Firm performance, knowledge transfer and international joint ventures [1]

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Abstract: Management and protection of proprietary intangible assets such as technology and management skills is important for firms considering international expansion via joint ventures. Joint venture partners have incentives to appropriate intangible property. Also many governments have instituted policies to help domestic firms maximise technology spillovers. Some require foreign firms interested in selling in domestic markets to enter into arrangements that ensure the flow of technology from the foreign firms. This gives the host country partners an advantage over their foreign counterparts when it comes to sharing intangible assets. It is often asserted that these sorts of host country advantages contribute to better economic growth for that country and the domestic firms involved in the international joint ventures. However, there is little empirical evidence on this. We present empirical evidence that transfer of intangible assets from foreign to host country partners contributes to the performance of the host country partner firms.

Keywords: multinational firms; joint ventures in Japan; productivity; technology; Japanese firm performance.

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1 Introduction

One of the basic issues for technology-based firms considering international expansion via foreign alliances is the management and protection of their proprietary technology. With all of the standard types of business alliances used for international expansion including the establishment of fully owned subsidiaries, joint ventures and technical licensing, there are risks for the participating firms of losing control of some of their technology and other intangible assets [3,4]. Nevertheless, there are also compelling reasons why technology-based firms that are interested in entering into foreign markets often enter into alliances such as equity joint ventures. The expected benefits can include access to the host country partners' expertise in domestic markets and politics, risk sharing, and, in some countries, a means of complying with government requirements for foreign firms.

The national governments of many countries count on and look for ways of ensuring technology spillovers from foreign firms. This is part of their national economic growth agenda. Indeed, some countries require foreign firms interested in entering their markets to establish joint ventures or make other arrangements that include guarantees of flows of technology from the foreign firms to domestic businesses.

In the case of Japan, up through the mid 1970s, foreign firms that wanted access to domestic markets were required to enter into an agreement such as technical licensing that enabled Japanese firms to produce the foreign-developed goods. Back then, it was only in exceptional cases involving foreign firms with significant bargaining power that actual joint ventures with domestic partners were sanctioned by the government of Japan. Those joint ventures involved strictly monitored licensing agreements between the foreign firms and their domestic partners. Many regard this historical Japanese industrial policy as having helped to raise the technological level of Japanese firms in a number of manufacturing industries, but also as something that left a legacy of business practices that, to this day, impede foreign firms' access into the Japanese market. One symptom of this is that, among developed countries, the ratio between the amounts of inward and outward foreign direct investment is especially low for Japan [5].

China has also had an industrial policy that forces foreign firms to transfer technology in return for rights of access to the Chinese market. The US Department of Commerce [6] sums this situation up as follows:

> "China is a buyer's market. As such, the leverage of such an enormous potential market allows Chinese officials to frequently play foreign competitors against one another in their bids for joint venture contracts and large-scale, government-funded infrastructure projects in China. The typical result is usually more technology being transferred as competitors bid up the level or type of technology that they are willing to offer. There are also recent cases, however, of foreign companies joining forces with domestic or foreign companies in the same industry in order to enhance their own leverage. Microsoft, DEC, and Oracle, for instance, have joined forces in selling software in China and Exxon, Raytheon, Dupont, and Union Carbide have teamed up with Japanese companies in China. Although cooperation may not be possible across all industries, where such an arrangement is possible, there will likely be less technology being transferred by or coerced from foreign firms. The answer given most often in interviews and in press reports as to why, despite demands made for commercial technology transfers and other unfair trade practices in China, US industry continues to invest heavily in China is that one cannot *not* be in China lest a competitor get a foothold. US high-tech firms seem willing to pay the price in technology transfers – in exchange for limited market access."

1.1 The dynamic underlying knowledge transfers

Firms acquire knowledge over time from their inter-firm relationships with other firms. These knowledge acquisitions are believed to affect firm strategies not only with regard to coping with existing inter-firm relationships but with regard to future alliances as well. Indeed, other studies offer evidence suggesting that prior experience in inter-firm collaboration increases the likelihood that a firm will enter into an alliance relationship and the likelihood of the success of these activities [see, for example, 7–15]. However, while there have been many studies that examine the impact of prior inter-firm relationships such as alliances and joint ventures on the future course of these inter-firm relationships, evidence is largely lacking concerning the impact of inter-firm relationships such as joint ventures on the current and future choices and performance of the parent firms themselves. (Exceptions include Hennart et al. [16] who consider Japanese firms' strategic motives for entering the US market using joint ventures initially and Nakamura et al. [17].) The purpose of this paper is to contribute to filling in this gap in the literature.

