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LEARNING FROM JOINT VENTURES: EMPIRICAL EVIDENCE FROM JAPANESE MANUFACUTRERING INDUSTRIES*

Masao Nakamura**
Faculty of Commerce and Business Administration
University of British Columbia
2053 Main Mall
Vancouver, BC, Canada V6T 1Z2

Tel. (604) 822-8434
Fax (604) 822-8477
Email: masao@pacific.commerce.ubc.ca

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Abstract

It is often argued that one of the potential benefits for a host country joint venture partner is the opportunity it has to appropriate the foreign parent firm's technology and other intangible skills through the joint venture operations. Such host country advantages, if realized, may contribute to the economic growth of that country. Host country partners have obvious advantages, geographical and otherwise, for learning new skills from their joint ventures with foreign firms. Except for some anecdotal evidence, however, relatively little empirical evidence exists for the presence of such skill and process spillovers from joint ventures to their host country parent firms. In this paper we present empirical evidence supporting this learning hypothesis using data on foreign firms' joint ventures located in Japan. Our evidence suggests that these joint ventures have contributed positively to the stock returns for the Japanese parent firms and to total factor productivity growth over time.

Keywords: Learning; Multinational firms; Joint ventures; Productivity; Technology; Firm Performance.

JEL classification: D23; F23; L23.

1. Introduction

The dynamic evolution of international joint ventures (IJVs) has attracted much interest in the literature.[1,2] There is special interest in the impact IJVs might have on the future course of the parent firms as well as the outcomes for the IJVsthemselves. For example, there is some empirical evidence suggesting that, regardless of the reasons that prompted two firms to form an IJV, the likelihood that this IJV will be stable and long-lasting versus abandoned or bought out depends crucially on the types of interactions the respective parent firms have with the IJVover time (Nakamura, Shaver and Yeung (1996)).

Suppose, for example, that a foreign firm with a new technology-based product sets up an IJV in a host country with a domestic firm with superb marketing capabilities. The IJV works well for the first few years, receiving complementary inputs from its parent firms. As the parent firm learns more about their IJV partner through interactions involving IJV operations, the foreign parent may come to feel it has accumulated enough knowledge about the domestic market, and the host country parent may also feel they have absorbed enough manufacturing knowledge of the products the IJV is producing. If the parent firms still see value in the division of labor based on the competence of the respective partners, the IJV will continue and may flourish over time. On the other hand if at least one partner thinks it has learned enough about the skill it was lacking at the outset of the IJV, the IJV will likely cease to exist. The parent firms' unique alliance experience trajectories also affect the nature and likelihood of the various possible ex post adjustments in these sorts of alliance partnerships (Reuer, Zollo and Singh (2002)).

The dynamic evolution of IJVs and other types of alliances has been studied by many authors. For example, termination patterns for IJVs were studied by Kogut (1989, 1991) and Barkema, Bell and Pennings (1996), Barkema and Vermeulen (1997) and Park and Ungson (1997). Roy Chowdhury and Roy Chowdhury (2001) consider the life cycles of IJVs and find that these depend on a number of parameter values. Joint ventures and other types of alliances are also formed by firms for the purpose of entry deterrence and collusive agreements but such arrangements are not always long-lasting.[3]

One of the essential factors that these studies suggest as determining the evolution of IJVs is inter-organizational learning by firms. As the above example illustrates, learning from joint ventures could impact not only the fate of the IJVs that the parent firms have created but also the possible strategic alternatives the parent firms themselves face over time.

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[1] Joint ventures are also commonly formed between domestic firms but such domestic joint ventures tend to be more fully integrated within their parent firms' organizational structures. Since we are interested in studying the behavior of the host country parent firms when they are exposed, for example, to new foreign technologies and management methods and culture, IJVs are the natural object of research in this paper. IJVs provide many research issues of interest in economics and management that domestic joint ventures do not. Such research issues of interest include problems of technology transfer and spillovers between the parent firms from countries with different cultures and different levels of economic development. How to take advantage of IJVs for their economic development is of much interest to many developing nations.

[2] Many firms also choose to set up fully-owned subsidiaries rather than joint ventures. See, for example, Nakamura and Xie (1998) for an economic model of choice between joint ventures and fully-owned subsidiaries.

[3] Levenstein and Suslow (2002, Table 1) find that many international cartels last for less than 6 years while a few last for much longer.

Learning

In this paper we interpret learning to mean firms' acquisition of knowledge from their inter-firm relationships with other firms over time. Such learning affects the firms' strategies to cope with not only the existing inter-firm relationships but also any new ones they may undertake in the future. Various activities firms undertake jointly with other firms provide the firms with opportunities for learning. For example, firms may perform joint research and development (R&D) with other firms to develop specific new products or manufacturing processes. Many studies have suggested that firms' prior experience in inter-firm collaborations increases the firms' probabilities for their future engagement in activities of this sort and the probabilities of success for these activities.[4] While many of these studies consider the impact of prior inter-firm relationships such as alliances and joint ventures on the future course of these inter-firm relationships themselves, relatively little literature exists that studies the impact of firms' inter-firm relationships such as joint ventures on the future course of their parent firms.[5]

There are a number of possible reasons for this. One likely reason is that the IJVs of most large domestic firms in developed economies are quite small relative to the size of the parent firms--too small to significantly impact the evolution of the domestic parent firms.[6] The situation can be quite different for the parent firms of IJVs in a host country since significant amounts of technology or other types of management skill can flow from the foreign parent firms into their joint ventures. This is particularly so if the host country parent firm is relatively small compared to the foreign parent firm.

