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ABSTRACT

This study examines how national culture influences the likelihood and rate of buyouts among R&D equity alliances and joint ventures in the biotechnology industry. We hypothesize that the interaction of specific national culture attributes and cultural differences between alliance partners bear upon: a) the amount of endogenous uncertainty surrounding the potential integration of the target firm and b) the marginal rate of learning in hierarchical versus collaborative governance. Applying a competing hazard model to a sample of 173 joint ventures and minority equity collaborations in the biotechnology industry, we found that investing firms from high power distance and high uncertainty avoidance countries are more likely to buy out their alliance partners. Furthermore, greater cultural distance between alliance partners increases the likelihood of partner buyout when investing firms are from high power distance countries.

As knowledge-intensive industries become increasingly global, high tech firms are confronted with the strategic challenges, opportunities, and risks associated with cross-border alliances. Indeed, considerable managerial and scholarly attention has been paid to not only the benefits of such alliances, but also on the transactional difficulties wrought by alliance partners from different national cultures. However, most of these efforts have focused on the choice of initial governance mode (e.g., Erramilli, 1996; Kogut & Singh, 1988; Shane, 1993). The present study is motivated in three respects. First, it is becoming clear that governance decisions may involve a strategy to sequentially invest equity in an alliance partner over time (Chang, 1995; Penner-Hahn, 1998). Second, partnerships often terminate with acquisition (Folta, 1998; Hurry, Kogut, 1991; Miller & Bowman, 1992) as opposed to other forms of termination, such as dissolution or third party buyouts. Third, little research to date has explicitly examined whether national culture characteristics influence patterns of sequential investment and the particular mode of alliance termination.

This paper is an attempt to fill the gaps noted above by examining the role of national culture on the likelihood and rate of buyouts among R&D equity alliances and joint ventures in the biotechnology industry. Partner buyouts are a relatively common occurrence in other knowledge-intensive industries. For example, Park and Russo (1996) found that 16.2 percent of joint ventures in the electronics industry were acquired within three years of founding, while Choi (1991) has found that 13.6 percent of minority investments ended in acquisition within one year of initiation.[1] Yet, despite their frequency, very few studies have explicitly treated partner buyouts as a distinct form of partnership termination. This is unfortunate because Park and Russo (1996) and Park and Ungson (1997) argue that termination by acquisition and termination by dissolution may be driven by entirely different factors.

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Like our study, Kogut (1991) examined the partner buyout decision through an option theory lens. Whereas his study examines the role of exogenous factors on buyouts, our focus is on endogenous uncertainty and the impact of national culture. To date, only Park and Ungson (1997) have examined the role of national culture on the partner buyout decision. They reveal some evidence that cultural distance increases the likelihood of buyout of the joint venture, even after controlling for other important factors such as organizational and operational differences between partners, the type of transaction, and the incidence of prior transactions between partners. Unfortunately, since their focus was termination by dissolution, they do not develop any *a priori* theoretical arguments about the determinants of buyouts. Neither do they offer any empirical evidence regarding the effects of dimensions of culture other than cultural distance.

There are other reasons to believe that national culture may play an important role in the partner buyout decision. Chang (1995) and Hurry et al. (1992) found that sequential investment patterns were found to differ across U.S. and Japanese venture capital firms. Relative to U.S. firms, Japanese firms exhibit incremental approaches to expansion. Subsequent to news indicating venture success, Japanese venture capital firms tended to upgrade a venture investment to a joint venture or acquisition, while U.S. firms tended to sell their ownership stake. Chang (1995) questions whether the sequential investment pattern holds for western firms, reasoning that cultural and institutional background of non-western firm favor an incremental and evolutionary approach to investment. Although he does not test this proposition, he encourages study of the matter.

Hofstede (1980) defined national culture as the collective programming of the human mind. His dimensions of culture are well known and include uncertainty avoidance, power distance, masculinity-femininity, and individualism and vary considerably across countries.

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Understanding which cultural dimensions bear upon the decision to buy out a partner may shed light on several important issues. For instance, investing firms in knowledge-intensive industries would benefit from knowing how target firms from different cultures tend to respond to sequential investment behavior by partners. This *ex ante* knowledge may prove helpful in negotiating the terms of R&D equity collaborations. Similarly, collaborating firms would be advised to understand whether foreign partners are likely to consider them an acquisition candidate. At a broader level, national culture may have significant implications for understanding the level and type of commitment firms make in emerging, high tech industries.

