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ON THE DETERMINANTS OF FOREIGN OWNERSHIP SHARES: EVIDENCE FROM U.S. FIRMS' JOINT VENTURES IN JAPAN*

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Abstract

It is often argued that firms' foreign expansion is motivated by economies of scale in production factors and, particularly, in information-based intangible assets. The owners of these intangible assets also face the possibilities of skills spillovers to partner firms and competitors and the agency behavior associated with the owners of local production inputs. In this paper a model is presented in which a parent firm's share of ownership of a joint venture is determined such that the marginal cost of control is set equal to the marginal benefit derived from a joint venture. The model is estimated using data for U.S.-Japan joint ventures located in Japan. Empirical results are consistent with the model predictions.

1. 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 the operation can increase a home country firm's revenues without increasing its cost. Because these inputs are information-based, arms-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 U.S. firms' subsidiaries in Japan that are among the largest of all U.S. 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 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. The desire to protect property rights leads investing firms to demand ownership control so as to keep these information-based skills in-house and away from potential competitors.[2]

In actual production, home country firms' intangible assets have to be combined with local production inputs. Local inputs often include not only labor and material but also local distribution and networking knowledge as well as managerial skills. Because the owners of local inputs[3] bear the full cost of their effort but do not share 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 are of the home country firms.

In determining the desired share of ownership of a foreign subsidiary, a home country firm must balance protection of its property rights against the benefits of retaining control of the local input owners' agency behavior. In this paper we present a model that incorporates both the property rights and agency behavior aspects of joint venture ownership within a profit maximization framework. This model is estimated using data on U.S. firms' subsidiaries in Japan.

In the next section, we report our modeling work which is an extension of that in Nakamura (forthcoming). Based on Diewert's (1985, 1986) duality approach, Nakamura (forthcoming) presents a profit maximization model for a firm with a foreign joint venture. The model is expanded here to incorporate both the cost of information leakage and the cost of agency behavior. We are interested in an ownership determination equation that provides a suitable basis for empirical testing with available data. Section 3 reports our empirical results. The paper ends with concluding remarks in section 4.

2. Our Model

Following Nakamura (forthcoming), we assume that there is a subsidiary, denoted by JV (joint venture), that is jointly owned by a foreign parent, denoted by UP (U.S. parent), and a local parent, JP (Japanese parent). We assume that a subsidiary makes autonomous decisions given exogenous prices for externally-traded goods and services and transfer prices for goods and services internally traded between the subsidiary and its parent firms.

We let the n_i-dimensional vectors, x^i, denote the inputs and outputs of each of the parent firms, with the corresponding price vectors denoted by p^i (i=1 for UP, i=2 for JP), where positive (negative) elements of x^i represent outputs (inputs). In addition to externally-traded goods and services, UP and JP also produce internally-traded goods and services denoted by the m_i-dimensional nonnegative vectors, y^i. These internally-traded goods and services are shipped from UP to JV (i=1) and from JP to JV (i=2). The elements of y^i may include goods and services derived from tangible and intangible assets owned by the parent firms, including intermediate goods, technical know-how and management services.

Suppose JV's production activities are characterized by x^0, an n_0-dimensional vector representing externally-traded goods and services and y^{0i}, the m_i-dimensional nonnegative vectors representing internally-traded goods and services shipped from UP to JV (i=1) and from JP to JV (i=2).

The short-run joint profit maximization problem for the parent firms is given by the following:

(1) <u>joint maximization problem</u>:

$$\max_{x^0, x^i, y^i, y^{0i}} \{p^1x^1 + p^2x^2 + p^0x^0 : y^i \geq y^{0i}, \ (x^i, y^i, A_i) \in T^i, \quad i = 1,2; \ (x^0, y^{01}, y^{02}, B) \in T^0\}$$

where the T^i are the technology sets of JV (i=0), UP (i=1) and JP (i=2). The technology sets are assumed to be closed and convex in the relevant x and y variables. The fixed vectors A_1, A_2 and B represent the factors of production and specific external circumstances that can be viewed as fixed in the short run. Internal transactions do not affect the firms' net profits and hence do not appear in the profit expressions in (1).

The optimal solution to the joint optimization problem given in (1) can be written using the Lagrangean

$$\text{(2)} \quad L = p^1x^1 + p^2x^2 + p^0x^0 + q^1(y^1 - y^{01}) + q^2(y^2 - y^{02})$$

$$= (p^1x^1 + q^1y^1) + (p^2q^2 + q^2y^2) + (p^0x^0 - q^1y^{01} - q^2y^{02})$$

as the following saddle point problem (see, for example, Mangasarian (1969, p. 117)):

$$\max_{x^0,x^i,y^i,y^{0i}} \{p^1x^1 + p^2x^2 + p^0x^0 : y^i \geq y^{0i},\ (x^i,y^i,A_i)\ \epsilon T^i, \quad i = 1,2; \ (x^0,y^{01},y^{02},B)\ \epsilon T^0\},$$

$$= \min_{q^1\geq 0,q^2\geq 0} \ \max_{x^0,x^i,y^i,y^{0i}} \ \{L\}$$

$$= \min_{q^1\geq 0,q^2\geq 0} \ [\pi^1(p^1,q^1) + \pi^2(p^2,q^2) + \pi^0(p^0,q^1,q^2)].$$