In this paper we are interested in measuring the impact of IJVs on the performance of their host country parent firms (Japanese firms in our case). In particular, assuming that IJVs reflect knowledge possessed by their foreign parent firms, we test our basic hypothesis that the host country parent firms of the IJVs learn from the IJVs in a variety of waysthat include learning to get involved in new IJVs, learning to take advantage of their IJVs in optimizing their investments in intangible assets such as R&D, marketing and advertising, and learning how to increase their long-run firm performance. Such learning takes place over time within as well as across organizational units (e.g. parent firms and their IJVs).[7]

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[4] See, for example, Anand and Khana (2000), Barkema, Dyer and Singh (1998), Gulati (1995), Oster (1992), Powell, Koput and Smith-Doer (1997) and Shenkar, Vermuelen and Bell (1997). A study by Hagedoorn, van Kranenburg and Osborn (2001) provides empirical evidence that firms' experience in joint patenting increases their likelihood of increased activity in joint patenting in the future.

[5] Exceptions include Hennart, Roehl, and Zietlow (1996) who consider Japanese firms' strategic motives for entering the U.S. market using IJVs initially and Nakamura, Shaver and Yeung (1996).

[6] On the other hand many small firms often don't want to get engaged in IJVs to begin with because of many possible changes in the business environment facing the small firms as they grow.

[7] Alternative economic theories in a dynamic framework provide such learning hypotheses under optimizing and/or bounded rationality principles (Arrow (1962), Solow (1997), Nelson and Winter (1982)). An important empirical implication of these model formulations is that history matters (e.g. Heckman (1981), Nakamura and Nakamura (1985a,b)).

Our sample consists of Japanese manufacturers listed in the first section of the Tokyo Stock Exchange for the period 1961-1990.[8] In particular we estimate: (1) the effects of a firm's past experience with having IJVs on the probability of the host country parent firm setting up another IJV; (2) the effects of past and present experience with IJVs on the host country parent firm's behavior in investing in such intangible assets as R&D and advertising and marketing; and (3) the effects of their past and present experience with IJVs on the host country parent firm's performance measured by stock returns and total factor productivity growth.

The organization of the rest of the paper is as follows. In Section 2 we review the business and economic environment as well as government policies that may have affected inward foreign direct investment (FDI) in Japan over the period 1961-1990. In Section 3 we present our estimation results for the characteristics of host country firms that entered into partnerships as the parent firms of IJVs. In Section 4 we present our estimation results for the evolution of the intangible assets of the host country parent firms in response to their IJVs. In Section 5 we present our estimation results for firm performance of the host country parent firms as related to their IJVs. We conclude in Section 5.

2. Environment for Inward Foreign Direct Investment in Japan, 1961-90

It is well known that the Japanese industrial policy in the 1950s through early 1970s strongly discouraged inward foreign direct investment (FDI) in many areas of industry, and particularly in what the Japanese government considered to be key strategic areas. Such key industry areas included autos, chemicals, computers, semi-conductors and many other manufacturing industries. The industrial policy generally gave preference to licensing technology from abroad over FDI. The primary tool to implement such a policy was the foreign exchange law by which the Japanese government was able to implement strict priorities on who could spend scarce foreign exchange. It is only in exceptional cases, such as when foreign firms with superior technologies that the Japanese wanted exercised their bargaining power, that the Japanese government permitted inward FDI.[9] Even under such exceptional circumstances the form of FDI allowed was typically a joint venture with foreign ownership shares limited to a maximum of 50%. Expatriation of earned funds was strictly controlled as well.

Some foreign firms such as IBM maintained their fully owned subsidiaries since before World War II. It is known, however, that in order to expand their business operations in Japan, IBM Japan and other fully owned subsidiaries of foreign technology-based firms had to make concessions to forced licensing of their technologies to Japanese competitors. Under these circumstances the U.S. Big Three automakers never established their manufacturing facilities in

[8] 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.

[9] Nakamura and Xie (1998), for example, consider economic models of ownership share determination in FDI as related to the relative bargaining power of IJV parent firms. Mason (1992) describes Japanese policies to deter inward FDI.

Japan.[10] (Note that Ford, like IBM, has maintained their fully owned subsidiary in Japan since before World War II.)

Although this government control on inward FDI formally ended in 1973 when the foreign exchange law was revised, continuing Japanese government policies, for example, to maintain regulations and anti-competitive behavior in many areas of the Japanese economy have continued to restrict the flow of inward FDI to date. Unlike other developed economies in North America and Europe where the amounts of inward and outward FDI are close to each other in the aggregate, Japan's inward FDI flow still amounts to a tiny fraction of its outward FDI flow.

The severe restrictions placed by the Japanese government on technology imports and inward FDI provide an interesting setting in which we could attempt to measure the impact of inward FDI on Japanese firms' performance. First, because the mode of the inflow of foreign technology via FDI was largely limited to joint ventures, the impact of joint ventures on their local host country (Japanese) parent firms may be more easily identifiable than otherwise. Secondly, because the Japanese government long recognized the importance of intangible assets (particularly technology) provided by foreign firms through licensing agreements or inward FDI operations, the signaling effects of joint ventures may have been stronger in Japan, at least in historical periods such as the ones we consider here, than in some other countries. Such signaling effects may make it easier to isolate the effects of IJVs on firm performance measured in terms of stock market measures.

The severe restrictions on entry into the Japanese FDI market from the 1950s to the end of 1970s, with a significant emphasis on R&D, could imply that the Japanese parent firms selected for setting up IJVs were able to advance their relative standings in their industries in terms of their skill levels in intangible assets such as R&D and advertising and marketing. It is also possible that these IJVs may have provided significant profits (economic rents) and other benefits to their Japanese parent firms. On the other hand, the IJVs established in later years in the 1980s did not enjoy government provided technology lead positions and hence might not have contributed to building the R&D stock of their Japanese parent firms. It is also possible that the IJVs established in the 1980s may have contributed more to the stock of certain intangibles, such as advertising and marketing skill, but not so much to the stock of R&D. These hypotheses will be considered in the empirical analysis to follow.