The organisation of the rest of the paper is as follows. In Section 2, we present the hypotheses we empirically investigate in this paper. In Section 3, we discuss our model specifications and estimation methods. Section 4 discusses our data. Our empirical results are presented in Section 5. Section 6 concludes.

2 Our hypotheses

In this paper we are interested in measuring the impact of a particular form of international alliances [18] – international joint ventures (IJVs) – on the performance of the Japanese host country parent firms for the joint ventures. In particular, we are interested in empirically exploring a number of hypotheses related to the impact of the acquisition of knowledge by the host country parent firms on their performance including their capacity to increase their investments in intangible assets such as R&D, marketing and advertising, and their productivity performance [19–25]. As in previous studies, we

also examine the impacts of involvement with an IJV on the propensity of a firm to become involved in the formation of subsequent IJVs.

We are interested in studying the following three related questions:

- effects of past experience forming IJVs on the probability that a host country parent firm will set up another IJV
- effects of past and present experience with IJVs on the host country parent firm's behaviour concerning investments in intangible assets such as R&D, advertising and marketing
- effects of past and present IJV experience on the host country parent firm's performance as measured by stock returns and total factor productivity growth.

The specific hypotheses to be considered empirically in this paper will now be introduced.

2.1 International experience with business alliances

Foreign firms interested in forming IJV alliances in a host country usually conduct searches for local partners. Previous research has revealed that considerable 'shopping around' takes place. The resulting matches are believed to depend on the characteristics of both the foreign and local partner firms, often referred to as the foreign and the local (host country) 'parents'. Our hypothesis is as follows.

Hypothesis 1: Past experiences in having IJVs increase the likelihood that a host country firm can set up another IJV successfully.

2.2 International alliances and host country (local) parent firms' intangible assets

An issue of interest is whether the Japanese parent firms (JPs) that entered into IJV arrangements with foreign parent firms (FPs) benefited from these IJVs in developing their firm-specific intangible assets such as R&D and advertising, using industry levels as the basis of comparison [26]. This could be part of the explanation for improvements in firm performance. Until the mid 1970s, Japan's heavily protected business environment worked against the establishment of joint venture alliances and the Japanese government required demonstrable technology spillover opportunities as a condition for granting permits for IJVs. This policy was eventually changed and from the 1980s on, foreign firms were free to invest in new alliances of any form in Japan and were also free to readjust the conditions of their existing alliances.

It would not be surprising if some of the Japanese firms that entered into IJV arrangements with foreign firms counted on technology spillovers to turn around their own faltering businesses. Certainly it is well known that many of the Japanese firms that sought to establish IJVs were not the industry leaders in their respective Japanese markets (For example [27]).

Even though the primary types of spillovers from IJVs to the host country partner firms that are of interest in this study involve technology, spillovers can also occur for intangible assets of other sorts such as advertising concepts and marketing strategies. For example, the concept of differentiated consumer markets and strategies for developing them were almost non-existent in Japan prior to the 1980s. It seems possible

that, intentionally or otherwise, the IJVs provided their host country partner firms (Japanese firms in the above) with opportunities to learn sophisticated advertising and marketing methods.

We summarise the above as follows.

Hypothesis 2: Past experiences in having IJVs increase a host country firm's investment in intangible assets.

2.3 Alliances and host country parent firms' performance

Another important issue is whether or not an IJV contributes to the enhancement of not only the host country firm's intangible assets accumulation but also the enhancement of the host country firm's performance. We use stock returns and total factor productivity (TPF) growth to measure the performance of the host country firm. Although it certainly cannot simply be assumed that a host country firm's improved intangible assets position will lead to improvements in the firm's overall performance, it seems likely that this will often be the case. Hence our third hypothesis is as follows.

Hypothesis 3: Past experiences in having IJVs improve a host-country firm's performance.

In the next section we present our empirical specifications and the estimation methods used to test these hypothesis.

3 Our models and methods

In this paper, in order to empirically test the above hypotheses, we use data for the 1980s for the Japanese technology-based manufacturers listed in the first section of the Tokyo Stock Exchange over the stated time period. Available databases for studies of IJVs tend to be country specific, and usually have information for the local but not the foreign parents for joint ventures in a country. This is the case as well for the Japanese data used in this study [28,29].

Our empirical model specifications to be used are given below.