In this saddle point problem, q^1 and q^2 are the nonnegative Lagrange multiplier vectors that yield the optimal transfer prices for y^1 and y^2, respectively. The symbols π^1, π^2 and π^0 appearing in the saddle point problem are defined by:

$$\text{(3)} \quad \pi^i(p^i,q^i) = \max_{x^i,y^i} \{p^ix^i + q^iy^i : (x^i,y^i,A_i)\ \epsilon T^i\}$$

and

$$\text{(4)} \quad \pi^0(p^0,q^1,q^2) = \max_{x^0,y^{01},y^{02}} \{p^0x^0 - q^1y^{01} - q^2y^{02} : (x^0,y^{01},y^{02},B)\ \epsilon T^0\}.$$

The π^i are short-run (restricted) profit functions for the UP (i=1), JP (i=2) and JV (i=0), and are convex in respective price variables p and q.[4]

Assuming appropriate differentiability, optimization by the parent firms and duality imply that, for UP, (5a) $(\partial\pi^1/\partial q^1) + (\partial\pi^0/\partial q^1) = 0,$

(5b) $y^1 = (\partial\pi^1/\partial q^1),\ -y^{01} = \partial\pi^0/\partial q^1$

and

(5c) $q^1(y^1 - y^{01}) = 0$ (complementary slackness).

If the optimal transfer price, q^1, is positive, then (5c) implies the market for internal goods y^1 is cleared; i.e. $y^1 = y^{01}$ which is satisfied by (5a).[5] The convexity of π^1 and π^0 in q^1 implies that the supply curve for internally traded goods is upward sloping so that $(\partial y^1/\partial q^1) = (\partial^2\pi^1/\partial(q^1)^2) > 0$, while the demand curve is downward sloping so that $(\partial y^{01}/\partial q^1) = -(\partial^2\pi^0/\partial(q^1)^2) < 0$. Similar conditions for the JP are:

(6a) $(\partial\pi^2/\partial q^2) + (\partial\pi^0/\partial q^2) = 0,$

(6b) $y^2 = (\partial\pi^2/\partial q^2),\ -y^{02} = (\partial\pi^0/\partial q^2)$

and

(6c) $q^2\ (y^2 - y^{02}) = 0$ (complementary slackness).

If UP sells to JV internally-traded goods and services derived from its tangible and intangible assets, UP's market power would be expected to be reflected in relatively low transfer prices it charges to JV.[6] (Transfer prices are not usually observable.) Since JV's profit function is a decreasing function of these transfer prices, the net result we would expect is that JV's profit function will be an increasing function of UP's market power-generating tangible and intangible assets.[7] The same circumstance should hold for JV and JP.[8] (See Appendix B for supporting empirical evidence.)

In the parent firms' joint profit maximization problem discussed so far UP's share of ownership of JV plays no role.

We now turn our attention to the control issues: the protection of property rights and the agency behavior by the owners of the local production inputs.

The foreign parent contributes to a subsidiary's operation by transferring its information-based, firm-specific assets such as skills in marketing, research and development, and management. A possible consequence of such a transfer is that these skills will be acquired by the local parent and possibly by other potential local competitors. The spillover of these skills can lead to a loss of competitive advantage and associated profits by the foreign parent. It is often argued that concern about protecting property rights is the primary reason for a foreign firm to opt for wholly owned foreign subsidiaries. For joint ventures, a foreign parent's property rights can be better protected the higher its share of ownership is. Moreover, when the share of its ownership is high, a foreign parent is entitled to a larger share of a joint venture's profits. This increases the incentive for a foreign parent to transfer its skills to a subsidiary.

Production in a subsidiary involves inputs from both foreign and local parents. When the owner of a production input is not the sole owner of a subsidiary, the marginal reward from an increase in the input owner's effort is inevitably less than the full marginal benefit to the subsidiary. However, the cost of any additional effort is fully borne by the input owner. When the supply of an effort is not readily observable, the input owner has an incentive and opportunity to undersupply his/her effort. This agency inefficiency can lead to a profit level for JV that is below its maximum possible level π^0. The agency inefficiency resulting from local production inputs is expected to be larger the lower the local parent firm's share is of the ownership of a subsidiary. Since the host country parent firm often provides significant portions of the production and management personnel required for a joint venture's operations, local production input owners such as managers and workers are expected to be under stricter supervision the larger the share is of ownership in the joint venture by the host country parent firm. Therefore we hypothesize that the cost of agency increases as the share of foreign ownership increases.