3. International Joint Venture Experience in the Formation of Joint Ventures

[10] From the early 1970s on though the 1990s, the foreign automakers were able to establish their FDI in Japan in response to the requests from the Japanese banks and other investors of often failing Japanese automakers. Chrysler at the request of the Mitsubishi Heavy Industries established an IJV (the Mitsubishi Motor Corporation) to produce passenger cars that the Mitsubishi keiretsu group was not producing, but Chrysler subsequently sold its MMC's shares. On the other hand Ford, GM and Renault all took control of Mazda, Isuzu and Nissan, respectively, at the requests of Japanese creditors of these respective Japanese automakers, all of which were facing bankruptcy. Major inward FDI in Japan so far has taken place only when the bargaining power of the Japanese side, however defined, was extremely weak relative to the bargaining power of the potential foreign investor.

Foreign firms interested in forming joint ventures in a host country engage in a process of search for their local partners. It is known that considerable "shopping around" takes place before local joint venture partners are found. Clearly such matching depends on the characteristics of both foreign and local partner firms. Unfortunately data do not exist for many of the foreign parent firms. Therefore, we will use only information on Japanese parent firms in the empirical analysis to follow.[11]

Our sample consists of Japanese manufacturing firms that were listed in the first section of the Tokyo Stock Exchange in fiscal year 1990. We are interested in the first section firms since they are considerably larger and more established than second section firms. Typically more data are available for first section firms. Relevant firm data were collected for the sample period 1961-90. During this period the first section firms and foreign firms established 134 manufacturing IJVs that were operational in 1991. (See the Data Appendix for further details of our data.)

Table 1A shows our probit regression estimation results for the reduced-form probability that an international joint venture (IJV) located in Japan was formed sometime during the sample period. Table 1B shows estimation results for three 10-year sub-periods.[12]

Probit regressions for the entire sample period, 1961-1990

The first three probit models (1) through (3) in Table 1A show that the amounts of technology assets such as licensed technologies (Tech_asset) that are owned by the potential Japanese parent firm (JP) significantly increases the probability of formation of an IJV. On the other hand, the JP's R&D-sales ratio (R&D) which is significant in (1) becomes insignificant once the total number of JVs set up through the previous time period (#JVs) by the JP is entered (models (2)-(3)). #JV clearly embodies JP's strengths in R&D and other IJV-related knowledge and increases in the value of this variable are expected to increase the probability of having a JV. The coefficient of #JV measures the JP's ability to successfully establish and operate joint ventures with foreign firms.

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[11] Information on their foreign parent firms is particularly important in estimating the determinants of IJV's 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 (Nakamura (1991)). 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 Sections 4 and 5 of 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 estimation of such probabilities in this section, we include in our econometric specifications the local partners' experience in 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.

[12] The economic decision model underlying these probit model specifications is such that an IJV is established if and only if the expected benefits associated with the IJV exceed the corresponding expected costs for both IJV partners. While reduced form specifications appear adequate for the purpose of this paper, we would need to specify the structure of the underlying economic decision model involving the behavior of both foreign and host country parent firms for certain policy purposes. Similarly the econometric specifications to follow in this paper are reduced form specifications.

Because of extensive vertical assembler-supplier relations (often called capital or production keiretsu) involving virtually all manufacturers in Japan, Japanese manufacturing industries have a high level of inter-firm technology diffusion.[13] For this reason, it is of interest to see if the significant effects of our technology variables, R&D and Tech_asset, that are observed for models (1)-(3) in Table 1A for JPs are aor the industries to which the JPs belong. This is exactly what we observe in model (4) that includes both firm-specific and industry values as explanatory variables. Over the 30-year sample period the probability for a Japanese manufacturer to successfully become a JP of an IJV increases significantly with the R&D-sales ratio and the stock of technology assets of the industry to which the Japanese manufacturer belongs.

Our results in Table 1A also show that the advertising and marketing expenditures of JPs (Adv_mktg), expenditures on other important intangible assets, have no significant effects on the probability of interest.[14]

In sum, Table 1A shows that the firm-specific variables that increase the probability for a Japanese manufacturer of successfully seting up an IJV are the firm size and past experience withIJVs in the case of the Japanese manufacturer, while two industry variables that increase the probability are R&D and technology assets.[15]

The time trend (Year) is consistently significant and negative, suggesting a general declining trend in the formation of IJVs in Japan involving Japanese manufacturing firms. This is consistent with the revision (liberalization) of the Japanese Foreign Exchange Control Law in 1973 that substantially reduced the amount of interference by the Ministry of International Trade and Industry and other Japanese government agencies in the process of foreign firms establishing their fully-owned subsidiaries in Japan. A further liberalization in Japanese foreign exchange laws followed in the 1980s. Foreign firms have not been subjected to government restrictions in the ownership of their affiliates in most industries in Japan over the last decade.[16]

Table 1B shows probit regression results for each of the three sample subperiods: 1961-70, 1971-80 and 1981-90. Our results show that firm-specific R&D is only significant in the 1960s while industry R&D becomes significant in the 1980s. This suggests that foreign parent firms (FPs) were first interested in Japanese firms with firm-specific R&D capacity in the 1960s. But in the 1980s high-tech industries characterized by high industry R&D ratios became the primary source for Japanese parents of foreign joint ventures. On the other hand, industry technical assets are

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[13] Joint production planning and new product development practices among member firms of Japanese vertical keiretsu groups such as the Toyota and Toshiba groups accelerate technology diffusion among the group firms. Because many suppliers work for multiple assemblers (for example, Toyota and Nissan), the technology developed by one keiretsu group is often spilled over to another group as well.

[14] We should be careful not to interpret this to mean that JP's advertising and marketing skill does not matter, since #JV may serve as a proxy for some of the JP's marketing skill which is relevant for IJV management.