Hypothesis 1. We use probit analysis to test Hypothesis 1 by determining the probability that a host country firm successfully sets up an IJV with a foreign firm. When a joint venture IJV is set up for the ith host country firm, then the dummy dependent variable z_i is set equal to one. That is, we define the dummy dependent variable as follows:

$$z_i = 1 \quad \text{if} \quad z_i^* > 0 \quad \text{and} \quad z_i = 0 \quad \text{if} \quad z_i^* \leq 0 \tag{1}$$

where

$$z_i^* = X_{1i}\, a + v_i \tag{2}$$

and where X_1 is a vector of explanatory variables, a is an unknown parameter vector and it is assumed that the normal random variable $v_i \sim N(0, s_v^2)$ is uncorrelated across firms. It is assumed here that some sort of a structural decision model underlies the reduced form equation (2).

Hypothesis 2. We are interested in estimating the effects of the dummy variable z defined above as well as other explanatory variables on our intangible assets variables denoted in our tables by R&D (research and development) and Adv_mktg (advertising and marketing). The econometric specifications we have used for this purpose are

$$y_i = X_{2i}\, b + p\, z_i + u_i \tag{3}$$

where y denotes the dependent variable of interest, X_2 is a vector of explanatory variables, b and p are, respectively, an unknown parameter vector and scalar to be estimated, and u is a normal random variable, $u_i \sim N(0, s_u^2)$,that is uncorrelated across firms but is correlated with v_i as follows:

$$\text{Cor}(u_i, v_j) = r \quad \text{if} \quad i = j \quad \text{and} \quad Cor(u_i, v_j) = 0 \text{ otherwise.}$$

The equation of our interest in this section is equation (3) that measures the effects of both X_2 and z on y. A potential source of estimation bias is the correlation between u_i and v_i. We will use two alternative econometric specifications to correct for the estimation bias resulting from this endogeneity problem.

The first specification is an instrumental variables (IV) method in which we substitute predicted values for z obtained from probit models as instruments for z in (3). The predicted probability is given by Prob(JV) = $F(X_{1i}\, a^*)$ where a^* is obtained by probit estimation and where F is the cumulative density function of a standard normal variable. Thus our estimating equation becomes

$$y_i = X_{2i}\, b + p\, F(X_{1i}\, a^*) + u_i \tag{4}$$

Another method that can be used to deal with the correlation between z and u is to explicitly include a term representing the correlation in the estimating equations. Selectivity bias arises because Japanese firms selected for IJV formation may be chosen because of their unobserved characteristics that are in the error term u. It is shown [30–32] that the conditional mean of y_i if firm i forms an IJV is given by

$$\begin{aligned} &E(y_i/X_1, z = 1) = X_{2i}\, b + p\, z_i + E(u_i/X_1, z = 1) \\ &= X_{2i}\, b + p\, z_i + (rs_u s_v) f(X_{1i}\, a^*)/F(X_{1i}\, a^*) \\ &= X_{2i}\, b + p\, z_i + (rs_u s_v)\, (SB_i) \end{aligned} \tag{5}$$

or in regression form as

$$y_i = X_{2i}\, b + p\, z_i + (rs_u s_v)\, (SB_i) + w_i \tag{6}$$

where f and F represent, respectively, the probability density and cumulative density functions for a standard normal distribution. SB_i is a selection bias term and its coefficient measures the unobservable degree of the strength of the correlation between the selection of firm i for IJV formation and unobservables determining firm performance as measured by y_i. The normal error term w_i has mean zero and a heteroskedastic variance. Application of OLS to (5) will result in consistent estimates for b, p and $(rs_u s_v)$ but the OLS estimates for the standard errors of the regression coefficients are not consistent. Heckman [31] provides expressions for consistent standard errors. In estimating (6) below we use consistent standard errors [33].

Hypothesis 3. To empirically test this hypothesis we use the same framework given above for Hypothesis 2. In particular, we use as the dependent variables stock returns and TFP growth. As regressors we use the number of IJVs from the past, the market return (for X_2) and the current IJV dummy (z). Equation (4) gives IV estimates and equation (6) gives sample selection estimates. For the TFP growth regressions were only present OLS estimates since both the current IJV dummy (z) and selection bias are found to be statistically insignificant.

4 Data

Our data sample is for Japanese manufacturing firms that were listed in the first section of the Tokyo Stock Exchange in fiscal 1990. We have confined our attention to the first section firms because they are considerably larger and more established than the second section ones and more information is available for the first section firms. The estimation data set formed for this study is for 1981–1990 [34]. During this period, the first section firms were involved in 134 manufacturing joint venture IJVs with foreign partner firms (0.26 per Japanese firm) that were still operational in 1991.

4.1 Description of the data used

We included in our sample joint ventures established between 1961 and 1990 and owned by Japanese firms and foreign firms reported in Toyo Keizai [35]. Our sample consists of Japanese firms listed in the first section of the Japanese stock exchanges omitting those for which the required information on the JPs was not available from the Japan Development Bank financial database. This left us with data for 141 joint ventures in various manufacturing industries.