Because of the geographical distance and differences in cultural and language backgrounds, the U.S. parent firm's ownership share (100α percent, $0<\alpha<1$) has asymmetric effects on the two parent firms. For instance, the local parent firm in Japan is likely to have little difficulty in obtaining relevant information on a subsidiary firm's operations regardless of their ownership share ($1-\alpha$).[9] This is not the case for the U.S. parent firm. Both the spillover cost and the agency cost resulting from partial ownership of a subsidiary are likely to be borne by the U.S. parent firm. With this in mind, in the rest of this section we will concentrate on the U.S. parent firm's decision processes.

We first assume that the actual transfer of UP's information-based, market-power-generating assets, y^1, from UP to its subsidiary firm, JV, is directly proportional to its ownership share α. Hence, the inequality for the UP in the joint maximization problem (1) becomes[10]

$$(7) \quad \alpha y^1 \geq y^{01}.$$

Incorporating this inequality in the profit function for the UP given by (3), we get

$$\pi^1(p^1,\alpha q^1) = \max_{x^1,y^1} \{p^1x^1 + \alpha q^1y^1 : (x^1,y^1,A_1 \ \varepsilon T^1)\}.$$

The skills spillover cost borne by UP is assumed to be a decreasing function of the foreign share of ownership α, 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 α. We also assume that these two types of cost sum to a quadratic function of α as follows:

(8) $C(\alpha) = a_0 - a_1\alpha + a_2\alpha^2$ $(a_1>0,\ a_2>0)$.

A diagramatic characterization of this function is found in Figure 1.

The convexity in α of $C(\alpha)$ implies that the U.S. parent firm's cost of control associated with a subsidiary firm decreases as α increases from zero to $(a_1/2a_2)$ and then increases as α 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 α less than one.

Combining UP's profit function and cost of control for the optimal transfer prices q^{1*} and q^{2*} derived from the joint profit maximization, we obtain the net profit expression for the UP

(9) $P(\alpha) = \pi^1\ (p^1, \alpha q^{1*}) + \alpha\pi^0\ (p^0, q^{1*}, q^{2*}) - C(\alpha)$.

UP is assumed to maximize this expression with respect to α. For the reason stated earlier, JP is assumed to accept the optimal value of α chosen by UP.[11]

Then, assuming an interior optimum, the first order condition for the optimal value of α evaluated at optimal transfer prices is:

$$\frac{\partial\pi^1}{\partial(\alpha q^1)}\ q^{1*} + \pi^0 - \frac{dC}{d\alpha} = 0$$

or[12]

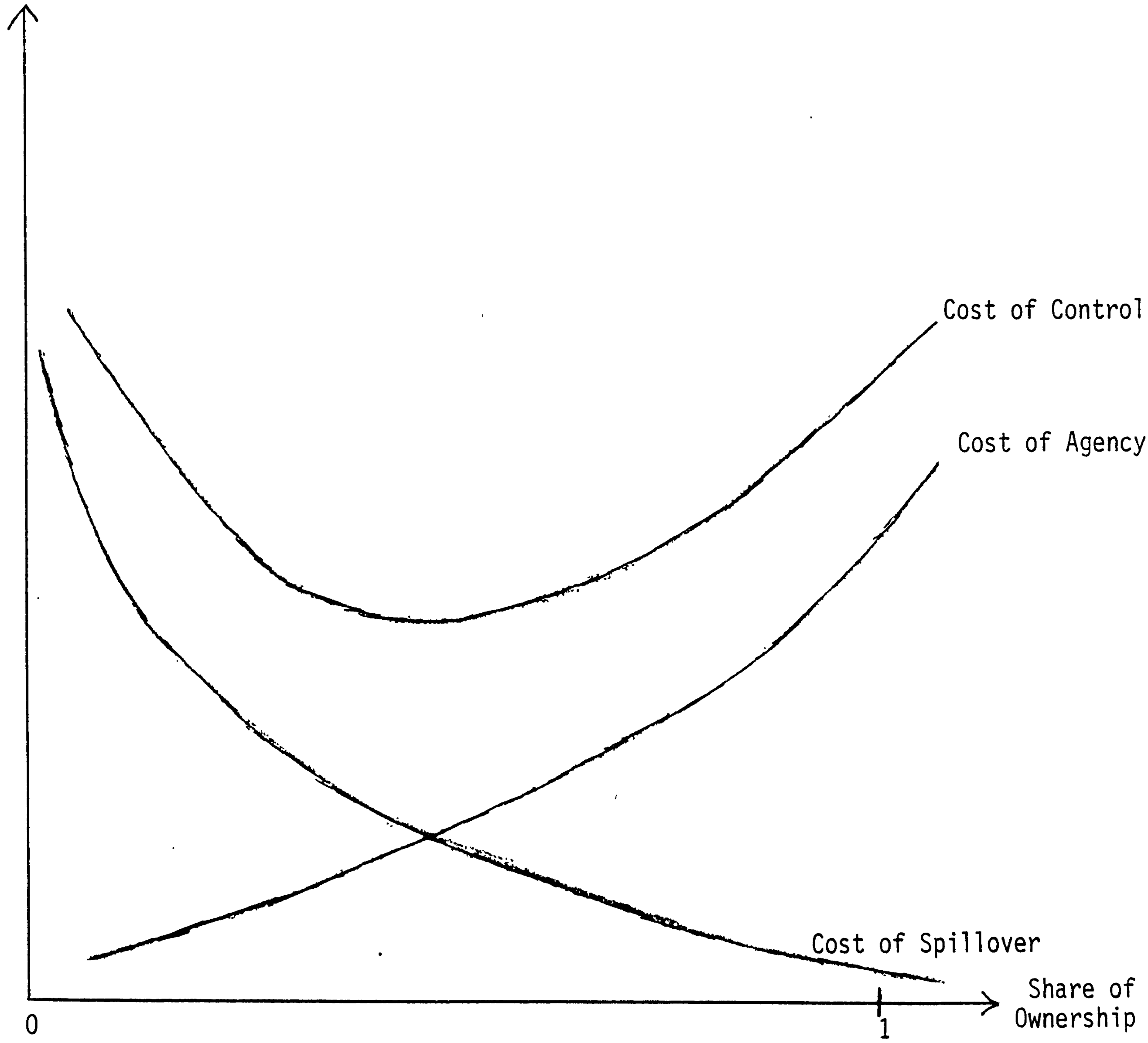
(10) $\dfrac{dC}{d\alpha} = q^{1*}y_1 + \pi_0$