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

[16] For example, in 1977, 7% of U.S. firms' subsidiaries in Japan reported that they were required by the Japanese government to limit their U.S. parent firms' equity while in 1982 this fraction decreased to 3% (Contractor (1990)). Clearly an increasing number of foreign firms have been choosing fully-owned subsidiaries as their mode of FDI in Japan.

only significant in the 1960s while firm-specific technical assets become increasingly more important (though not necessarily statistically significant) from the 1960s to 1980s. Even in high-tech industries, the Japanese firms that become joint venture partners are the ones that have accumulated technical assets such as patents.[17]

We also see that the effects of the total number of IJVs (JV#) have increased over time, suggesting the importance of JPs' prior experience in successfully operating JVs on the likelihod of becoming JV partners.

Since potential FPs can observe JPs' past performance in managing the IJVs they have had, the increasing significance over time of the variable #JV in determining the probability of setting up IJVs implies that #JV also serves as a proxy for a JPs' past performance in successfully running joint ventures with foreign firms.

Overall, we find from Table 1A (model (4)) and table 1B that the industry (but not firm-specific) technological level measured by R&D and by the technological assets ratios is an important factor affecting the likelihood of JPs getting into IJV arrangements. Another intangible asset of interest, advertising and marketing ratio, is not significant at either the industry or firm levels. This finding appears to be inconsistent with an often cited FDI scenario in which technology-based FPs enter foreign markets in search of local partners with marketing skills. Our tentative conclusion here, however, is that this scenario is consistent with our findings that the variable #JV in our models reflect JPs' firm-specific capacity in both R&D and advertising and marketing. Our estimation results in the next section show that the JPs' capacity in advertising and marketing increases substantially with learning through their IJVs. One interesting observation regarding this scenario is that, even if the FPs are highly technology-oriented, they still seem to require high R&D competence on the part of their IJV partners in the host country. It does not seem to be the case that FPs handle technology-based manufacturing while their local partners handle distribution and marketing in their IJV operations. There does not seem to be this sort of a division of labor for the IJVs we consider here.[18]

Another issue of interest is whether JPs that entered into IJV arrangements with FPs benefited from such IJVs in developing their firm-specific intangible assets such as R&D and advertising when considered relative to their industry levels.[19] This would be an important management problem for firms contemplating entering into IJVs, both in developing and developed countries.

Estimating the effects of a newly established IJV and the management experience from existing IJVs on JPs' firm-specific intangible assets requires careful econometric analysis because the selection decisions of certain Japanese firms as IJV partners may be correlated with unobserved

[17] Our technical assets variable reflects primarily Japanese firms' stocks of value of technologies and other intangible assets licensed from other firms.

[18] Often learning requires firms to possess a capacity to learn (e.g. Hamel (1991), Prahalad and Hamel (1990), Steesma (1996), Lane, Salk and Lyles (2001)). This also confirms the importance of the technological capacity potential FPs require of their potential local IJV partners in developing economies. Where host countries such a capacity, technology-based IJVs may not succeed. This is consistent with the notion that the initial levels of social capability matter in economic development (e.g. Adelman (1999)).

[19] Host country IJV partners almost always expect such spillovers, even though FPs may try very hard to prevent their intangible assets from spilling over from the factories of their IJVs.

factors determining the behavior of the JPs' intangible assets. Our econometric specifications used below explicitly account for potential endogeneity problems of this sort.

4. International Joint Ventures and Local Parent Firms' Intangible Assets

Under our learning hypothesis we expect that the effects on the behavior of the host country partners of IJVs will manifest themselves in improved levels of intangible assets such as R&D and skill in advertising and marketing, as well as in improved firm performance.

Because of the heavily protected environment in which IJVs were set up in the earlier years of our sample period in Japan, it is possible that the Japanese government exercised a requirement that there be some calculated technology spillovers out of IJVs in order for permit to be issued to the IJVs. It would not be surprising either that some of the JPs which entered into IJV arrangements in the 1960s and early 1970s with foreign firms counted on such spillovers to turn around their failing business strategies. For example, it is well known that many of the Japanese firms that sought IJVs were not necessarily the industry leaders in the respective Japanese markets.[20]

Even though the primary area of focus for spillovers from IJVs to JPs was technology, such spillovers could have also taken place in the area of advertising and marketing skill. For example, the notion of differentiated consumer markets and strategies for developing them by investing in advertising and marketing were almost non-existent in Japan in the 1960s. It is possible that the IJVs gave their JPs opportunities to learn sophisticated advertising and marketing methods.

Econometric specifications

Suppose that an IJV is set up for the i-th Japanese firm when dummy dependent variable z_i equals one. Assume that

(1) $z_i = 1$ if $z_i^* > 0$ and $z_i = 0$ if $z_i^* \leq 0$

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

where X_1 is a vector of explanatory variables, a is an unknown parameter vector and v is a normal random variable $v_i \sim N(0,s_v^2)$ which is uncorrelated across firms. It is assumed here also that some structural decision model underlies equation (2) that is in reduced form. Probit estimation results for equations (1)-(2) are presented in Tables (1A) and (1B). We are interested in estimating the effects of dummy variable z as well as other explanatory variables on our

[20] For example, 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 JVs 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.

intangible assets variables R&D and Adv_mktg (advertising and marketing). Our econometric specifications for these dependent variables are

(3) $y_i = X_{2i}\ b + p\ z_i + u_i$

where X_1 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:

$Cor(u_i, v_j) = r$ if i=j

and

$Cor(u_i, v_j) = 0$ otherwise.

The equation of our interest in this Section is equation (3) which 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 econometric specifications both of which correct for the estimation bias resulting from this endogeneity problem.