We have used Japan Development Bank's manufacturing industry classification system to calculate industry means for some of the variables used in this study. Seven Japanese firms established two joint ventures in the same years. We do not distinguish between the event of establishing two joint ventures and the event of establishing a single joint venture in a year. Our sample therefore has 134 events of joint ventures. About 60% of the foreign parent firms of these joint ventures are US firms while the remaining foreign parent firms are from Western Europe.

There are 424 Japanese manufacturing firms included in the sample ($424 \times 10 = 4240$ firm-years). Their records over the 1981–1990 period were matched to the events of joint venture establishments. A few observations were eliminated for which negative sales and/or negative assets were reported. We note that the joint venture event dummy is one only for less than 1% of all pooled observations and zero for the remaining cases. Our aim is to estimate long-run effects of joint ventures on host country parent firms using the pooled data.

Mean values, standard errors and minimum and maximum values for the variables used in this study are shown in Table 1.

Table 1 Descriptive statistics

Variable	*1981–1990 Mean (s.d.)*	*Min.*	*Max.*
R&D	0.00972 (0.01519)	0	0.1280
Tech_asset	0.00028 (0.00174)	0	0.0590
Adv_mktg	0.00839 (0.02436)	0	0.3420
Log(sale)	10.815 (1.2970)	7.211	15.25
#JVs	0.26633 (0.77961)	0	6
Ind_R&D	0.00970 (0.00870)	0	0.059
Ind_tech_asset	0.00019 (0.00059)	0	0.0070
Ind_adv_mktg	0.00843 (0.01358)	0	0.174
Year*	25.128 (2.653)	21	30
JV-dummy	0.003998	0	1
No. obs.	4502		

*The values used for the variable Year are: 21 (for 1981), 22 (1982), 30 (1990).

5 Empirical results

5.1 Hypothesis 1: probit regressions

Table 2 shows our probit estimates for the coefficients of reduced-form equations for the probability that an IJV located in Japan was formed sometime during the sample period (1981–1990) [36].

Table 2 Probit estimates of the effects of host firm characteristics on the probability of forming a Japanese joint venture[a,b]

	1981–1990	
	(1)	*(2)*
Constant	–5.64*** (3.93)	–5.18*** (3.42)
R&D	0.628 (0.103)	–6.43 (0.93)
R&D-ind	–	28.5** (2.43)
Tech_asset	48.7* (1.65)	39.8 (1.12)
Tech_asset-ind	–	96.6 (0.71)
Adv_mktg	–6.37 (1.00)	–6.96 (0.97)
Adv_mktg-ind	–	1.29 (0.15)
Profitability	0.821 (0.24)	0.864 (0.23)
Profitability-ind	–	–0.258 (0.04)
Log(sale)	0.295*** (3.12)	0.316*** (3.23)
#JVs	0.234*** (3.56)	0.174** (2.44)
Year	–0.028 (0.76)	–0.669 (1.56)
Log likelihood	–88.1	–84.4
Chi-squared (deg. of freedom)	58.6 (7)	66.0 (11)
No. obs.	4502	4502

[a]Numbers in parentheses are absolute asymptotic t-ratios.

[b]Mean; *,** and ***Significance levels at 10%, 5% and 1% respectively.

The results for model (1) shown in column 1 of Table 2 reveal that the amounts of technology assets (Tech_asset), including licensed technologies, that are owned by a potential Japanese parent firm (denoted hereafter by JP) significantly increase the probability the firm will enter into an IJV. In contrast, the impact on the probability of forming an IJV of the JP's ratio of R&D expenditures to sales (the R&D variable) is statistically insignificant. The variables for the total number of IJVs established by a JP up through the previous time period (denoted by #JVs) and for the JP's size measured by its sales revenue (Log(sale)) are both found to have significant positive impacts on the probability a Japanese firm will form an IJV.

The #JV variable for the total number of IJVs established by a JP is believed to reflect the strengths of the JP in technology and other forms of intangible capital that firms can gain from IJV relationships or that they need to be able to attract IJV partners. Thus, increases in the value of #JV are expected to also increase the probability that a Japanese firm will establish a new IJV relationship. That is, the coefficient of the #JV variable is thought to measure the JP's ability to successfully establish and operate joint ventures with foreign firms.

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Model (2) in Table 2 includes the same firm-specific variables as model (1) plus industry-specific variables. The R&D characteristics of the industries the firms in our sample are part of are of special interest in this study. Over the 10-year sample period, the probability for a Japanese manufacturer to become a JP that has formed a successful IJV increases significantly as the R&D to sales ratio of the industry for the JP rises.