We explicitly examine the effects of national culture on the rate of partner buyout across twelve different countries. Our hypotheses are developed using aggregate measures of cultural distance by Hofstede (1980) and Ronen and Shenkar (1985), as well as more specific dimensions of culture relating to the investing firm. Using a time varying model, we test these hypotheses on a sample of minority investments and joint ventures in the biotechnology industry. In the past two decades, the biotechnology industry has grown explosively, largely due to the recognition that biotechnology could disrupt old markets, create new products, and cheapen current manufacturing process. Virtually every developed country has targeted leadership in biotechnology as a national goal (Office of Technology Assessment, 1991).

BACKGROUND

Following Kogut (1991), we characterize R&D equity collaborations as a two-stage compound option; whereby investing firms holding a limited equity stake in a target firm can track knowledge development and (market and technological) opportunities in industries. Such equity collaborations allow firms to maintain strategic flexibility to respond to industry trends

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that are difficult to predict. Following the initial equity investment, exercise of the first stage of the option is represented by the full acquisition of a target partner. In the case of R&D partnerships where an investing firm has taken a minority equity stake, partner buyout refers to the acquisition of the R&D supplier/partner. Partner buyout for joint ventures refers to the acquisition of the joint venture by one of the parents.[2] Exercise of the second stage growth option is represented by making further discretionary investments in research or commercial opportunities resulting from the first stage commitment. In this view, equity collaborations may be initiated as a way to manage endogenous and exogenous uncertainty. Exogenous and endogenous uncertainty have different effects on the decision to commit additional capital (Dixit & Pindyck, 1994; Rivoli & Salorio, 1996).

Exogenous uncertainty cannot be reduced by the actions of the firm. In the case of emerging technology industries, *exogenous uncertainty* exists when, for example, the technological trajectory of the industry is indeterminate, industry infrastructure is lacking, and/or when key legislation affecting the industry is pending. Given these conditions, the premature acquisition of firms developing emerging technologies may impose considerable risks because the investing firm gives up the *option of waiting* for new information that might affect the desirability or timing of the investment. The ability to delay irreversible investment expenditures until exogenous uncertainty is resolved can be an important source of flexibility in a project and profoundly affect subsequent decisions to invest (McDonald & Siegel, 1986).

By contrast, *endogenous uncertainty* can be decreased by actions of the firm. Potential sources of endogenous uncertainty for the investing firm include: expansion into unfamiliar international markets, integration of firms from diverse cultures, initiation of R&D projects that take time to develop, or inability to assess the target firm's knowledge. This form of uncertainty

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is primarily resolved by learning; that is, actually performing the activities associated with a given project. Previous research suggests that greater endogenous uncertainty increases the value of information, and thus, increases incentives to invest in knowledge generation or acquisition (McCardle, 1985). In the presence of endogenous uncertainty, the key characteristic that makes the investment in knowledge so attractive is the ability to temporarily or permanently suspend further equity investment if the expected value of the completed projects declines due to exogenous shocks. Roberts and Weitzman (1981) have shown that if learning is enhanced by moving to the next stage of the project, there is an incentive to speed up the rate of commitment.

We argue that it is the combination of endogenous uncertainty and enhanced learning by moving to the next stage that motivates the decision to commit incrementally. This staged investment approach takes on value when internalizing the partner increases the rate of learning about the project. In this sense, exercising the buyout of a partner is comparable to the exercise of a call option on equities that pay dividends. In the presence of dividends (that come in the form of learning advantages) there may be an incentive to exercise the partner buyout option early. If the target turns out to have skills that are relevant for the partner but cannot be easily transferred across firm boundaries after a brief interchange, a buyout may be the only viable alternatives. Relative to arm's-length contracts, internalization facilitates transfer of technological capabilities because the acquirer can tap into its repository of social knowledge that structures cooperative action. According to Kogut and Zander (1992), this difference in the marginal efficiency of technology transfer constitutes the ownership advantage of the firm.[3] Internalizing the partner firm may increase the efficiency of knowledge transfer, thus enabling the firm to reduce future R&D costs so that growth opportunities can be exercised at a lower cost.