The first specification is a two-stage least squares (2SLS) 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

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

Another method to deal with the correlation between z and u is to explicitly include a term representing the correlation to correct for selection bias in the estimating equations. Such selectivity bias arises because Japanese firms selected for IJVs may be chosen because of their unobserved superior characteristics that are factored into the error term u. It is shown[21] that the conditional mean of y_i if firm i gets an IJV is given by

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

or in regression form

(6) $y_i = X_{2i}\ b + p\ z_i + (rs_u s_v)\ f(X_{1i}\ a^*) / F(X_{1i}\ a^*) + w_i$

[21] Heckman (1979) and also Amemiya (1985). Applications are also found in Nakamura and Nakamura (1981, 1985b).

where f and F represent, respectively, the probability density and cumulative density functions for a standard normal distribution. $SB_i = f(X_{1i}\, a^*) / F(X_{1i}\, a^*)$ 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 an IJV 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 (1979) provides expressions for consistent standard errors. In estimating (6) below we use consistent standard errors.[22]

Estimation results

We now measure the learning 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, firm size, #JV and time trend as in Tables 1A and 1B. 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 by JV-dummy below), the time trend (calendar year) and the industry mean for the dependent firm performance variable. The primary variables of interest are #IJV and JV-dummy. #JV is a proxy for learning from JPs' older IJVs, while JV-dummy is a proxy for learning from the current IJV contracted within the past 12 months.

Table 2 shows our regression results for both 2SLS and sample selection models. We see that the estimation results for both 2SLS and sample selection models are qualitatively similar, suggesting that we can have reasonable confidence in our estimated parameters.

Research and development

The first panel in Table 2 shows that, after controlling for industry effects, #JVs have significantly positive effects on increasing a JP's R&D level. It is of interest to note that the degree of impact increased significantly from the period 1961-70 (when the impact was negative) to the period 1981-90. This implies that joint ventures' spillover effects on JPs' R&D have become increasingly important over time. This is in contrast to the immediate effects of newly set up joint ventures (JV-dummy) that were positive in the 1960s but became increasingly more negative over time. This suggests that in the 1960s foreign firms chose Japanese IJV partners that were strong in R&D but this practice was dropped in the 1970s and 1980s. In the last two decades, the Japanese partners chosen were generally weak in R&D (and increasingly so). This is consistent with the notion that, because of the industrial policy that was operational from the late 1950s to 1960s, joint ventures were allocated to Japanese firms with strong R&Dto maximize the effectiveness of transfers of overseas technology. This was no longer the case in the 1970s and 1980s when firms with weaker technology bases attempted to improve their positions by getting involved in IJVs. Our overall results for the period 1961-90 (models (1) and (2)) are that JPs continue to receive positive spillovers in R&D from their IJVs even though they do not receive any benefit from the IJV established in the current year.

[22] See also Amemiya (1985). Heteroskedasticity-corrected standard errors a la White could also be used for this purpose.

Advertising and marketing

The second panel of Table 2 shows our empirical estimates for the impact of IJVs on JP's advertising and marketing (Adv_mktg) expenditures. After controlling for industry effects, #JVs have a significant impact on the JPs' advertising and marketing expenditures. The impact increased significantly between the 1960s and the 1980s. In fact our numerical estimates suggest that #JVs have had much larger effects on the JPs' advertising and marketing than on R&D. (Coefficients for #JVs in models (1) and (2) are: .0013 and .0011 for R&D and .0021 and .0023 for Adv_mktg.) This finding is new and is consistent with our observation that Japanese firms have increased their sophistication in their marketing ability. Our empirical results provide evidence that JPs' IJVs contributed significantly to the enhancement of their ability in advertising and marketing. For example, JPs' average Adv_mktg is approximately 0.8% (Table A1). Table 2 shows that an additional IJV would increase this value by 0.2%. While many U.S. firms are concerned about the potential spillover of their R&D skill to their Japanese partners, our findings suggest that they should also be concerned about the potential spillover of their advertising and marketing skills.

The estimated coefficients for the JV-dummy are significant for all three decades, suggesting that foreign IJV partners look for Japanese firms that are strong in advertising and marketing. This is consistent with the standard notion that foreign firms trying to enter foreign markets may set up IJVs with local partners who are familiar with local advertising and marketing methods. Looking at each of the three decades, however, we see that such a notion was particularly true for the 1970s. 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 coefficients for #JVs show. We conclude that in the 1980s the Japanese IJV partners chosen were weak in both R&D and advertising and marketing skills and that they improved their skills in these areas significantly by learning from their foreign joint ventures.

5. International Joint Ventures and Host Country Parent Firms' Performance

We have also estimated the impact of joint ventures over time on the firm performance of the Japanese parent firms. We used stock returns and total factor productivity (TFP) growth as our dependent variables.[23]

Table 3 shows our regression results for the JPs' stock returns. We have calculated stock returns for most of our sample firms for the period 1981-90 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 for the 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. Table 2 2SLS and sample selection methods give estimates that are qualitatively similar. Since JV-dummy and selection bias terms are not statistically significant, OLS estimates excluding these two variables provide efficient

[23] We chose not to use standard accounting profit-based measures since they are likely to be subject to considerable manipulations.

estimates. First, it is of some interest to note that the new IJVs established do not have any impact on JPs' stock returns in the year they are established. This may be in part because of the sample period used (1981-90). For example, during this period there may not have been good investment opportunities for potential inward FDI in Japan.[24] Another reason may have been the significant uncertainty (or financial risk) that characterized the Japanese economy in this period.[25]

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

The second firm performance measure we used is total factor productivity (TFP) growth, which was calculated for each of the sample firms in certain industries for specific time periods: 1980-85, 1986-90, 1991-95, and 1996-98. 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. .[26] Only the firms for which TFP measures were calculated were included in our regressions. As in the regressions for stock returns reported in table 3, the JV-dummy and selection bias terms were statistically insignificant in all of our regressions and hence were deleted from the subsequent regressions.