Our results in Table 2 also show that the advertising and marketing expenditures of JPs (Adv_mktg) have an insignificant effect on the probability of interest [37].

In summary, the results in Table 2 suggest that the variables that increase the probability a Japanese firm will successfully establish an IJV are the size of the firm and the past experience of the firm with joint venture IJVs as well as the industry-specific variable for R&D [38]. While our results are consistent with Hypothesis 1, we have also found that other factors matter in the determination of setting up new IJVs. These results suggest that the Japanese manufacturers that enter into joint venture IJVs may tend to be weak in their firm-specific R&D capabilities but located in industries with strong R&D capacity [39]. The results in Table 2 also suggest that the firms that enter into IJVs tend not to possess above-industry levels of advertising and marketing capacity and tend not to be located in advertising-intensive industries.

5.2 Hypothesis 2: the impacts of IJVs on host country parents' intangibles

We now measure the effects of IJVs on JPs' intangible assets using the two econometric specifications (4) and (6) given above. In estimating (4) and (6), we include in X_1 all the industry variables as well as firm size, #JV and a time trend. X_2 includes the total number of IJVs being operated by Japanese firms up to the previous year (#JVs), an IJV dummy (corresponding to z in equation (6) above, denoted as the JV-dummy below), the time trend (calendar year) and the industry mean for the dependent firm performance variable. The primary variables of interest are #JV and the JV-dummy. #JV is a proxy for acquisition of knowledge from the JPs' existing IJVs, while the JV-dummy is a proxy for acquisition of knowledge from the current IJV contracted within the past 12 months.

Table 3 shows our regression results for both the IV and the sample selection methods. We see that the estimation results for both are qualitatively similar, raising our confidence in these results.

Table 3 Alliance effects on intangible assets[a,b]

	1981–1990			
	R&D		*Advertising & marketing*	
	(*1*) *IV*	(*2*) *Sample selection*	(*3*) *IV*	(*4*) *Sample selection*
Constant	0.0039	0.0009	0.0026	0.0005
	(1.05)	(0.43)	(0.50)	(0.17)
#JVs	0.0053***	0.0019***	0.0095***	0.0048***
	(5.26)	(5.40)	(6.74)	(8.59)
Ind_R&D	1.09***	1.007***	1.004***	1.002***
	(21.4)	(37.4)	(25.4)	(39.5)
Year	–0.0002	–0.0000	–0.0001	–0.0000
	(1.24)	(0.54)	(0.64)	(0.42)
JV-dummy	–0.3525***	–0.0824***	–0.4866***	–0.1335***
	(5.04)	(4.98)	(5.23)	(4.96)
Selection bias	–	0.0329***	–	0.0533***
		(5.11)		(5.11)
Adjusted R^2	–	0.334	–	0.326
No. obs.	4502	4502	4502	4502

[a]Numbers in parentheses are absolute t-ratios based on heteroskedasticity-corrected standard errors; [b]Mean; *,** and ***Significance at 10%, 5% and 1% levels respectively.

Research and development. The first panel in Table 3 shows that, after controlling for industry effects, the #JVs variable has significantly positive effects on increasing a JP's R&D level. This is in contrast to the immediate effects of newly established joint ventures (JV-dummy), which is significantly negative. In the 1980s, the Japanese partners chosen were generally weak in R&D. Our overall results are that JP's continue to receive positive spillovers in R&D from their IJVs even though we do not detect any benefit from the IJV established in the current year.

Advertising and marketing. The second panel of Table 3 shows our empirical estimates for the impact of IJVs on the JP's advertising and marketing (Adv_mktg) expenditures. After controlling for industry effects, the variable #JVs has a significant impact on the JP's advertising and marketing expenditures. In fact our numerical estimates suggest that the variable #JVs has much larger effects on the JP's advertising and marketing than on R&D (the coefficient estimates for the #JVs variable in models (1) and (2) are: 0.0053 and 0.0019 for the R&D equation and 0.0095 and 0.0048 for the Adv_mktg one). Our empirical results provide evidence that the JP's IJVs contributed significantly to the enhancement of their ability in advertising and marketing. While many US firms are concerned about the potential spillover of their R&D knowledge to their alliance partners, our findings suggest that they should also be concerned about the potential spillover of their advertising and marketing skills.

Our estimation results seem to suggest that in the 1980s the selected Japanese joint venture partners were relatively weak in advertising and marketing skills. This may be why they learn significantly from their IJVs, as the coefficient estimates for the #JVs variable show. We conclude that in the 1980s the Japanese IJV partners chosen were weak in both R&D and in advertising and marketing skills and that they significantly improved their skills in these areas by learning from their foreign joint ventures. This seems consistent with our Hypothesis 2.