or

(11) $\alpha = (1/2a_2)(a_1 + q^{1*}y^1 + \pi^0)$.

According to our model, in equilibrium, a U.S. 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 U.S. parent firm and consists of the payment for the total transfer of internally-traded goods and services $(q^{1*}y^1)$ and the profit of the subsidiary (π^0). It is readily seen from (11) that the optimal

FIGURE 1. Cost of Control



share of foreign ownership is greater than the value of α that minimizes the cost of control $C(\alpha)$, since $q^{1*}y^1$ and π^0 are generally positive.[13] The optimal value of α is seen to be higher the greater the transfer is of intangible assets and the more profitable a subsidiary is.

3. Ownership Patterns for U.S.-Japan Joint Ventures: Empirical Results

In this section, data for U.S.-Japan joint ventures located in Japan are used to empirically test the implications for optimal ownership share determination underlying Equation (11).

Foreign firms increased their direct investments in Japan from about 930 million dollars in 1984 to more than 3.2 billion dollars in 1988. About 50 percent and 24 percent of the total foreign direct investment during the 1950-1988 period come, respectively, from the U.S. and Europe[14]. Foreign firms' subsidiaries are large relative to domestic Japanese firms. About one third of foreign firms' subsidiaries are capitalized at more than 100 million yen, while 99 percent of all domestic Japanese firms are capitalized at less than 100 million yen.[15] Available evidence also suggests that U.S. firms' subsidiaries in Japan are large relative to U.S. foreign affiliates in other countries. In 1977 and 1982, the mean sales per U.S. foreign affiliate in 47 countries were 21 million and 49 million dollars, respectively. The highest country-specific mean sales per U.S. foreign affiliate were 60 million in 1977 and 122 million dollars in 1982, both for Japan (U.S. Department of Commerce (1980, 1985)).

The ownership patterns of foreign firms' subsidiaries in Japan have been affected to a certain extent by Japanese government policies. By the 1950 Law Concerning Foreign Investment, foreign firms were permitted to own at most 49 percent of Japanese firms. The law was changed in 1973 to permit foreign firms to obtain, subject to certain exceptions, 100 percent ownership. In 1977, 7 percent of U.S. firms' subsidiaries reported they were required to limit their U.S. parent firms' equity, while in 1982 the fraction decreased to 3 percent. This compares with 1982 fractions of, for example, 1 percent for France and for West Germany, 2 percent for Italy and 3 percent 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 the foreign and Japanese parent firms and Japanese domestic considerations.[16] About 46 percent of U.S. firms' subsidiaries are fully owned. The ownership patterns for the jointly-owned firms (joint ventures) are as follows: the ownership share exceeds 50 percent for 17 percent of the joint ventures, the share is exactly equal to 50 percent for 23 percent of the joint ventures, and the share is less than 50 percent for the remaining 14 percent. Thus U.S. parent firms have majority ownership (more than 50 percent share) in more than 60 percent of their subsidiaries in Japan (Tozo Keizai Shimposha (1989)).

We turn our attention now to empirical results for U.S.-Japan joint ventures located in Japan. We will concentrate on joint ventures because more abundant and reliable data are available for joint ventures than for wholly-owned subsidiaries. Therefore we will not discuss firms' problems of making the binary choice between jointly-owned and wholly-owned subsidiaries. While using data on U.S.-Japan joint ventures makes our results region specific, applying the theory developed to a homogeneous sample has several advantages. First, since all the subsidiaries are in Japan, the agency behavior of local production input owners may be viewed as reasonably homogenous. Significant agency and spillover costs due to the large size of U.S. subsidiaries in Japan also make it easier to empirically identify the ownership equation that specifies an equilibrium between the marginal cost of control and the marginal benefit. Thirdly, given the sophistication and complexity found in the Japanese business system, the assumption that agency concern is asymmetric between foreign and local parents may be more acceptable.

