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On the Determinants of Foreign Ownership Shares: Evidence from US Firms' Joint Ventures in Japan

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It is often argued that firms' foreign expansion is motivated by economies of scale in information-based intangible assets. Since these assets are combined with local factors in real production, their owner often has to deal with local factor owners' opportunistic behavior such as siphoning of skills which reduces the return on intangibles to the original owner. Local factor owners' agency behavior can also reduce a subsidiary's profit. Maintaining ownership mitigates the former type of opportunistic behavior, while ceding ownership reduces the latter type. Hence there is a non-linear relationship between ownership and the cost of control. In this paper we present a model that incorporates these aspects of a joint venture ownership. In our model the share in a joint venture of a foreign parent firm with a superior technology is determined such that its marginal cost of control is set equal to the marginal benefit it derives from a joint venture. We assume that, because of the uniqueness and mobility of its intangible factor, the foreign partner has more bargaining power than its local counterpart regarding the ownership of their joint venture and that the local partner is less concerned than its foreign counterpart about the problems of agency and property rights protection because of its geographic and cultural proximity to the joint venture. As a consequence, the foreign partner is able to exert its preference for its ownership share in the joint venture. Our theoretical results allow a decomposition of ownership share into components explained by the cost of control and by the profitability of a joint venture. Our empirical results using data on technology-based US firms' subsidiaries in Japan are consistent with our model predictions. In particular, the fraction of ownership share explained by the cost of control relative to the fraction explained by intrinsic profitability is higher for industries that rely more heavily on intangible assets, as expected from the model.

INTRODUCTION

The path-breaking research by Coase (1937), Hymer (1960, 1976), Caves (1971) and Williamson (1967, 1975) has led to the general belief among economists that firms' foreign expansion is motivated by economies of scale in production factors and particularly in intangible assets. An important issue facing firms contemplating foreign direct investment is the form of organization for their international expansion. International expansion requires production inputs from both home- and host-country firms. Production inputs from a home-country firm are often knowledge-based intangible assets with public good properties. Due to the public good properties of these inputs, expanding the scope of operation can increase a home-country firm's revenues without increasing its costs. Because these inputs are information based, arm's-length transactions are usually impractical. The owners of information-based inputs typically want to internalize the market for them. This is particularly true, for example, for technology-oriented US firms' subsidiaries in Japan, which are among the largest of all US foreign affiliates throughout the world. Such market internalization often implies that the owners of these intangible assets maintain some direct control of foreign production activities.[1]

Underlying multinational firms' preference for

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direct ownership control is the issue of property rights. Because the intangible assets being transferred are information based, the leakage of information to competitors or business partners could lead to a substantial loss in the return accruable to the original owners. As a result of these concerns, a foreign firm transferring its intangible assets tends to demand ownership control.

Local inputs often include not only labor and material but also local marketing ability and managerial skills. Because the owners of local inputs bear the full cost of their effort but do not receive the full benefit, and because of the information asymmetry regarding their effort, they will have both an incentive and an opportunity to shirk. Shirking will reduce the return to home-country firms' intangible assets. Thus home-country firms must deal with the problem of controlling the agency behavior of the owners of local inputs. The degree of this agency behavior is higher, the larger the ownership shares of the home-country firms.

We assume in our model that, because of the uniqueness and mobility of its intangible factor, the home-country partner has more bargaining power than its local counterpart regarding the ownership of their joint venture. We also assume that the local partner is less concerned than its foreign counterpart about the problems of agency and property rights protection because of its geographic and cultural proximity to the joint venture. As a consequence, the home-country partner is able to exert its preference for its ownership share in the joint venture.[2]

In determining the desired shares of ownership in foreign subsidiaries, home-country firms must balance the protection of their property rights against the benefits of mitigating the local input owners' agency behavior. In this paper we present a model that incorporates both aspects of a joint venture ownership in home-country firm's decision processes. We assume in our model that the local joint venture partner plays a passive role in the ownership-decision process. Our theoretical results allow a decomposition of ownership share into components explained by the cost of control and by the profitability of participating in a joint venture. Our empirical results using data on US firms' subsidiaries in Japan are consistent with our model predictions. They also shed light on the importance of organizational economics in explaining ownership.

In the next section we present our modeling work which leads to an ownership determination equation suitable for empirical testing. The third section reports our empirical results which are obtained using data on US subsidiaries in Japan. Conclusions and possible future research are discussed in the final section.

A MODEL FOR JOINT VENTURE OWNERSHIP DETERMINATION

Suppose a firm, UP, operating in the USA (the home country) owns a share, s, of a foreign joint venture, JV (say in Japan), where $0<s<1$. A local firm, JP (the Japanese parent), owns the remaining portion, $1-s$, of JV. We denote by n^i-dimensional (column) vectors, x^1 and x^2, the inputs and outputs for parent firms with the corresponding market price (row) vectors denoted by p^1 and p^2 ($i=1$ for UP and $i=2$ for JP), where positive (negative) elements of x^i represent outputs (inputs). In addition to externally traded goods and services given by x^i, UP and JP also produce and sell internally to JV goods and services denoted by non-negative m^i-dimensional vectors, y^i. The elements of y^i may represent, for example, intermediate goods as well as intangible assets such as technical knowhow, management services and other information-based assets. (x^i, y^i) is a vector in the production possibility set T^i for UP ($i=1$) and JP ($i=2$). UP's profit is equal to p^1x^1 plus the earnings from intra-firm trade with JV and its share of JV's profit. JV's production possibility set consists of vectors (x^0, y^1, y^2), where x^0 is a vector of inputs and outputs traded in external markets with price vector p^0. JV's profit is p^0x^0 minus the transfer payments to UP and JP.