Table 4 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 1986-90. The regressors in our OLS regressions are constant and #JV, where the value of #JV that was used comes from the sample period specified in the first row of Table 4. For example, consider the three regressions reported in the three columns under the sample period 1980-85. Since #JV used in these regressions comes from our sample of firms for the period 1980-85, these regressions measure the impact of the number of IJVs that the sample firms had during the period 1980-85 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 1986-90 show the impact of #JV as observed in the sample period 1986-90 on the contemporaneous tfp(86-90), future tfp(91-95) and another future tfp(96-98).

Our regression results in Table 4 show persistent positive effects of the IJVs on the Japanese partners' TFP growth. Such effects begin to become significant in the 1980s and continue into the late 1980s.

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[24] 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.

[25] 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.

[26] See Nakajima, Nakamura and Yoshioka (1998) for the estimation (regression) method used here to calculate TFP growth rates for individual firms. In estimating TFP growth used in the regressions here we controlled for the effects due to scale economies. In this sense these TFP growth rates may be interpreted as representing technical progress.

The positive impact of #JVs on JPs' stock returns and TFP growth rates may be interpreted in various ways. To the extent that TFP growth represents the firms' technical progress, IJVs contribute to JPS' stock of knowledge. Such technical progress need not be limited to taking place in the area of strictly 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,[27] 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 JPs' future growth generally lead to high stock returns also.

6. Concluding Remarks

International joint ventures provide many opportunities to host country firms. Technology-based IJVs generally generate transfers of 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 same sorts of calculations would be required by potential foreign partners.) In this paper we have shown the interactions between IJVs and their host county parent firms (JPs) over a historical period 1961-90.

We found for the entire sample period 1961-90 that, despite some fluctuations over time, JPs entering into IJV agreements tend to be under-achievers in R&D and over-achievers in advertising and marketing. (See the coefficients for the JV-dummy in Table 2, models (1) and (2).) This is not quite consistent with what is often stated to be the standard reason for IJVs to exist--namely that FPs seek JPs with strong marketing skill. But, more importantly, JPs seem to learn 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 will generally increase. (See coefficients for #JVs in Table 2, models (1) and (2).)

In this paper we have used IJVs as an econometric setting where we estimate the effects of IJVs' parent firms' learning from the IJVs. We expect these learning effects to significantly differ depending on the arrangements and the circumstances surrounding IJVs. Further estimation tasks are left for future research. More detailed estimates are of potential interest not only to the management of the companies involved but also to governments, particularly those of developing nations which generally count on learning effects of this sort for their economic growth when permits for IJVs are issued.

[27] For example, see Nakamura (1991).

Data Appendix

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 (1991). We only included in our sample Japanese firms which are listed in the first section of Japanese stock exchanges. Only joint ventures for which relevant records required for their JPs exist in the Japan Development Bank financial data base were included. There were 141 such joint ventures. These joint ventures are 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 don't 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 U.S. firms while the remaining foreign parent firms are from Western Europe. There are 424 Japanese manufacturing firms included in the sample (424x30=12,720 firm-years). Their records over the 1961-1990 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 1% of all pooled observations and zero for the remaining 99% of the remaining cases. Our aim is to estimate long-run effects of joint ventures on host country parent firms using the pooled data.

Potential sample selection bias

Because of our interest in isolating long-term effects of joint ventures on their local partner firms, we could only include in our sample Japanese firms which have been operational for a long term (30 years). This may potentially cause estimation bias due to the longevity of the Japanese firms included in the sample. We expect this type of bias to be insignificant in our study, since the Japanese firms which function as controls in our performance comparison are long-lived firms as well. Since both event firms and controls are both long lived, there's no obvious reason to believe that any performance difference observed between these two types of firms is contaminated by longevity bias.

Joint ventures included in this study are those which are operational in 1991. Since many joint ventures established in the earlier years of the sample period undoubtedly perished long before 1991, joint ventures included in our study may potentially cause survival bias in our estimation. For this reason it is important to be cautious in interpreting our estimation results. In our view, in comparing the long-run performance between Japanese firms which have joint ventures with foreign firms and Japanese firms which do not, however, it would make sense to consider only long-run successful joint ventures. This is because failed joint ventures by definition cannot have long-run impact on their parent firms.

TABLE A1. DESCRIPTIVE STATISTICS

	1961-90 Mean (s.d.)	min,max	1961-70 Mean (s.d.)	min,max	1971-80 Mean (s.d.)	min,max	1981-90 Mean (s.d.)	min,max
R&D	.00544 (.01125)	0,.1280	.00045 (.00229)	0,.0460	.00532 (.00916)	0,.0630	.00972 (.01519)	0,.1280
Tech_asset	.00044 (.00193)	0,.0590	.00076 (.00270)	0,.0560	.00036 (.00117)	0,.0190	.00028 (.00174)	0,.0590
Adv_mktg	.00823 (.02053)	0,.3600	.00981 (.02009)	0,.3600	.00677 (.0161)	0,.2590	.00839 (.02436)	0,.3420
Profitability	.02383 (.05584)	-3.845, .9440	.03266 (.03408)	-.3860, .1810	.01874 (.04655)	-1.605, .4680	.02157 (.07479)	-3.845, .9440
Log(sale)	10.506 (1.3320)	6.084, 15.25	10.070 (1.3170)	6.084, 14.52	10.559 (1.2820)	6.219, 14.55	10.815 (1.2970)	7.211, 15.25
#JVs	.20186 (.63620)	0,6	.09962 (.36851)	0,3	.22227 (.64167)	0,5	.26633 (.77961)	0,6
Ind_R&D	.00544 (.00694)	0,.059	.00045 (.00143)	0,.0160	.00532 .00447	0,.0270	.00970 (.00870)	0,.059
Ind_tech_ asset	.00038 (.00080)	0,.0080	.00070 (.00111)	0,.0080	.00031 .00054	0,.0030	.00019 (.00059)	0,.0070
Ind_adv_ mktg	.00825 (.01254)	0,.1740	.00982 (.01415)	.0010, .0990	.00678 .00949	.0010, .0660	.00843 (.01358)	0,.174
Ind_ profitability	.02379 (.01929)	-.1870, .1190	.03261 (.01615)	-.0190, .0860	.01874 .01798	-.0950, .0720	.02151 (.02046)	-.1870, .1190
Year	16.100 (8.2236)	1,30	5.8187 2.7702	1,10	15.598 2.8694	11,20	25.128 (2.653)	21,30
JV-dummy	.01054	0,1	.01848	0.1	.01049	0,1	.003998	0,1
No. of obs.	12717		3734		4481		4502	