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In sum, there are at least three important factors which need consideration when examining determinants of partner buyouts: (1) the level of exogenous uncertainty, (2) the level of endogenous uncertainty, and (3) the relative rate of learning inside versus outside firm boundaries. Unless endogenous uncertainty (2) is present, the relative rate of learning inside versus outside the firm (3) will have no consequence. This implies an interaction effect. In this paper, we focus explicitly on the expected interaction between endogenous uncertainty and learning. In the presence of endogenous uncertainty firms will invest sequentially when such commitment yields information about future opportunities. *Firms that learn more efficiently in hierarchies are candidates to buy out their partners.*

In the next section we describe our main thesis: that national culture traits and cultural differences between partners should contribute to endogenous uncertainty and rates of learning in hierarchy, and therefore, should bear upon the buyout decision.

HYPOTHESES

When valuable, but unexplored technology is resident in a target firm, investing firms differ in terms of how learning activities are to be organized. Consistent with previous research (e.g., Adler, 1991; Hofstede, 1991; Olie, 1994; Osborn & Hagedoorn, 1997; Powell, Koput & Smith-Doerr, 1996), we argue that the cultural attributes of among investing firms are principal determinants of how firms choose to organize learning activities. We motivate our hypotheses using two of Hofstede's (1980) dimensions of national culture: *power distance* and *uncertainty avoidance*. We believe that these two dimensions are the most relevant in the study of partner buyouts for several reasons. First, as noted by Hofstede, "Of the four dimensions of national culture, power distance and uncertainty avoidance in particular affect our thinking about

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organizations. Organizing always demand the answering of two questions: (1) Who has the power to decide what? And (2) What rules or procedures will be followed to attain the desired ends?" (1991: 140).[4] In contrast, Hofstede believes that while his other two dimensions, masculinity and individualism, broadly reflect the values of the national culture, they imply little about administrative practices within organizations. Consistent with the importance placed on power distance and uncertainty avoidance inside organizations, these two dimensions have been the most pervasive in research examining the behaviors of multinational corporation as evidenced by the work of Erramilli (1996), Gatignon and Anderson (1988), Kogut and Singh (1988), and Shane (1993). Finally, Hofstede (1991) argues that various combinations of power distance and uncertainty avoidance correspond directly to each of Mintzberg's (1983) preferred authority configurations and coordinating mechanisms, thereby capturing both national and organizational traits. It seems that power distance and uncertainty avoidance are the most distinctive cultural dimensions which influence organizational structure and functioning (Hoecklin, 1995).

We argue that power distance of a national culture will influence the degree to which the investing firm can learn in hierarchy. Also, uncertainty avoidance and cultural distance are argued to contribute to endogenous uncertainty in the equity partner relationship.[5]

Power Distance and Learning Inside versus Outside the Firm

As noted, Kogut and Zander (1992) point to the important differences in learning efficiency across governance modes. They argue that it is more efficient to transfer complex knowledge within the boundaries of a firm because learning processes are a function of shared values and assumptions. If national culture embodies social knowledge and organizing principles, it

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therefore bears upon the expected efficiency of learning subsequent to partner buyout. Firms from certain cultures may learn more efficiently when internalized, while the marginal rate of learning in hierarchy may be lower for firms from other cultures. Hall (1976) argued that cultures vary greatly in the processing of information and patterns of communication.

One cultural attribute that should influence the rate of learning in hierarchies relative to collaborations is power distance (PD). Power Distance is defined as "the extent to which members of a society accept that power in institutions and organizations is distributed unequally" (Hofstede, 1985: 348-349). As applied to organizations, control, decision making, and authority are likely to be highly centralized (Hofstede, 1980). Acquiring firms from cultures characterized as high PD operate most comfortably in hierarchy. In such countries, we expect the marginal rate of learning or technology transfer to be highest in hierarchy. Indeed, Hofstede (1991) discusses the implications of culture in an important learning context – in schools. In high PD cultures, such as Japan, learning is structured and hierarchical. By contrast, learning is loose and more unstructured in low PD cultures.

One might expect that firms from high PD cultures will move directly to outright acquisition, and avoid the first stage equity collaboration. Consistent with this expectation, Shane (1993) found that the higher the PD, the greater the likelihood of hierarchical control in transactions. More recently, Erramilli (1996) found that firms from countries with higher PD are more likely to seek majority ownership in foreign subsidiaries.

In the absence of endogenous uncertainty, firms from high PD cultures will acquire outright. However, in the presence of endogenous uncertainty, they will invest incrementally, beginning with the first stage equity collaboration. Several cultural attributes influence endogenous uncertainty.