The transfer of intangible assets from a foreign parent (UP) to JV (denoted here by y^1) is particularly important for JV's successful operation (Nakamura, 1991), since the scale economies that motivate UP's foreign direct investment are often embedded in UP's intangible assets (Hymer, 1960; Caves, 1971).

The Transfer of Intangible Assets

In addition to technical difficulties in transferring information-based assets, the literature on technology transfer strongly suggests that a transferrer's effort and thoroughness is positively associated with its ownership control of a transferee's operation. (See, for example, Davies, 1977.) Economic

considerations include not just a transferrer's agency incentives in technology transfer but also its concerns about the property rights protection.

For example, in discussing alternative ways to establish business operations in Japan, James Morgan and Jeffrey Morgan, who head successful Japanese operations for Applied Materials, Inc. and RAD Technologies, respectively, note that 'Of the four main ways to address the Japanese market, product and technology licensing has proven the most dangerous and least effective avenue for American companies . . . Once a Japanese competitor has right to utilize or reproduce a technology, it will move quickly to absorb the technology and own it outright' (Morgan and Morgan, 1991, p. 167). Hahn (1984) also discusses the types of legal difficulty some US firms encountered in their joint ventures with Japanese firms and notes that 'When the Japanese partner had acquired the needed technology from the foreign company, it frequently began to manifest a desire to use the technology on its own, an act prohibited by the joint-venture agreement' (Hahn, 1984, p. 71). These types of anecdotal evidence, observed not just for Japan but also for other countries, are consistent with the notion that the ownership control of foreign operations reflects the degree of thoroughness in protecting property rights.

Since skills spillover to competitors leads to a loss of competitive advantage and thus profits, the transferrer tends to provide less information about its skills when it has less control of its intangible assets. Moreover, when its share of ownership is higher, the foreign parent is entitled to a larger share of a joint venture's profits. For these reasons, a foreign parent's incentive and thus its efforts to transfer its skills to a subsidiary increases with its ownership.

We incorporate the relationship between ownership and a transferrer's effort in our modeling framework by assuming that the actual transfer is proportional to the transferrer's ownership share. That is, the transfer from UP to JV is assumed to be valued at sq^1y^1, where q^1 is an agreed upon (given) transfer price and sy^1 is the amount of skills UP effectively transfers to JV even though the maximum transferable amount is y^1. It follows that UP's profit is the sum of p^1x^1, sq^1y^1, and its share of JV's profit P_J

$$P_u = p^1x^1 + sq^1y^1 + sP_J \qquad (1)$$

where P_u and P_J are, respectively, optimal profits for UP and JV.

The Cost of Control Associated with Intangible Assets Transfer

The costs associated with the transfer of technology and other intangible assets from a parent firm to a joint venture can be broadly classified into two types. The first type, as described in the previous subsection, represents the loss of UP's competitive advantage due to skills spillover in exposing its intangibles such as technological, marketing, and management skills.[3] This loss, which reduces UP's profits, decreases as the probability of successfully protecting its information-based skills increases. This probability is expected to increase as UP's ownership control increases.[4] Thus this cost due to skills spillover is expected to decrease as UP's share of ownership increases.

The second type of control cost is the more typical agency cost. JV's operation inevitably relies on production efforts from both UP and JP. Without full ownership, however, a parent's marginal reward from an increase in such an effort is less than the full marginal benefit to JV, while it has to bear the full cost of any additional effort. When the supply of effort is not readily observable, a supplying parent has an incentive and opportunity to undersupply its effort. Such an agency inefficiency leads to an observed profit level for JV that is below its maximum possible level P_J. Since a host-country parent firm (say, JP) often provides a significant portion of the production and management personnel required for a joint venture operation, shirking typically takes place when a host-country parent puts JV's workers under less strict supervision. This is likely to occur when JP's ownership share is low. Thus the cost of agency is higher, the higher is UP's ownership share in JV.

UP's Ownership Share Equation

Because of the geographical distance and differences in cultural and language backgrounds, ownership shares in JV have asymmetric effects on the two parent firms. In our data on US subsidiaries in Japan, UP is a US firm and JP is a (local) Japanese one. The local parent firm in Japan is likely to have little difficulty in obtaining relevant information on its subsidiary firm's operations regardless of their ownership share.[5] This is not the case for the US parent firm. Furthermore, it is usually US firms' intangible assets that have attracted Japanese firms to establishing US–Japan joint ventures in Japan. The uniqueness and mobility of

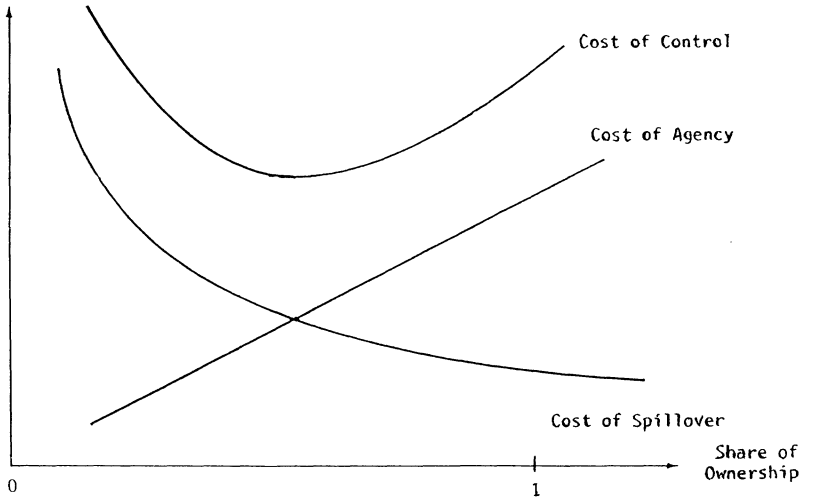

Figure 1. An illustration of the cost of control.

its intangibles often give UP more bargaining power, relative to JP, in choosing its JV's ownership structure. We therefore assume that UP with information-based intangible assets form a joint venture with a JP that will accept its preference for its ownership. In the following we will concentrate on the US parent firm's decision processes.

