Foreign Direct Investment*, University of Chicago Press, Chicago.

Ghemawat, P., and M. Spence, 1988, "Modeling Global Competition," in M. Porter (ed.), *Competition in Global Industries*, Harvard Business Press, Cambridge, MA.

Gomes-Casseres, B., 1985, "Multinational Ownership Strategies," unpublished DBA thesis, Harvard Business School.

Gomes-Casseres, B., 1988, "Joint Venture Cycles: The Evolution of Ownership Strategies of U.S. MNEs, 1945–1975," in F. Contractor and P. Lorange (eds.), *Cooperative Strategies in International Business*, Lexington Books, Lexington, MA.

Hansen, R., 1987, "A Theory for the Choice of Exchange Medium in Mergers and Acquisitions," *Journal of Business*, 60, 75–95.

Harris, M., and R. Townsend, 1981, "Resource Allocation Under Asymmetric Information," *Econometrica*, 49, 33–64.

Heckman, J., 1979, "Sample Selection Bias as a Specification Error," *Econometrica*, 47, 153–161.

Hladik, K., 1985, *International Joint Ventures: An Economic Analysis of U.S.-Foreign Business Partnerships*, Lexington Books, Lexington, MA.

Holmstrom, B., and L. Weiss, 1985, "Managerial Incentives, Investment, and Aggregate Implications: Scale Effects," *Review of Economic Studies*, 52, 403–426.

Innes, R., 1990, "Limited Liability and Incentive Contracting with Ex-ante Action Choices," *Journal of Economic Theory*, 52, 45–67.

Kamien, M., E. Muller, and I. Zang, 1992, "Research Joint Ventures and R&D Cartels," *American Economic Review*, 82, 1293–1306.

Kamien, M., and I. Zang, 1993, "Competing Research Joint Ventures," *Journal of Economics & Management Strategy*, 2, 23–40.

Kogut, B., 1988, "Joint Ventures: Theoretical and Empirical Perspectives," *Strategic Management Journal*, 9, 319–332.

Lee, I., and S. Wyatt, 1990, "The Effects of International Joint Ventures on Shareholder Wealth," *Financial Review*, 25, 641–649.

Lummer, S., and J. McConnell, 1990, "Stock Valuation Effects of International Joint Ventures," in S. Rhee and R. Chang (eds.), *Pacific Basin Capital Markets Research*, Elseivier Science Publishers, New York.

Parasuram, T., 1995, "Global Economic Power Shifting to BEMs," Press Trust of India wire release, July 26.

Porter, M., and M. Fuller, 1986, "Coalitions and Global Strategy," in M. Porter (ed.), *Competition in Global Industries*, Harvard Business Press, Cambridge, MA.

Riley, J., 1979, "Informational Equilibrium," *Econometrica*, 47, 331–360.

Sercu, P., and R. Uppal, 1995, *International Financial Markets and the Firm*, Southwestern College Publishing, Cincinnati, Ohio.

Stoughton, N., and E. Talmor, 1994, "A Mechanism Design Approach to Transfer Pricing by the Multinational Firm," *European Economic Review*, 38, 143–170.

Stulz, R., and W. Wasserfallen, 1995, "Foreign Equity Investment Restrictions, Capital Flight, and Shareholder Wealth Maximization: Theory and Evidence," *Review of Financial Studies*, 8, 1019–1057.

Teece, D., 1977, "Technology Transfer by Multinational Firms," *Economic Journal*, 87, 242–261.

Yoffie, D., 1993, Review of *Rival States, Rival Firms: Competing for World Market Shares*, by J. Stopford and S. Strange with J. Henley, Cambridge University Press, New York; in *Journal of Economic Literature*, 31, 1462–1463.