5.3 Hypothesis 3: the impacts of IJVs on host country parents' firm performance

We have estimated the impact of joint venture IJVs over time on the performance of the Japanese parents. We used stock returns and total factor productivity (TFP) growth as our dependent variables.

Table 4 shows our regression results for the JP stock returns. We have calculated stock returns for most of our sample firms for the period 1981–1990 using monthly returns that included reinvested dividends for these firms. Annual returns were calculated as the geometric mean of the monthly returns over 12 months. In order to control market fluctuations, we have included the market return (with dividends reinvested) for the Tokyo Stock Exchange calculated in the same way as for individual firms' stock returns. In Table 4, the IV and sample selection methods give estimates that are qualitatively similar. Since the JV-dummy and selection bias terms are not statistically significant, OLS estimates excluding these two variables provide efficient estimates. First, it is of interest to note that the new IJVs established do not have any impact on JP stock returns in the year they were established. This may be in part because of the sample period used (1981–1990). For example, during this period there may not have been good investment opportunities for potential inward FDI in Japan [40]. Another reason may have been the significant uncertainty (or financial risk) that characterised the Japanese economy in this period [41].

We see from Table 4 that, consistent with Hypothesis 3, the past experiences of JPs with IJVs (#JV) are well rewarded in terms of their stock returns.

Table 4 Host country partners' performance: annual stock returns, 1981–1990[a,b,c]

Variable	*(1) IV*	*(2) Sample selection*	*(3) OLS*
Constant	0.00467** (0.00227)	0.01534*** (0.00104)	0.01534*** (0.00100)
#JVs	0.00120* (0.00072)	0.00129*** (0.00066)	0.00123*** (0.00048)
Market return[d]	0.05924*** (0.01031)	0.00906** (0.00410)	0.00906** (0.00391)
JV_dummy	–0.00326 (0.01999)	–0.00431 (0.01519)	–
Selection bias	–	0.00116 (0.00780)	–
Adjusted R^2	0.000	0.001	0.031
No. of. obs.	3387	3387	3387

[a]Numbers in parentheses are absolute t-ratios based on heteroskedasticity-corrected standard errors.

[b]Mean; *,** and ***Significance at the 10%, 5% and 1% levels respectively.

[c]Firms' annual stock returns were calculated as the geometric mean of firms' 12 monthly returns over the relevant periods. Dividends were included in our calculations.

[d]The market returns were calculated as the geometric mean of 12-month monthly returns for the Tokyo Stock Exchange stock index (value-weighted). Dividends were included in our calculations.

The second firm performance measure is total factor productivity (TFP) growth. This was calculated for each of the sample firms in selected industries for the following specific time periods: 1980–1985, 1986–1990, 1991–1995, and 1996–1998. The industries included for this part of our calculations were: electric machinery, auto, chemicals, pharmaceutical, general machinery and precision. The needed data to

calculate these TFP growth rates are not available for some of the firms in these industries that are included in our sample [42–46]. Only the firms for which TFP measures were calculated were included in our regressions. As in the regressions for stock returns reported in Table 4, the JV-dummy and selection bias terms were statistically insignificant in all of our regressions and hence were deleted from the subsequent regressions. Thus only OLS regressions are reported here.

Table 5 shows our OLS regression results. In the regressions reported here, the dependent variables are firm-specific TFP growth rates estimated for particular sub-periods. For example, tfp(86–90) denotes the TFP growth rate for the sample firms measured for the period 1986–1990. OLS estimates were computed for a constant term and the coefficient of the variable #JV, where the value of #JV that was used comes from the sample period specified in the first row of Table 5. For example, consider the three regressions reported in the three columns under the sample period 1980–1985. Since #JV used in these regressions comes from our sample of firms for the period 1980–1985, these regressions measure the impact of the number of joint venture IJVs that the sample firms had during the period 1980–1985 on contemporaneous TFP growth (i.e. tfp (80–85)), future TFP growth (i.e. tfp(86–90)) and another measure of future TFP growth (i.e. tfp(91–95)). Similarly, the last three columns under the sample period 1986–1990 show the impact of #JV as observed in the sample period 1986–1990 on the contemporaneous tfp(86–90), future tfp(91–95) and another future tfp(96–98).