The skills spillover cost[6] borne by UP is assumed to be a decreasing function of the foreign share of ownership s, while the agency cost that causes a reduction in JV's profit and that is also borne by UP is assumed to be an increasing function of s. We also assume that these two costs sum to a quadratic function in s as follows:

$$C(s)=a_0-a_1s+a_2s^2 \quad (a_1>0,\ a_2>0) \tag{2}$$

A diagrammatic characterization of this function is found in Fig. 1.

The convexity in s of $C(s)$ implies that UP's cost of control associated with a subsidiary firm decreases as s increases from zero to $(a_1/2a_2)$ and then increases as s increases beyond $(a_1/2a_2)$. If $(a_1/2a_2)$ is less than 1, then the minimum cost of control is achieved for a value of s less than one.

Combining UP's profit function given by Eqn (1) and the cost of control (2), we obtain the net profit expression for UP

$$P_u=p^1x^1+sq^1y^1+sP_J-C(s) \tag{3}$$

UP is assumed to maximize this expression with respect to s. Assuming an interior optimum, the first-order condition for the optimal value of s evaluated at given q^1 and P_J is:

$$q^1y^1+P_J-\frac{dC}{ds}=0$$

or

$$\frac{dC}{ds}=q^1y^1+P_J \tag{4}$$

or

$$s=(1/2a_2)\,(a_1+q^1y^1+P_J) \tag{5}$$

According to our model, in equilibrium, a US parent firm's ownership share is chosen such that the marginal cost of control is set equal to the marginal benefit it derives from a joint venture. The marginal benefit is the payment a subsidiary makes to the US parent firm and consists of the payment for the total transfer of internally traded goods and services (q^1y^1) and the profit of the subsidiary (P_J). It follows from Eqn (5) that the optimal share is greater than the value of s, $a_1/(2a_2)$, that minimizes the cost of control $C(s)$ since q^1y^1 and P_J are generally positive. $(q^1y^1+P_J)$ can be viewed as UP's intrinsic earnings from JV. Hence the contribution of the cost of control to the determination of ownership share relative to the contribution by the intrinsic profitability of participating in a joint venture is given by the ratio $a_1/(q^1y^1+P_J)$.

EMPIRICAL RESULTS

In this section data on US–Japan joint ventures located in Japan are used to test empirically the

implications for the optimal ownership share determination underlying Eqn (5).

US Foreign Direct Investment in Japan

US firms have substantial foreign direct investments in Japan. About half of the total foreign direct investment in Japan during the 1950–88 period came from the US (Toyo Keizai Shimposha, 1989). Foreign firms increased their direct investments in Japan from about $930 million in 1984 to more than $3.2 billion in 1988. Foreign firms' subsidiaries are large relative to domestic Japanese firms. About one third of foreign firm's subsidiaries are capitalized at more than 100 million yen, while 99% of all domestic Japanese firms are capitalized at less than 100 million yen (Toyo Keizai Shimposha, 1989).

Available evidence also suggests that US firms' subsidiaries in Japan are large relative to US foreign affiliates in other countries. The mean sales per US foreign affiliate in 47 countries were $21 million in 1977 and $49 million in 1982. The mean sales per US foreign affiliate in Japan were $60 million in 1977 and $122 million in 1982. In both years, these numbers were the highest country-specific mean sales per US foreign affiliate (US Department of Commerce, 1980, 1985). US firms' subsidiaries are also more profitable than domestic Japanese counterparts.[7]

US firms own relatively large shares of their direct investment in Japan. About 46% of US firms' subsidiaries are fully owned. The ownership patterns for jointly owned firms (joint ventures) are as follows: the ownership share exceeds 0.5 for 31% of the joint ventures, the share is exactly equal to 0.5 for 43% of the joint ventures, and the share is less than 0.5% for the remaining 26%. Thus US parent firms have majority ownership (more than 50% share) in more than 60% of their subsidiaries in Japan (Tozo Keizai Shimposha, 1989).

Our theoretical discussion assumes that US firms' ownership determination is unaffected by government policies. It is, therefore, important to verify the extent to which this is true.

The ownership patterns of foreign firms' subsidiaries were under strict government supervision until 1950. By the 1950 Law Concerning Foreign Investment, however, foreign firms were permitted to own, at most, 49% of Japanese firms. This law was changed in 1973 to permit foreign firms to obtain, subject to certain exceptions, full ownership. In 1977, 7% of US firms' subsidiaries reported they were required to limit their US parent firms' equity. In 1982 the fraction decreased to 3%. This compares with 1982 fractions of, for example, 1% for France and for West Germany, 2% for Italy and 3% for Australia (Contractor, 1990). Thus it appears that the shares of foreign ownership in Japan could be, and were, adjusted relatively frequently in recent years in response to company and government policies reflecting the interests of foreign and Japanese parent firms and Japanese domestic considerations. For example, at least 314 (190) foreign firms' subsidiaries were established in Japan in 1988 (in 1989) while the ownership patterns for at least 151 (100) subsidiaries have changed during the same period.[8]

Data and Empirical Model

We turn our attention now to empirical results for US–Japan joint ventures located in Japan. Although our empirical model encompasses the case of wholly owned foreign subsidiaries, we concentrate on joint ventures because more abundant and reliable data are available for joint ventures than for wholly owned subsidiaries.