Equation (11) implies that the optimal ownership share depends positively on a subsidiary's profitability π^0 as well as on the total amount of transfer of internally-traded goods and services ($q^{1*}y^1$). Although we do not observe π^0 or $q^{1*}y^1$ directly, it is possible to derive a statistically estimable version of Equation (11) as follows. Since the potential maximum profit (π^0) for JV is greater than the actually observed profit (π^{0*}) by the amount of the agency cost $A(\alpha)$ which is an increasing function of α (Figure 1), we have $\pi^0 = \pi^{0*} + A(\alpha)$. If we approximate $A(\alpha)$ by $A(\alpha) = c_2\alpha$ $(c_2>0)$, then, by substitution into (11), we get

$$\alpha = b_1 + b_2q^{1*}y^1 + b_2\pi^0 = b_1 + b_2q^{1*}y^1 + b_2\{\pi^{0*} + c_2\alpha\},$$

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

$$(12) \quad \alpha = d_1 + d_2q^{1*}y^1 + d_2\pi^{0*}$$

where $d_1 = \{b_1/(1-b_2c_2)\} > 0$ and $d_2 = \{b_2/(1-b_2c_2)\} > 0$ and where $d_1>0$ and $d_2>0$ imply $b_2c_2<1$.

In estimating (12), π^{0*} is JV's observed profit (JV-PR) but we do not observe the actual values for the total internal transfer payments ($q^{1*}y^1$). This total may be approximated, however, by the size of a subsidiary's operation (JV-S) and the subsidiary's import share for raw materials (JV-IMP). If JV-S and JV-IMP are proxies for total internal transfer payments ($q^{1*}y^1$), then both JV-S and JV-IMP should have positive signs. Certain implications of our model can be tested by estimating Equation (12). In particular, the constant term $d_1(>0)$ represents the relative contribution of the cost of control to the determination of α, while $\alpha - d_1 = d_2q^{1*}y^1 + d_2\pi^{0*}$ corresponds to the relative contribution to α of internal transfer payments ($d_2 q^{1*} y^1$) plus subsidiary profits ($d_2 \pi^{0*}$).

Equation (12) was estimated using data for U.S.-Japan joint ventures in manufacturing industries. If UP from time to time adjusts its ownership share α based on the subsidiary's expected profitability, the UP's expected profits from a subsidiary's operation in the near future will consist of its current profit π^{0*} and growth (JV-GR). The growth component can be viewed as delayed (or future) profits resulting from economic rents associated with a large future market share. It is an empirical issue to determine the relative contributions of a subsidiary's short-run profits and growth rate to UP's ownership share. Therefore JV-GR was included as an explanatory variable in some of the empirical specifications.

Table A1 provides summary characteristics of the data sample used. (See Appendix A for details on the data used.) Estimation results are reported in Table 1. Ordinary least squares results are presented in Columns 1, 5 and 7 of this table. All of the estimated coefficients have the expected signs and are statistically significant except JV-GR. In practice UP's ownership share, α, is often determined before a new subsidiary is established. The ownership share is also revised sometimes in anticipation of high profitability and new growth opportunities for an existing subsidiary. Since a subsidiary's profit and growth behavior and the ownership share α could reflect the same underlying management strategies, it is possible that the regression error term assumed for Equation (12) 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. The IV results, like the OLS results, show that a subsidiary's short-term growth rate, as we measure it, is not a statistically significant determinant of α. Estimation results for our Equation (12) without JV-GR presented in Columns 5 (for OLS) and 6 (for IV) are generally consistent with the results reported in the rest of the table and reassuring. The only discrepancy between the OLS and IV estimation results is found with respect to the estimated coefficient of 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, α, 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.[17] Finally our estimates for the constant term (d_1 in Equation (12)) are relatively stable, ranging from .39 to .43. Using the mean values given in Table A1 of $\bar{\alpha}$ = .511 and $\overline{\text{JV-PR}}$ = .082, and using mean values of $\bar{d}_1 \simeq .41$ and $\bar{d}_2 \simeq .65$ for the estimated regression coefficients (the constant term and the coefficient of JV-PR-IV from Table 1), the relative contribution of the cost of control to the optimal value of α is estimated to be about 80 percent (= .41/.511)[18] while the remaining 20 percent of the value of α can be attributed to the effects of internal transfer and profitability. In particular, the contribution to α of JV's profitability is estimated to be about 10 percent (= (.65)(.082)/.511).