Table 5 Host country partners' performance: TFP growth

Sample period	*1981–1985*[c]			*1986–1990*		
Dependent variable	*tfp(81–85) current*[d]	*tfp(86–90) future 1*[e,f]	*tfp(91–95) future 2*[f]	*tfp(86–90) current*	*tfp(91–95) future 1*	*tfp(96–98) future 2*
Constant[a,b]	0.01337*** (0.00187)	0.01127*** (0.00086)	0.01468*** (0.00076)	0.01161*** (0.00134)	0.01402*** (0.00095)	0.01461*** (0.00196)
#JVs	0.00002*** (0.000003)	0.00001*** (0.000002)	0.00001*** (0.000002)	0.00001*** (0.000004)	0.00001*** (0.000003)	0.00001*** (0.000003)
Adjusted R^2	0.057	0.024	0.036	0.012	0.026	0.030
No. of. obs.[e]	1170	1170	1170	828	828	195

[a]Numbers in parentheses are absolute t-ratios based on heteroskedasticity-corrected standard errors.

[b]Mean; *,** and ***Significance at the 10%, 5% and 1% levels respectively.

[c]In the OLS regressions reported here, the dependent variable is TFP growth estimated for the specified period. The regressors are from the sample sub-period specified in the first row of this table.

[d]For example, this column reports the OLS coefficients for firm-specific TFP growth rates for the period 1981–1985 on #JV observed for 1981–1985. Only firms in our sample for 1981–85 with relevant data for estimating TFP growth were used in this estimation.

[e]For example, this column reports OLS regression of estimated firm-specific TFP growth rates for the period 1986–1990 regressed on #JV observed for 1981–1985. Only firms in our sample for 1981–1985 with relevant data on TFP growth were used in this estimation.

[f]The dependent variables used in the regressions reported here correspond to current or future TFP growth rates, relative to the sample period. For example, for firms in the sample over the period of 1981–1985, tfp(1981–1985) denotes the current TFP growth, while tfp(1986–1990) and tfp(1991–1995) denote, respectively, future TFP growth for the periods of 1986–1990 and 1991–1995.

Our regression results in Table 5 show persistent positive effects of the IJVs on the TFP growth of the Japanese parent. Such effects begin to become significant in the 1980s and continue into the late 1980s.

The positive impact of #JVs on a JP's stock returns and TFP growth rates may be interpreted in various ways. To the extent that TFP growth represents the firm technical progress, IJVs contribute to a JP's stocks of knowledge. Such technical progress need not be limited to scientific research. It could take place in management areas where more efficient methods of marketing and production management are successfully implemented. Because successful IJVs are typically more profitable than domestic firms (For example [29]), their high profitability may contribute to high stock returns. Over time it is also possible that competent JPs with successful IJVs may attract more good opportunities for potential IJVs with foreign firms. Such high expectations for a JP's future growth would be expected to lead to high stock returns also. Thus our results are consistent with Hypothesis 3, but there are other alternative interpretations and more research is warranted.

6 Concluding remarks

International joint ventures provide many opportunities to host country firms. Technology-based IJVs generally generate transfers of intangible assets such as technology and other management skills between the IJVs and their parent firms. The management of host country firms needs to carefully assess the returns to themselves (e.g. dividends, profits, licensing fees, etc. paid by the IJVs) in comparison to what the foreign parent firm might get from the IJVs (the corresponding sorts of calculations need to be made by potential foreign parent firms). In this paper we have shown the interactions between IJVs and their host county parent firms (JPs) in the 1980s.

We found that JPs entering into IJV agreements tend to be under-achievers in R&D-intensive industries (Table 2). This is not quite inconsistent with what is often stated to be the standard reason for IJVs to exist – namely that foreign firms seek JPs with strong marketing skill. Nevertheless we also find that the JPs seem to gain significantly in both the R&D and the advertising and marketing areas. In particular, we have found that the more experience a JP has with operating IJVs, the more opportunities it will have for participating in new IJVs. Having gained more experience in managing IJVs, JPs will also have more opportunities to invest in such intangible assets as R&D and advertising and marketing, and JPs' firm performance generally increases.

References and Notes

1 This research was in part supported by standard and strategic research grants from the Social Sciences and Humanities Research Council of Canada. We thank the editors (Drs. B. Bowonder and Nick Vonortas) and anonymous reviewers of this journal.

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5 Unlike Japan, many developed countries have been seeking foreign investment for decades, most importantly, for generating local employment.

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7 Anand and Khana [8], Barkema and Vermeulen [9], Dyer and Singh [10], Gulati [11], Oster [12], Powell *et al.* [13] and Barkema *et al.* [14]. A study by Hagedoorn *et al.* [15] provides empirical evidence that firms' experience in joint patenting increases their likelihood of increased activity in joint patenting in the future.

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18 Specifically, the type of international alliances we study are formally incorporated joint ventures established by foreign and host country parent firms.