Using data on US–Japan joint ventures makes our results region specific, but applying the theory developed to a relatively homogeneous sample of firms in a single country has several advantages. First, since all the US subsidiaries are rather large and are not easy to monitor, the agency behavior by local (Japanese) parent firms is expected to be non-trivial. Yet such behavior is expected to be similar among Japanese firms. Second, given the keen global commercial competition between the USA and Japan, US firms' concern about skills spillover is likely to be serious. Third, the assumption that the cost of control is asymmetric between foreign and local parents is more acceptable for US–Japan joint ventures located in Japan because of the sophistication and complexity found in the Japanese business system and the geographic as well as cultural distance between the USA and Japan.

The basis for our empirical work is Eqn (5). The latter suggests that the foreign ownership share depends positively on a subsidiary's potential profitability P_J as well as on $T\ (=q^1y^1)$, the potential transfer of internally traded goods and services. Although both T and P_J are unobservable, it is

possible to derive a statistically estimatable version of Eqn (5) as follows.

Since the potential maximum profit (P_J) for JV is greater than the actually observed profit (P_J^*) by the amount of the agency cost $A(s)$ which is an increasing function of s (Fig. 1), we have $P_J = P_J^* + A(s)$. If we approximate $A(s)$ by $A(s) = c_2 s$ ($c_2 > 0$), then, by substitution into Eqn (5), we get

$$s = b_1 + b_2 T + b_2 P_J = b_1 + b_2 T + b_2 \{P_J^* + c_2 s\}$$

where $b_1 = (a_1/2a_2) > 0$ and $b_2 = (1/2a_2) > 0$. Solving for s we get

$$s = d_1 + d_2 T + d_2 P_J^* \tag{6}$$

where $d_1 = \{b_1/(1 - b_2 c_2)\} > 0$ and $d_2 = \{b_2/(1 - b_2 c_2)\} > 0$ and where $d_1 > 0$ and $d_2 > 0$ imply $b_2 c_2 < 1$.

The empirical model (6) sheds light on the importance of the cost-of-control concern on the determination of foreign ownership. The constant term d_1 represents the contribution of the cost of control to the determination of s, while $s - d_1 = d_2 T + d_2 P_J^*$ corresponds to the contribution to s of internal transfer payments, T, plus subsidiary profits, P_J^*.

In estimating Eqn (6), P_J^* is JV's observed profit (*JV-PR*). In a growing market like the Japanese one UP's expected profits from a subsidiary's operation may consist of its current profit P_J^*, sales growth (*JV-GR*) and market power proxied by size (*JV-S*). The growth component can be viewed as delayed (or future) profits resulting from economic rents associated with a large future market share, while the market power component encourages such a growth. It is an empirical issue to determine the relative contributions of a subsidiary's short-term profits, growth rate and market power to UP's ownership share. Therefore *JV-GR* and *JV-S* were included as explanatory variables in some of our empirical specifications. We expect the regression coefficients for *JV-PR*, *JV-GR* and *JV-S* to be positive.

Another explanatory variable in Eqn (6) for which we do not observe actual values is T, the potential internal transfer from a US parent to its joint venture. This variable, however, can be approximated by the joint venture's fraction of procurement from its US parent (*JV-IMP*) and the size of a joint venture's operation (*JV-S*). The latter variable is included because the amount of internal transactions (T) is expected to increase as the size of a joint venture increases. As proxies for T, both *JV-S* and *JV-IMP* should have positive signs. Thus *JV-IMP*, *JV-GR* and *JV-S* will be used to approximate internal transfer (T) and a joint venture's expected profit in our econometric specifications. (*JV-S* reflects the combined effects of both T and expected profit due to market power and is expected to have a positive sign.)

Equation (6) was estimated using data for US–Japan joint ventures located in Japan during the period 1984–8 for three manufacturing industries: *General Machinery, Electrical Equipment, and Chemicals.* Table A1 provides summary characteristics of the data sample used. (See Appendix A for details of the data used.)

Estimation Results

Estimation results are reported in Table 1. Ordinary-less-squares (OLS) results are presented in columns 1, 5 and 7 of this table. All the estimated coefficients have the expected signs and are statistically significant except *JV-GR*, which is only marginally significant. Furthermore, the constant term is always significantly positive, which is consistent with our assumption of an interior optimal solution (5). Our results indicate that the intrinsic profitability of a joint venture characterized by *JV-IMP*, *JV-S* and *JV-PR* does significantly increase ownership.

The explanatory power of these intrinsic profitability measures, however, seems relatively small compared to that of the cost of control. Only a small portion (32% based on column 1) of the variation in UP's share of ownership is explained by the intrinsic profitability measures. As we discussed earlier, the constant term in Eqn (6) represents the contribution of the cost of control to ownership share determination. Our estimates for the constant term given in Table 1 are quite stable and have a mean of about 0.41. Using the mean value of ownership share (=0.511) from Table A1, we see that the relative contribution of the cost of control to the desired ownership share is about 80%[9] (=0.41/0.511) while the remaining 20% of the value of s can be attributed to the effects of intrinsic profitability (internal transfer and profitability). In particular, a joint venture's profit (*JV-PR*) accounts for only 6% of the US ownership share (0.06 = (0.35) (0.082)/0.511 where 0.35 is the regression coefficient from Table 1 and 0.082 is the mean value of *JV-PR* from Table A1). We conclude, albeit tentatively, that the cost of control