4. Concluding Remarks

In this paper we presented a model for the determination of ownership patterns for foreign joint ventures. In this model the share of ownership of a foreign subsidiary is determined by equating the marginal benefit a parent firm derives from its subsidiary and the marginal cost of control. The marginal benefit is the payment a subsidiary makes to its parent. The cost of

TABLE 1. U.S. OWNERSHIP SHARE EQUATION ESTIMATES[a]

	(1) OLS	(2) IV	(3) IV	(4) IV	(5) OLS	(6) IV	(7) OLS	(8) IV
JV-IMP	.19864**[b,c] (5.50)	.19523** (5.40)	.18293** (4.03)	.17610** (3.91)	.19653** (5.36)	.17959** (3.92)	.21835** (5.89)	.21503** (5.73)
JV-S	.0000018** (6.16)	.0000016** (4.76)	.0000017** (6.42)	.0000015** (4.94)	.0000017** (5.51)	.0000016** (5.80)	.0000018** (5.58)	.0000016** (4.38)
JV-GR	.05320* (1.71)	---	.04499 (1.35)	---	---	---	.05023 (1.58)	---
JV-G-IV[d]	---	-.02829 (.38)	---	-.04678 (.64)	---	---	---	-.02459 (.31)
JV-PR	.35147** (2.76)	.34791** (2.64)	---	---	.34719** (2.66)	---	---	---
JV-PR-IV[d]	---	---	.62246** (1.68)	.67109** (1.81)	---	.64644** (1.74)	---	---
Constant	.40600** (27.7)	.41019** (27.4)	.39002** (12.96)	.39155** (13.17)	.40886** (23.42)	.39077** (13.11)	.42744** (30.84)	.43109** (30.65)
R^2	.322	.363	.351	.347	.363	.345	.333	.326

[a] The dependent variable, α, is the U.S. parent firm's share of ownership of a subsidiary. Industry dummies for General Machinery, Electric Equipment and Automotive 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 with asterisks are significant at a 90% level (*) and at a 99% level (**), respectively, based on normal probabilities.

[d] JV-G-IV and JV-PR-IV are, respectively, instrumental variables representing the predicted values for JV-G and JV-PR. The auxiliary equations used are reported in Table B1 in Appendix B.

control consists of the cost resulting from skills spillover to partner firms and potential competitors and the agency cost imposed by the owners of local production inputs. The spillover cost arises because of imperfection in the markets for property rights. These costs are sometimes suggested to be the primary motivation for foreign direct investment. The agency cost is a consequence of the information asymmetry with regard to the effort by the owners of local production inputs.

The model was estimated using data on U.S. firms' subsidiaries in Japan. Estimation results are generally consistent with the predictions of the model.

Footnotes

1 The idea is often referred to as internalization in the literature related to multinational firms. Helpman (1984), Markusen (1984) and Ethier (1986), for example, incorporate internalization theory within a trade theory framework. These authors develop trade models based on the premise that multinational firms have a factor of production which behaves like public goods. See, for example, Morck and Yeung (1990, 1991) for empirical findings supporting the internalization theory.

2 The property rights issue arises because, a priori, agreeing on the price of an intangible asset is difficult. The potential buyer will have difficulty in assessing the value of an information-based intangible asset because of, for instance, the market for lemons problem. The seller's problem is that the potential buyer will have no incentive to pay once the information itself is made known to the potential buyer.

The property rights issue is also of prime concern to Western firms considering establishing joint ventures in, for example, China, where the joint venture law allows joint ventures with foreign firms to be established, provided that they will be dissolved in a prespecified amount of time. Ho and Huenemann (1984, p. 80) notes, "Because industrial property rights are likely to make up a substantial share of the foreign participant's contributions to a joint venture, foreign investors are understandably disturbed that the joint venture law is silent on the issue of industrial property rights, particularly in view of the fact that China does not have a patent law and is not a signatory to the Paris Convention. The inclusion of a 'non-disclosure clause' in the joint venture agreement may provide a degree of protection, but the enforcement of such a clause may prove problematic in China." It should also be pointed out that, like joint ventures in China, joint ventures based on strategic alliances such as NUMMI between Toyota and GM often have prespecified (sometimes stochastic) planning horizons. In strategic alliances a joint venture ceases to exist when both parent firms have learned from a joint venture specific technological, managerial and other skills they originally lack in.

[3] The owners of local inputs refer to, for example, local workers and managers hired by a subsidiary in the host country. They are usually different from the local owner(s) of a subsidiary if it is jointly owned by home and host country owners. See also Brickley and Dark (1987), for example, who analyze the choice between owning and franchising from the agency point of view.

[4] See, for example, Lasdon (1970, p. 412) and Diewert (1974, 1986).

[5] The important case of the internal transfer of a pure public good for which q = 0 is not considered in this paper.