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TABLE 1A. LOCAL HOST FIRM CHARACTERISTICS: PROBIT ESTIMATES[a,b]

	(1)1961-90	(2)1961-90	(3)1961-90	(4)1961-90
Constant	-1.91***	-1.92***	-5.67***	-5.81***
	(26.3)	(25.1)	(15.2)	(14.5)
R&D	7.69**	4.75	.350	-5.19
	(2.31)	(1.18)	(.081)	(1.01)
R&D-ind	-----	-----	------	21.1**
				(2.45)
Tech_asset	31.7***	31.4***	26.2***	6.77
	(3.60)	(3.40)	(2.54)	(.56)
Tech_asset-ind	-----	-----	------	128.3***
				(3.74)
Adv_mktg	1.10	1.22	-.429	1.49
	(.79)	(.89)	(.26)	(.69)
Adv_mktg-ind	-----	-----	------	-5.64
				(1.30)
Profitability	.587	1.23	2.08	2.14
	(.64)	(1.22)	(1.56)	(1.47)
Profitability-ind	-----	-----	------	-.57
				(.20)
Log(sale)	------	-------	.353***	.361***
			(10.7)	(10.7)
#JVs	------	.406***	.179***	.133***
		(11.6)	(4.42)	(3.14)
Year	-.036***	-.050***	-.057***	-.061***
	(7.27)	(8.39)	(8.80)	(7.60)
Log likelihood	-702.0	-643.8	-580.3	-569.6
Chi-squared (deg.of freedom)	82.7	199.1	326.1	347.5
	(5)	(6)	(7)	(11)
No.of obs.	12717	12717	12717	12717
No.of ones	134	134	134	134

[a] Numbers in parentheses are absolute asymrotic t-ratios.
[b] *,** and *** mean, respectively, significance levels at 10%,5% and 1%.

TABLE 1B. LOCAL HOST FIRM CHARACTERISTICS: PROBIT ESTIMATES[a,b]

	(1)1961-70	(2)1961-70	(3)1971-80	(4)1971-80	(5)1981-90	(6)1981-90
Constant	-5.95***	-5.99***	-4.42***	-5.04***	-5.64***	-5.18***
	(11.1)	(10.4)	(5.68)	(5.59)	(3.93)	(3.42)
R&D	55.2***	50.7**	-15.7*	-12.4	.628	-6.43
	(3.64)	(2.46)	(1.73)	(1.17)	(.103)	(.93)
R&D-ind	-----	21.9	-----	-15.3	-----	28.5**
		(.44)		(.79)		(2.43)
Tech_asset	23.2**	-.507	40.3	29.2	48.7*	39.8
	(1.93)	(.04)	(1.09)	(.72)	(1.65)	(1.12)
Tech_asset-ind	-----	152.3***	-----	173.4	-----	96.6
		(3.78)		(1.50)		(.71)
Adv_mktg	-3.45	4.08	4.85**	15.3***	-6.37	-6.96
	(1.01)	(.1.35)	(1.99)	(3.04)	(1.00)	(.97)
Adv_mktg-ind	-----	2.64	-----	-36.5**	-----	1.29
		(.42)		(2.16)		(.15)
Profitability	2.50	4.08	1.48	2.10	.821	.864
	(.99)	(1.34)	(.51)	(.60)	(.24)	(.23)
Profitability-ind	-----	-5.59	-----	4.72	-----	-.258
		(1.14)		(.78)		(.04)
Log(sale)	.402***	.408***	.348***	.382***	.295***	.316***
	(8.47)	(8.30)	(5.76)	(5.94)	(3.12)	(3.23)
#JVs	.150	.084***	.170**	.134*	.234***	.174**
	(1.43)	(.78)	(2.49)	(1.85)	(3.56)	(2.44)
Year	-.120***	-.130***	-.133***	-.116***	-.028	-.669
	(5.40)	(5.23)	(4.82)	(3.83)	(.76)	(1.56)
Log likelihood	-271.0	-263.4	-202.5	-197.1	-88.1	-84.4
Chi-squared (deg.of reedom)	145.5	160.6	116.9	127.6	58.6	66.0
	(7)	(11)	(7)	(11)	(7)	(11)
No.of obs.	3734	3734	4481	4481	4502	4502
No.of ones	69	69	47	47	18	18

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

[b] *,** and *** mean, respectively, significance levels at 10%,5% and 1%.