Table 1. US Ownership Share Equation Estimates[a]

	(1) OLS	(2) IV	(3) IV	(4) IV	(5) OLS	(6) IV	(7) OLS	(8) IV
JV-IMP	0.19864[b,d]	0.19523[d]	0.18293[d]	0.17610[d]	0.19653[d]	0.17959[d]	0.21835[d]	0.21503[d]
	(5.50)	(5.40)	(4.03)	(3.91)	(5.36)	(3.92)	(5.89)	(5.73)
JV-S	0.0000018[d]	0.0000016[d]	0.0000017[d]	0.0000015[d]	0.0000017[d]	0.0000016[d]	0.0000018[d]	0.0000016[d]
	(6.16)	(4.76)	(6.42)	(4.94)	(5.51)	(5.80)	(5.58)	(4.38)
JV-GR	0.05320[c]	—	0.04499	—	—	—	0.05023	—
	(1.71)		(1.35)				(1.58)	
JV-G-IV[e]	—	−0.02829	—	−0.04678	—	—	—	−0.02459
		(0.38)		(0.64)				(0.31)
JV-PR	0.35147[d]	0.34791[d]	—	—	0.34719[d]	—	—	—
	(2.76)	(2.64)			(2.66)			
JV-PR-IV[e]	—	—	0.62246[d]	0.67109[d]	—	0.64644[d]	—	—
			(1.68)	(1.81)		(1.74)		
Constant	0.40600[d]	0.41019[d]	0.39002[d]	0.39155[d]	0.40886[d]	0.39077[d]	0.42744[d]	0.43109[d]
	(27.7)	(27.4)	(12.96)	(13.17)	(23.42)	(13.11)	(30.84)	(30.65)
R^2	0.322	0.363	0.351	0.347	0.363	0.345	0.333	0.326

[a] The dependent variable, *s*, is a US parent firm's share of ownership in a subsidiary. Industry dummies for General Machinery and Electric Equipment were also included as control variables. (The omitted category is Chemicals.)
[b] Numbers in parentheses are absolute *t*-ratios calculated using heteroskedasticity-corrected standard errors.
[c] Coefficient estimates significant at a 90% level based on normal probabilities.
[d] Coefficient estimates significant at a 99% level based on normal probabilities.
[e] *JV-G-IV* and *JV-PR-IV* are, respectively, instrumental variables representing predicted values for *JV-G* and *JV-PR*. The auxiliary equations used are reported in Table B1 in Appendix B.

appears to be an economically significant factor in explaining UP's ownership shares.

In practice, UP's ownership share, *s*, is often determined before a new subsidiary is established. The ownership share is sometimes revised in anticipation of high profitability and new growth opportunities for an existing subsidiary. Since a subsidiary's profit and growth behavior and UP's ownership share could reflect the same underlying management strategies, it is possible that the regression error term assumed for Eqn (6) is correlated with *JV-GR* and/or *JV-PR*.

To assess potential bias problems arising from such a correlation problem, instrumental variables (IV) estimates are also presented in columns 2–4, 6 and 8, where *JV-G-IV* and *JV-PR-IV* represent, respectively, predicted values for *JV-GR* and *JV-PR* calculated using the estimated coefficients reported in Table B1. These IV results are very similar to our OLS results. The only discrepancy between OLS and IV estimation results is in the estimated coefficient for *JV-PR*. Given an increase in a joint venture's profitability, our IV results predict there will be almost twice as large an increase in UP's share, *s*, as is predicted by our OLS results. A larger data set than the one used in this study may allow us to empirically determine this response coefficient with more precision in the near future.[10]

In both OLS and IV regressions *JV-GR* is statistically insignificant. We therefore repeated our regressions without including *JV-GR*. The estimated results are presented in columns 5 (for OLS) and 6 (for IV). They are generally consistent with the results reported in the rest of the table, which is reassuring.

In order to see if our theoretical sign predictions still hold for our ownership share equation for individual industries we also estimated Eqn (6) for each of the three manufacturing industries. Estimating Eqn (6) by industry allows for variations across industries in the cost of control at the expense of estimation efficiency. Estimation results for General Machinery, Electric Equipment and Chemicals are reported in Table 2. (The corresponding auxiliary estimation results are reported in Table B2). As in Table 1, the coefficients for *JV-IMP* and *JV-S* are generally positive and statistically significant, as

Table 2. US Ownership Share Equation Estimates by Industry[a]

	General Machinery		Electric Equipment		Chemicals	
	OLS	IV	OLS	IV	OLS	IV
JV-IMP	0.65079[d]	0.65090[d]	0.07722[c]	0.05972	0.15807[d]	0.08456[d]
	(8.63)	(8.34)	(1.75)	(1.22)	(3.26)	(2.74)
JV-S	0.000013[d]	0.000014[d]	0.0000023[d]	0.0000021[d]	0.00000097[c]	0.0000016[d]
	(3.89)	(3.75)	(7.61)	(6.55)	(2.01)	(3.03)
JV-GR	0.05636	—	0.08225[c]	—	−0.08272	—
	(0.84)		(2.51)		(0.94)	
JV-G-IV[e]	—	0.25733[c]	—	0.04267	—	−0.00698
		(1.99)		(0.87)		(0.07)
JV-PR	−0.24366	—	0.63242[d]	—	0.25710	—
	(0.47)		(2.87)		(1.56)	
JV-PR-IV[e]	—	−0.39122	—	1.0276[d]	—	1.1449[d]
		(0.70)		(2.81)		(3.07)
Constant	0.35657[d]	0.35173[d]	0.38998[d]	0.37416[d]	0.43383[d]	0.37229[d]
	(11.4)	(13.2)	(13.7)	(11.66)	(26.7)	(12.2)
R^2	0.769	0.785	0.481	0.443	0.293	0.472
No. of observations	27	27	48	48	59	59

[a] The dependent variable, *s*, is a US parent firm's share of ownership in a subsidiary.
[b–e] As in Table 1.

expected. The coefficients for *JV-GR*, *JV-G-IV*, *JV-PR* and *JV-PR-IV* are also positive as expected when statistically significant. Estimated constant terms are also quite stable, ranging between 0.35 and 0.43 across these industries. This range also includes constant term estimates given in Table 1. Overall, these estimates by industry are not qualitatively different from our pooled estimates.