[6] While we mean by transfer prices the economic transfer prices, there are other types of transfer prices specifically designed to achieve certain managerial objectives. For large firms of the sort found in our data sample, however, Caves (1982, p. 246) notes: "... large firms generally are not in a position to keep two sets of books ... transfer prices directly affect decentralized decisions in the large firm--for example, whether some component should be secured from a corporate sibling or bought on the open market. The transfer price serves as a 'shadow price' within the company to guide its own resource-allocation decisions. ... the MNE (multinational enterprise) hoping to confuse the tax collector runs some danger of confusing itself and demoralizing subsidiaries required to report low profits." Caves (1982, p. 247) states, however, that large MNEs, lacking arm's length bases for setting transfer prices, "can justify the overhead expense of a complicated cost-based system of transfer pricing capable of

compromise among administrative and tax-avoidance objectives...." Overall, the companies do heed tax considerations and some other government fiscal incentives, but they clearly also manage transfer prices for internal-control objectives." Yunker (1982, p. 40) also notes that active manipulation of transfer prices for enhancement of corporate goals faces obstacles in the legal and regulatory environment and in the general variability and unpredictability of the business environment.

7 This is consistent with, for example, the hypothesis put forward by Caves (1971) that firms invest abroad to capitalize on the ownership of such firm-specific assets as production processes, products, managerial abilities and R&D capabilities, provided that firms are able to transfer these assets at zero (or very low) marginal cost to foreign operations.

8 As an example of this approach, suppose that the technology sets are given by:

$T^1 = [(x^1_1, x^1_2, x^1_3, y^1_1, y^1_2) : x^1_2 \leq \{(x^1_1)^{\frac{1}{2}} + (y^1_1)^{\frac{1}{2}}\}\ A_1,\ y^1_1 + y^1_2 \leq (x^1_3)^{\frac{1}{2}} A_2]$ for UP,

$T^2 = [(x^2_1, x^2_2, x^2_3, y^2_1, y^2_2) : x^2_2 \leq \{(x^2_1)^{\frac{1}{2}} + (y^2_1)^{\frac{1}{2}}\}\ B_1,\ y^2_1 + y^2_2 \leq (x^2_3)^{\frac{1}{2}} B_2]$ for JP,

and

$T^0 = [(x^0_1, x^0_2, y^1_2, y^2_2) : x^0_2 \leq \{(x^0_1)^{\frac{1}{2}} + (y^1_2)^{\frac{1}{2}} + (y^2_2)^{\frac{1}{2}}\} C_1]$ for JV.

Using x^i_3 purchased from external markets, the two parent firms produce intermediate goods to be used partly for the parent firms' production (y^i_1) and partly for the JV's production (y^i_2) (i=1,2). The parent firms produce x^i_2 to sell in external markets using as inputs the external goods x^i_1 and the intermediate goods y^i_1. JV produces x^0_2 using external goods x^0_1 and internal goods y^i_2 purchased from parent firm i (i=1,2). Scalars A_1, A_2, B_1, B_2 and C_1 represent factors such as technologies, fixed capital stocks and business environments which affect the firms' production but are slow to change and hence can be assumed to be constant. For simplicity all variables in this example, x^i_1, x^i_2, x^i_3, y^i_1, y^i_2, x^0_1 and x^0_2 (i=1,2), are assumed to be scalar and nonnegative.

It can be shown that the profit functions for the parent firms and their subsidiary are given by:

$$\pi^1(p^1{}_1, p^1{}_2, p^1{}_3, q^1) = (1/4)A_1{}^2(p^1{}_2)^2\{(1/p^1{}_1) + (1/(q^1))\}$$
$$+ (1/4)A_2{}^2(q^1)^2(1/p^1{}_3).$$
$$\pi^2(p^2{}_1, p^2{}_2, p^2{}_3, q^2) = (1/4)B_1{}^2(p^2{}_2)^2\{(1/p^2{}_1) + (1/q^2)\}$$
$$+ (1/4)B_2{}^2(q^2)^2(1/p^2{}_3).$$

and

$$\pi^0(p^0{}_1, p^0{}_2, q^1, q^2) = (\tfrac{1}{4})(p^0{}_2)^2\{(1/p^0{}_1) + (1/q^1) + (1/q^2)\}C_1{}^2.$$

The expressions for optimal transfer prices and demand and supply functions are given in Nakamura (forthcoming).

9 Nagatani (1989, Ch. 9), for example, provides an excellent description of Japanese government and business practices which 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.

10 This implies the transfer is more effective when α is large. That is, the UP produces y^1 to be transferred to the JV, but the latter can utilize at most αy^1.

11 We also assume here that the UP does not exhibit a behavior like Stackelberg behavior in which it exploits its opportunity to shirk in choosing α or exploits JP's reaction to its supply of intangible assets (e.g. skills and effort).

[12] Duality implies $y^1 = \partial\pi^1/\partial(\alpha q^1)$. Note also that (10) also follows from

(9′) $P(\alpha) = \pi^1(p^1,q^{1*}) - (1-\alpha)q^{1*}y^1 + \alpha\pi^0(p^0,q^{1*},q^{2*}) - C(\alpha)$

where $(1-\alpha)q^{1*}y^1$ represents the direct production cost of the spillover $(1-\alpha)y^1$.

[13] The values of a_1 and a_2 determine the contribution of the cost of control, relative to that of a subsidiary's total payment $(q^{1*}y^1 + \pi^0)$, to the determination of the optimal ownership share.