TABLE 2. JAPANESE PARENT FIRMS' LEARNING FROM THEIR JOINT VENTURES[a,b]

Dependent variable: R&D

	(1)2SLS	*(2)Sample selection*	*(3)2SLS*	*(4) Sample selection*	*(5)2SLS*	*(6) Sample selection*	*(7)2SLS*	*(8) Sample selection*
	1961-90	1961-90	1961-70	1961-70	1971-80	1971-80	1981-90	1981-90
Constant	.0004** (2.01)	.0002 (.96)	-.0005*** (4.37)	-.0002*** (2.91)	.0015* (1.87)	.0010 (1.35)	.0039 (1.05)	.0009 (.43)
#JVs	.0013*** (8.44)	.0011*** (8.11)	-.0005*** (4.24)	-.0003*** (2.65)	.0018*** (7.06)	.0016*** (7.72)	.0053*** (5.26)	.0019*** (5.40)
Ind_R&D	.9861*** (69.2)	.9832*** (70.5)	.944*** (.03)	.9637*** (35.4)	.9591*** (33.5)	.963*** (35.0)	1.09*** (21.4)	1.007*** (37.4)
Year	-.0000* (1.83)	-.0000 (.99)	.00005*** (3.30)	.00003** (2.22)	-.0001* (1.86)	-.0001 (1.38)	-.0002 (1.24)	-.0000 (.54)
JV-dummy	-.0214*** (4.72)	-.0114*** (3.92)	.0123*** (9.26)	.0067*** (7.45)	-.0292*** (3.60)	-.0181*** (4.46)	-.3525*** (5.04)	-.0824*** (4.98)
Selection bias	---------	.0048*** (3.82)	---------	-.0030*** (7.56)	---------	.0077*** (4.44)	---------	.0329*** (5.11)
AdjustedR^2	---------	.383	---------	.393	---------	.245	---------	.334
No.of obs.	12717	12717	3734	3734	4481	4481	4502	4502

Dependent variable: adv_mktg

Constant	-.0009** (2.21)	-.0006* (1.67)	-.0002 (.30)	-.0001 (.19)	-.0088*** (4.33)	-.0048*** (3.10)	.0026 (.50)	.0005 (.17)
#JVs	.0021*** (7.57)	.0023*** (9.24)	.0016** (2.29)	.0017** (2.52)	-.0014** (2.13)	.0003 (.52)	.0095*** (6.74)	.0048*** (8.59)
Ind_Adv-mktg	1.0021*** (86.2)	1.0021* ((87.0)	1.000*** (60.1)	.9999*** (60.2)	1.004*** (30.0)	1.004*** (36.7)	1.004*** (25.4)	1.002*** (39.5)
Year	.0000 (.28)	-.0001 (.331)	-.0000 (.84)	-.0000 (.29)	.0005*** (3.73)	.0002** (2.53)	-.0001 (.64)	-.0000 (.42)
JV-dummy	.0297*** (3.63)	.0185*** (3.44)	.0069	.0047 (.80)	.1732*** (8.56)	.0937*** (6.97)	-.4866*** (5.23)	-.1335*** (4.96)
Selection bias	---------	-.0078*** (3.35)	---------	-.0021 (.77)	---------	-.0401*** (7.17)	---------	.0533*** (5.11)
AdjustedR^2	---------	.380	---------	.496	---------	.377	---------	.326
No.of obs.	12717	12717	3734	3734	4481	4481	4502	4502

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

TABLE 3. JAPANESE PARENT FIRMS' PERFORMANCE: STOCK RETURNS, 1981-90

Dependent variable: annual stock return, 1981-90[a,b,c]			
	(1)2SLS	(2)Sample selection	(3)OLS
constant	.00467**	.01534***	.01534***
	(.00227)	(.00104)	(.00100)
#JVs	.00120*	.00129***	.00123***
	(.00072)	(.00066)	(.00048)
Market return[d]	.05924***	.00906**	.00906**
	(.01031)	(.00410)	(.00391)
JV_dummy	-.00326	-.00431	---
	(.01999)	(.01519)	
Selection bias	---	.00116	---
		(.00780)	
Adjusted R^2	.000	.001	.031
No. of obs.	3387	3387	3387

[a]Numbers in parentheses are absolute t-ratios based on heteroskedasticity-corrected standard errors.
[b] *,** and *** denote, respectively, significance at 10%, 5% and 1% levels.
[c] Firms' annual stock returns were calculated as the geometric mean of firms' 12 monthly returns over 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.

TABLE 4. JAPANESE PARENT FIRMS' PERFORMANCE: CURRENT AND FUTURE TOTAL FACTOR PRODUCTIVITY GROWTH, 1980-98

Sample period	**1976-79**[a,b]		**1980-85**			**1986-90**		
Dependent variable	**tfp(80-85)**[c,d] ***future 1***[f]	**tfp(86-90)**[e] ***future 2***[f]	**tfp(80-85)** ***current***[f]	**tfp(86-90)** ***future 1***	**tfp(91-95)** ***future 2***	**tfp(86-90)** ***current***	**tfp(91-95)** ***future 1***	**tfp(96-98)** ***future 2***
Constant	.01112***	.00956***	.01337***	.01127***	.01468***	.01161***	.01402***	.01461***
	(.00231)	(.00141)	(.00187)	(.00086)	(.00076)	(.00134)	(.00095)	(.00196)
#JVs	.00071	.00143	.00002***	.00001***	.00001***	.00001***	.00001***	.00001***
	(.00228)	(.00109)	(.000003)	(.000002)	(.000002)	(.000004)	(.000003)	(.000003)
Adjusted R^2	.000	.000	.057	.024	.036	.012	.026	.030
No.of obs.[e]	756	756	1170	1170	1170	828	828	195

[a]Numbers in parentheses are absolute t-ratios based on heteroskedasticity-corrected standard errors.
[b] *,** and *** denote, respectively, significance at 10%, 5% and 1% levels.
[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 OLS regression of firm-specific TFP growth rates for the period 1980-1985 on #JV observed for 1976-1979. Only firms in our sample for 1976-79 with relevant data on 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 on #JV observed for 1976-1979. Only firms in our sample for 1976-79 with relevant data on TFP growth were used in this estimation.
f 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 period 1980-85, tfp(1980=85) denotes the current TFP growth, while tfp(1986-90) and tfp(1991-95) denote, respectively, future TFP growth to be observed in the periods 1986-90 and 1991-95.