Finally, it would be interesting to estimate for each industry the portion of ownership share explained by its constant term and the variation in ownership share explained by intrinsic profitability variables. Our theoretical analysis suggests that the importance of the cost of control varies from one industry to another. In particular, among the three manufacturing industries, the concern about the cost of control is expected to be most important in the chemical industry where production methods and other information and knowledge-based intangible assets are essential to commercial success. It is expected to be least important in General Machinery where production processes and final products are relatively easy for competitors to understand and hence commercial success relies less on information based intangible assets than Chemical or Electric Equipment industries.

The relative contributions of the cost of control to optimal ownership share for these industries are given by the ratios between estimated constant terms in OLS regressions reported in Table 2 and the mean ownership shares for these industries in Table A1. They are estimated to be: 88% (Chemicals), 76% (Electrical Equipment) and 65% (General Machinery).[11] The fractions of variation in observed ownership shares that are explained by intrinsic profitability variables for these industries are given by the R^2's reported for OLS regressions in Table 2 as follows: 0.293 (Chemicals), 0.481 (Electric Equipment) and 0.769 (General Machinery). These estimates are consistent with our expectation that, because a firm's success in Chemical and Electrical Equipment industries relies more heavily on information-based factor inputs than in General Machinery industries, the cost of control is more important in explaining ownership in the former industries.[12]

CONCLUSIONS AND FUTURE RESEARCH

In this paper we have presented an empirical model for the determination of ownership patterns for

foreign joint ventures. In this model the share of ownership in a foreign subsidiary is determined by equating the marginal benefit a foreign parent firm derives from its subsidiary and the marginal cost of control. The marginal benefit is the payment a subsidiary makes to its foreign parent. The cost of control consists of the cost resulting from skills spillover to potential competitors and the cost resulting from a local parent firm's agency behavior. The spillover cost which arises because of imperfections in the markets for intangible assets is sometimes suggested to be a primary motivation for foreign direct investment. The agency cost, however, is a consequence of the information asymmetry embedded in the management of effort and other intangibles associated with foreign joint ventures.

The empirical model was estimated using data on US firms' subsidiaries in Japan. Estimation results are generally consistent with the model predictions. We found that profits and transfer payments from a joint venture are positively related to the US parent firm's ownership share. Yet these intrinsic profitability measures seem to account for a relatively small portion of the variation in observed ownership shares. It appears that the cost of control is a significant factor determining ownership. Moreover, the importance of the cost of control in explaining the ownership share increases, as expected, when the information-based factor inputs become more crucial in determining commercial success.

The maintained hypothesis underlying our model is that the decision on ownership share in a joint venture rests with the US parent firm. To the extent that all US firms in our sample have some special technology-based intangible assets that are marketable in Japan, this assumption seems justified, since it is up to UP to decide the form of foreign expansion and/or ownership or the share in a joint venture to protect their property rights. Moreover, because of their geographical and cultural proximity to the joint ventures, Japanese parent firms would have less concern than US parent firms about protecting their property rights. In this framework a US firm forms a joint venture with a Japanese firm that accepts its preference for ownership share. Because of the lack of data the interaction between a joint venture and JP has not been explicitly considered in the present empirical work and is left for future research.

Another important topic left for future research is the application of the theory of contracts to the form of a firm's foreign expansion. The theory of contracts addresses the question of allocation of decision rights between contracting parties (see Grossman and Hart, 1986; Hart and Moore, 1990) and may give an alternative model involving symmetrically positioned parties negotiating a contract to the model given in this paper based on the Williamson-type framework.

APPENDIX A: DATA

Data for the period 1984–8 for subsidiaries in the Japanese manufacturing industries that are jointly owned by US and Japanese parent firms were primarily collected from Toyo Keizai Shimposha (1989), which contains information on large subsidiary firms with at least 20% foreign ownership as well as on smaller subsidiary firms with at least 49% foreign ownership and a capitalization of at least 50 million yen. The manufacturing industries included are: chemicals, general and electrical machineries. Data for Japanese parent firms were collected from Nihon Keizai Shimbunsha (1988) and Toyo Keizai Shimposha (various years), while data for US parent firms were collected from Compustat Tapes as well as various issues of *Value Line Investment Survey*: *Ratings and Reports* and *Moody's Industrial Manual*. Information for a subsidiary is usually available only for a fraction of the period 1984–8. It is matched with information for its parent firms. (See Nakamura, 1991a, for another application of the data sets discussed here.)

Table A1 gives the means and standard deviations for the following variables (with their units of measurement in parentheses). $JV\text{-}GR$ = growth rates (measured as (sales $(t+1)$ − sales (t))/sales (t)) for the sales revenue of subsidiary firms (JV); $JV\text{-}PR$ = the before-tax income divided by sales revenue; $JV\text{-}S$ = the sales revenue for JV's (million (M) yen); $UP\text{-}SHARE$ = UP's share of JV ownership; $JV\text{-}IMP$ = the share of imports in the materials procured for JV.