[14] These are the numbers compiled by the Ministry of Finance and reported in Toyo Keizai Shimposha (1989).

[15] Toyo Keizai Shimposha (1989).

[16] For example, at least 314 (190) foreign firms' subsidiaries have been established in Japan in 1988 (in 1989) while the ownership patterns for at least 151 (100) subsidiaries have changed during the same period. Changes in ownership patterns include changes (increases or decreases) in foreign firms' shares of ownership of 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).)

[17] 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.

[18] One should be cautious in interpreting estimated values for a regression constant term as an estimate for a behavioral (structural) parameter since a constant term can pick up various unobservable effects including firm-specific fixed effects.

Appendix A. Data

Data for the period 1984-1988 for subsidiaries in the Japanese manufacturing industries that are jointly owned by U.S. and Japanese parent firms were primarily collected from Toyo Keizai Shimposha (1989) which contains information on large subsidiary firms with at least 20 percent foreign ownership as well as on smaller subsidiary firms with at least 49 percent foreign ownership and a capitalization of at least 50 million yen. The manufacturing industries included are: chemicals, general and electrical machineries and automotive. Data for Japanese parent firms were collected from Nihon Keizai Shimbunsha (1988) and Toyo Keizai Shimposha (various years), while data for U.S. 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 1984-1988. It is matched with information for its parent firms.

Table A1 gives the means and standard deviations for the following variables (with their units of measurement in parentheses). AGE = the age of a subsidiary (years); JV-GR, UP-GR, JP-GR = growth rates (measured as (sales (t+1) - sales (t))/sales (t)) for the sales revenue of subsidiary firms (JV), U.S. parent firms (UP) and Japanese parent firm (JP), respectively; JV-PR, UP-PR, JP-PR = the before-tax income divided by sales revenue; JV-S, UP-S, JP-S = the sales revenue for JV's (million (M) yen), for UP's (M dollars) and for JP's (M yen), respectively; UP-RD, JP-RD = the R & D spending divided by sales revenue; UP-SHARE = UP's share of JV ownership; JV-BV = JV's capitalization at book value (M yen); JV-#W, UP-#W, JP-#W = the numbers of workers for JV, UP and JP, respectively; JV-IMP = the share of imports in the materials procured for JV; JV-EXP, JP-EXP = the shares of export in the sales

TABLE A1. CHARACTERISTICS OF DATA[a]

	Jointly-Owned Firms
JV-AGE	16.0 (7.2)
JV-GR	.069 (.224)
UP-GR	.045 (.162)
JP-GR	.040 (.202)
JV-PR	.082 (.078)
UP-PR	.062 (.077)
JP-PR	.042 (.038)
JV-S	13172 (19891)
UP-S	9485.3 (16425)
JP-S	941820 (2778600)
UP-RD	.039 (.032)
JP-RD	.035 (.029)
UP-SHARE(α)	.511 (.124)
JV-BV	1298.2 (1981.9)
JV-#W	405.8 (584.9)
UP-#W	76524 (105510)
JP-#W	8879.4 (14242)
JV-IMP	.234 (.277)
JV-EXP	.136 (.155)
UP-S.FRN	.231 (.156)
JP-EXP	.228 (.184)
GEN. MACHINERY	.196 (.398)
ELEC. MACHINERY	.348 (.478)
AUTOMOTIVE	.029 (.168)
CHEMICALS	.427 (.496)
No. of Firms	42
No. of Pooled Observations	138

[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 text for the data source and the definitions of these variables.

revenues for JV and JP, respectively; UP-S.FRN = the share of foreign business in UP's sales; GEN. MACHINERY, ELEC. MACHINERY, AUTOMOTIVE, PRECISION, CHEMICALS = industry dummy variables representing respective industries. It should be noted that the JP-related variables are not based on consolidated financial statements while figures for U.S. parent firms are based on consolidated statements reflecting the figures for both the parent and relevant subsidiary firms.

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* (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, 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 (Newlett-Packard, Yokogawa Electric), Yokogawa Medical Systems (General Electric, Yokogawa Electric), Daikin-R/M (Raytech, Daikin).

* 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.

APPENDIX B. AUXILIARY EQUATIONS ESTIMATES

TABLE B1. AUXILIARY PROFITABILITY AND GROWTH EQUATIONS

	Profitability[a]	Growth[a]
JV-IMP	.06195*[b,c] (1.83)	-.14520 (1.62)
US-RD	-.05623 (.24)	.34175 (.42)
US-S	.00000097** (4.19)	.00000037 (.56)
JV-S	-.0000002 (1.10)	-.000002* (2.05)
JP-RD	.83584** (2.90)	.42489 (.80)
JP-S	.000000002* (1.89)	.000000004 (1.10)
JP-GR	---	.54868** (2.68)
Constant	.01734 (1.08)	.00792 (.22)
R^2	.327	.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, Electric Equipment and Automotive 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 with asterisks are significant at a 90% level (*) and at a 99% level (**), respectively, based on normal probabilities.

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