19 This acquisition of knowledge by firms may take place over time within as well as across organizational units. Alternative dynamic economic theories may provide theoretical frameworks based on optimizing and/or bounded rationality principles [20–22]. An important empirical implication of these model formulations is that history matters (e.g. our use of empirical methods for which explanations can be found in Heckman [23] and in Nakamura and Nakamura [24,25].

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26 Host country international alliance partners almost always expect such spillovers, even though the foreign parents may try very hard to prevent their intangible assets from spilling over from the factories of their international alliances.

27 Mitsubishi Heavy Industry (MHI) set up an IJV (Caterpillar_Mitsubishi) with Caterpillar in the construction machinery industry where Komatsu was the industry leader and another IJV (Mitsubishi Motor Corporation) with Chrysler in the passenger car industry where Toyota and Nissan were the industry leaders. It is interesting to note that Komatsu and Toyota, which are both still industry leaders, never had IJVs in Japan with foreign firms. MHI was not a player in either the construction machinery or passenger car industries at the time these IJVs were set up. Nevertheless, MHI (or, more broadly, the Mitsubishi keiretsu group) was desperate to enter these markets and establish separate companies.

28 Information on their foreign parent firms is particularly important for estimating the determinants of IJV performance. For example, the transfer of technology from its foreign parent, represented by the foreign parent firm's R&D capacity, contributes significantly to an IJV's profitability [29]. We suspect that, once the presence of IJVs is controlled for, the impact of the foreign parent firm's characteristics on the performance of the local host country parent firm is insignificant, since skill spillover generally takes place through the IJVs. This is assumed for our econometric specifications in this paper. Foreign parent firms' characteristics, however, might be an important determinant of the probability that a local firm becomes the host country partner of an IJV. For example, technology-based foreign firms with a promising new product but with weak marketing skills may want to find a local partner with particularly strong skills to market and sell the product in that country. Without information on the foreign parent firms, the estimated probabilities might be biased. In our equations for these probabilities, we include the local partners' experience with IJVs. In so doing, we hope to control for some of the unobserved factors, including the characteristics of the foreign parent firms of the IJVs.

29 Nakamura, M. (1991) 'Modeling the performance of US direct investment in Japan: some empirical estimates', *Managerial and Decision Economics*, Vol. 12, pp.103–121.

30 See Heckman [31] and also Amemiya [32]. Applications can also be found in Nakamura and Nakamura [24,25].

31 Heckman, J.J. (1971) 'Sample selection bias as a specification error', *Econometrica*, Vol. 47 pp.153–161.

32 Amemiya, T. (1985) *Advanced Econometrics*, Harvard University Press, Cambridge, MA.

33 See also Amemiya [32]. Heteroskedasticity-corrected standard errors a la White could also be used for this purpose.

34 These years are fiscal years. Most Japanese firms' fiscal years end in March. So data for fiscal year 1990 were typically measured at the end of March 1990. A few firms have their fiscal years end in June or December. In these cases, data for fiscal 1990 were typically measured at the end of December 1989 and the end of June 1990, respectively.

35 Toyo Keizai *Overseas Investments by Japanese Firms*, (in Japanese), Tokyo, various years.

36 The economic decision model underlying these probit model specifications is such that a joint venture IJV is established if and only if the expected benefits associated with this exceed the corresponding expected costs for both parent firms. While reduced form specifications appear adequate for the purposes of this paper, we would need to specify the structure of the underlying economic decision model involving the behaviour of both foreign and host country parent firms for certain policy purposes. The econometric specifications used in this paper are in reduced forms.

37 We should be careful not to interpret this to mean that the advertising and marketing skill of the JP does not matter, since #JV may serve as a proxy for some of the JP's marketing skill.

38 It is not clear what kinds of economic reasons underlie the increased probabilities of IJVs for larger compared with smaller Japanese firms.

39 This is consistent with anecdotal evidence. See (For example [27]).

40 In fact many Japanese firms found little in the way of domestic investment opportunities and decided to go overseas to invest (outward FDI). The 1980s were the decade in which the most extensive Japanese overseas investments were made.

41 The massive appreciation of the Japanese currency due to the Plaza Accord in 1985 and the emergence of a financial bubble all took place in the 1980s.

42 See Nakajima *et al.* [43] for the estimation (regression) method used here to calculate TFP growth rates for individual firms. In estimating the TFP growth used in the regressions here were controlled for the effects of scale economies. In this sense, these TFP growth rates may be interpreted as representing technical progress. See also Diewert and Nakamura [44]. For other aspects of the measurement of productivity, see Diewert [45,46].

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