The following are the jointly owned firms included in the samples and their parent firms. Asahi-Penn Chemical (UP = PPG Industries, JP = Asahi Glass), Ube Cycon (General Electric, Ube Industries), 3M Health Care[13] (Minnesota Mining & Mfg., Sumitomo 3M), Sumitomo Naugatuck (Dow Chemical, Sumitomo Chemical), Toshiba Silicone (General Electric, Toshiba), Mitsui-Cyanamid (American Cyanamid, Mitsui Toatsu Chemicals), Lucidol Yoshitomi (Pennwalt,

Table A1. Characteristics of Data[a]

	Jointly owned firms			
	All three industries	General Machinery	Electrical Equipment	Chemicals
UP-SHARE(s)	0.511 (0.124)	0.552 (0.160)	0.512 (0.128)	0.493 (0.101)
JV-IMP	0.234 (0.277)	0.238 (0.251)	0.310 (0.274)	0.176 (0.288)
JV-S	13 172 (19 891)	4468 (4752)	16 888 (25 129)	14 765 (18 906)
JV-PR	0.082 (0.078)	0.086 (0.044)	0.077 (0.080)	0.071 (0.076)
JV-GR	0.069 (0.224)	0.056 (0.152)	0.132 (0.313)	0.039 (0.239)
No. of firms	41	9	14	18
No. of pooled observations	134	27	48	59

[a] These are the mean values and standard deviations (in parentheses) for some of the variables of the data sample used in this study. See the text for the data source and the definitions of these variables.

Yoshitomi Pharmaceutical Industries), Union Showa (Union Carbide, Showa Denko), Asahi-Olin (Olin, Asahi Glass), Toyo-Petrolite (Petrolite, Toyo Ink), Nalken (Vista Chemical, Nissan Chemical Industries), Nikki-Universal (Allied-Signal, Nikki), Nissan Ferro Organic Chemical (Ferro, Nissan Chemical Industries), Nippon Petroleum Detergent (Chevron, Nippon Sekiyu), Japan Butyl (Exxon, Japan Synthetic Rubber), Harima M.I.D. (Mead Corp. and Inland Container Corp., Harima Chemicals Industries), Mitsubishi Monsanto Chemicals (Mitsubishi Kasei, Monsanto), Japan Meltex (Asarco, Iwaki), STS (Sundstrand, Teijin Seiki), NSK Torrington (Ingersoll-Rand, NSK), Summitomo Eaton Hydraulics (Eaton, Sumitomo Heavy Industries), Daido-Sprag (Dana, Daido Tokushuko), Niigata Masoneilan (Dresser Industries, Niigata Tekkojo), Nihon MRC (Materials Research, Mitsubishi Corp.), Japan Fawick (Eaton, Mitsui Co.), Moog Japan (Moog, Nozaki), Mitsui Zosen Eimco (Baker Hughes, Mitsui Shipbuilding), Eye Lighting Systems (General Electric, Iwasaki Electric), Okura-Rosemount (Emerson Electric, Okura Electric), Oki Unisys (Unisys, Oki Electric), New Japan Radio (Raytheon, Japan Radio), Tel-Genrad (GenRad, Tokyo Electron), Tel-Varian (Varian Associates, Tokyo Electron), Drive System (General Electric, Sumitomo Heavy Industries), Nichicon-Sprague (Penn Central, Nichicon), Burndy Japan (Burndy, Furukawa Electric/Sumitomo Electric), Bailey Japan (McDermott International, Kyokuto), Hirose Cherry Precision (Cherry, Hirose Electric), Mitsubishi Precision (Singer, Mitsubishi Electric), Yokogawa-Hewlett-Packard (Hewlett-Packard, Yokogawa Electric), Yokogawa Medical Systems (General Electric, Yokogawa Electric), Daikin-R/M (Raytech, Daikin).

APPENDIX B: AUXILIARY EQUATIONS ESTIMATES

Table B1. Auxiliary Profitability and Growth Equations

	Profitability[a]	Growth[a]
JV-IMP	0.06195[b,c]	−0.14520
	(1.83)	(1.62)
JV-S	−0.0000002	−0.000002[c]
	(1.10)	(2.05)
US-RD[e]	−0.05623	0.34175
	(0.24)	(0.42)
US-S	0.00000097[d]	0.00000037
	(4.19)	(0.56)
JP-RD	0.83584[d]	0.42489
	(2.90)	(0.80)
JP-S	0.000000002[c]	0.000000004
	(1.89)	(1.10)
JP-GR	—	0.54868[d]
		(2.68)
Constant	0.01734	0.00792
	(1.08)	(0.22)
R^2	0.327	0.319

[a] The dependent variables for the regression results reported here are *JV-PR* (the ratio of a subsidiary firm's before-tax income to its sales revenue) and *JV-GR* (a subsidiary's annual growth rate in sales revenue). Industry dummies for General Machinery and Electric Equipment were also included as control variables. (The omitted category is Chemicals.)

[b] Numbers in parentheses are absolute *t*-ratios calculated using heteroskedasticity-corrected standard errors.

[c] Coefficient estimates significant at a 90% level based on normal probabilities.

[d] Coefficient estimates significant at a 99% level based on normal probabilities.

[e] Auxiliary regressions were also run without *US-RD* as a regressor. Results reported in Table 1 changed little.

Table B2. Auxiliary Profitability and Growth Equations by Industry[a]

	Profitability			Growth		
	General Machinery	Electric Equipment	Chemicals	General Machinery	Electric Equipment	Chemicals
JV-IMP	−0.02739	0.11182[c]	0.03778	−0.56276[d]	−0.25574	−0.12041[c]
	(0.55)[b]	(2.00)	(0.78)	(2.60)	(1.48)	(1.77)
JV-S	0.0000031[c]	0.00000054	−0.00000073[d]	−0.000029[d]	0.00000051	0.0000030[d]
	(1.98)	(1.31)	(3.12)	(3.80)	(0.40)	(3.71)
US-RD[e]	2.1929[d]	−0.49290[c]	0.31473	9.4021[c]	0.06080	1.3030
	(4.03)	(1.73)	(0.88)	(1.88)	(0.07)	(1.43)
US-S	0.000029[d]	0.0000030[d]	0.000069[c]	0.0000056	0.0000012	0.00000025
	(5.03)	(3.11)	(2.30)	(0.10)	(0.42)	(0.46)
JP-RD	−2.2372[c]	−0.13694	1.2242[d]	0.60422	−1.3944	0.28206
	(2.24)	(0.28)	(5.45)	(0.14)	(1.09)	(0.62)
JP-S	−0.0000000022[c]	−0.000000037[d]	0.0000000032	−0.0000000045	0.000000020	0.000000023[c]
	(1.92)	(3.18)	(0.38)	(0.54)	(0.35)	(1.99)
JP-GR	—	—	—	0.27804	1.2212[d]	0.28458[d]
				(1.33)	(3.80)	(2.71)
Constant	−0.02272	0.05057	0.00515	0.01721	0.15914[c]	−0.00107
	(0.72)	(1.49)	(0.20)	(0.08)	(1.69)	(0.03)
R^2	0.729	0.308	0.430	0.325	0.530	0.342
No. of observations	27	48	59	27	48	59

[a] The dependent variables for the regression results reported here are *JV-PR* (the ratio of a subsidiary firm's before-tax income to its sales revenue) and *JV-GR* (a subsidiary's annual growth rate in sales revenue).
[b] Numbers in parentheses are absolute *t*-ratios calculated using heteroskedasticity-corrected standard errors.
[c] Coefficient estimates significant at a 90% level based on normal probabilities.
[d] Coefficient estimates significant at a 99% level based on normal probabilities.
[e] Auxiliary regressions were also run without *US-RD* as a regressor. Results reported in Table 1 changed little.

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NOTES

1. The idea is often referred to as internalization in the literature related to multinational firms. For recent empirical evidence, see, for example, Grubaugh (1987) and Morck and Yeung (1991, 1992).
2. There is considerable anecdotal evidence that suggests that this assumption approximately holds for many of joint ventures in Japan of US firms with intangible assets based on superior technologies. Potential joint venture partners often accept foreign firms' ownership decisions and opt for bargaining for benefits from joint ventures which do not infringe the ownership rights of US parent firms. Because of data limitations, we focus on explaining ownership shares in US–Japan joint ventures located in Japan. In practice, however, US firms also face decisions to choose among alternative forms of foreign expansion: fully owned subsidiaries, joint ventures and technical licensing. The latter decisions are not discussed in this paper and are left for future research.
3. It is sometimes argued that the concern about protecting property rights is a primary reason for a foreign firm to opt for wholly owned foreign subsidiaries (Magee, 1977).
4. With a larger share in ownership, UP can also better protect itself against the overuse of its intangibles by JV, excess demand on the specification and quality of its intermediate inputs it supplies to JV, and siphoning by JP of JV's profit.
5. Nagatani (1989, Ch. 9), for example, provides a description of Japanese government and business practices that facilitate the dissemination of detailed firm- or industry-specific information relevant for the long-range planning for firms and the national economy. All major foreign-affiliated firm are also covered by the same information umbrella.

6. As suggested in note 4 above, this cost could also be viewed more broadly as the cost to UP of the exploitation of JV by JP. As such, this cost is expected to decrease as UP's share in JV increases.
7. Imports from US parent firms, among other factors, contribute to the profitability and sales growth of US–Japanese joint ventures located in Japan (Nakamura, 1991). Intra-firm trade, in general, is shown to be an important source of profits for both parent and subsidiary firms (Nakamura, 1991a).
8. Changes in ownership patterns includes changes (increases or decreases) in foreign firms' shares of ownership in jointly owned subsidiaries, where in extreme cases foreign firms bought out Japanese parent firms' shares or vice versa, and reorganizations of subsidiaries due to mergers and acquisitions involving subsidiaries and/or parent firms (Toyo Keizai Shimposha, 1989, 1990).
9. The relative contribution of the cost of control to the desired ownership share, found above to be $a_1/(q^1y^1+P_J)$, can be estimated by $d_1/(d_2(T+P_J^*))$, where $T=q^1y^1$ and d_1 and d_2 are defined by Eqn (6). One should be cautious, however, in interpreting an estimated value for a regression constant term as an estimate for a behavioral (structural) parameter, since a constant term can pick up various unobservable effects.
10. Since our auxiliary equations (Table B1) have relatively low R^2s, we have not used specification tests such as a Durbin–Wu–Hausman test (e.g. Nakamura and Nakamura, 1981) to choose between OLS and IV results. When auxiliary equations are not well determined, for example, the power properties of such tests are unpredictable.
11. The same observation also holds for the ratios calculated using IV regression estimates as follows: 75% (Chemicals), 73% (Electrical Equipment) and 64% (General Machinery).
12. A similar conclusion follows from IV regression results.
13. Sumitomo 3M is owned by Minnesota Mining & Mfg. (50%), NEC Corp. (25%) and Sumitomo Electric Industries Ltd. (25%). NEC, the larger of the two Japanese parent firms, is assumed to be the 3M Health Care's JP. The same convention applies to JVs in similar situations.

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