Uncertainty Avoidance, Cultural Distance, and Endogenous Uncertainty

The study of national culture on governance modes has predominantly focused on transaction cost explanations, where the cultural attributes or partner differences in national culture are expected to moderate the ability of managers to perceive the potential for opportunistic behavior by partners (Harrigan, 1985). As noted earlier, these transaction costs were found to be a key determinant for dissolution of equity partnerships and joint ventures and have been carefully articulated in the literature. Building on previous research, we argue that *uncertainty avoidance* (UA) and *cultural distance* (CD) are two important contributors to endogenous uncertainty.

Uncertainty avoidance (UA) is defined as the "degree to which the members of a society feel uncomfortable with uncertainty and ambiguity, which leads them to support beliefs promising certainty and to maintain institutions protecting conformity" (Hofstede, 1985: 348-349). In an organizational context, having high levels of UA leads managers to make less risky decisions and develop coping mechanisms to control uncertainty, such as developing complex systems of rules and regulations and following structured, ritual behavior (Hofstede, 1980).

Uncertainty avoidance was shown to be an important predictor of foreign market entry modes. For instance, Kogut and Singh (1988) found that multinational corporations from cultures high in UA are more likely to choose joint ventures or greenfield entry modes over full acquisitions. These authors attribute this result to the fact that the uncertainty associated with integrating the management teams of both subsidiary and parent firms is untenable. Therefore, these firms are more comfortable with either a greenfield investment or establishing an equity partnership with the host county target. Shane (1993) found that firms from high UA societies favor licensing over acquisition-type entry modes.

Given their proclivity toward risk avoidance, it is not surprising that firms from high UA cultures prefer staged investment to outright commitment. At the same time, we expect firms from high UA cultures to benefit from a transition toward hierarchy because of the added structure in place to control opportunistic behavior. When firms are from cultures that are also high in power distance, we expect there is added incentive to internalize the target firm in order to learn about growth opportunities more efficiently. Our proposition that high PD, high UA cultures are quicker to internalize appears consistent with arguments made by Hurry et al. (1992) and Chang (1995), who asserted that Japanese firms, relative to U.S. firms, were more likely to eventually acquire target firms. By contrast, U.S. firms are more likely to sell their equity positions in target firms following the target firm's initial public offering. Indeed, according to Hofstede (1980), the Japanese are ranked significantly higher on both PD and UA compared to the United States.

Hypothesis 1: When established firms are from cultures ranked high in uncertainty avoidance and high in power distance, partner buyouts are more likely.

In the passage above, we argued that established firms from cultures with higher power distance learn more efficiently from their partners, and that the marginal incentive to acquire their partners is highest when the relationship is confronted with endogenous uncertainty. While uncertainty avoidance is one dimension that accentuates endogenous uncertainty, cultural distance (CD) between the partners may also influence the amount of endogenous uncertainty. Cultural distance is defined as the degree to which the home country culture of an investing firm is dissimilar from that of the host country market and firms operating therein. When there is more cultural distance between partners, the ability to effectively observe and predict opportunism among partners is hindered (Kogut, 1988), leading to higher potential transaction

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costs. Here, transaction costs represent communication and control costs embodied in cultural differences.

A large body of work has focused on initial governance choice and found cultural differences lead firms to shy away from hierarchy (Kogut and Singh, 1988; Gatignon and Anderson, 1988; Shane 1993). Other researchers have attended to the role of cultural distance on the stability of existing partnerships, finding that it contributes to a higher rate of partnership dissolution (Harrigan, 1985; Barkema, Bell, & Pennings, 1996; Barkema, Shenkar, Vermeulen, & Bell, 1997; Park and Ungson, 1997). More relevant to our study, Olie (1994) and Elsass and Veiga (1994) argued that the blending of diverse cultures tends to be a challenging obstacle to successful mergers. Indeed, cultural differences between firms was found to predict stress, negative attitudes toward merger, and the lack of cooperation between firms subsequent to merger (Weber, Shenkar, & Raveh, 1996).

These findings suggest that for existing partnerships, cultural differences raise the degree of endogenous uncertainty facing partnerships, and the endogenous uncertainty facing prospects for successful mergers of the firms. The successful transfer of knowledge among culturally distant partners is an indeterminate process. This view is captured clearly by Luostarinen, who defined cultural distance as "the sum of factors creating, on the one hand, a need for knowledge, and on the other hand, barriers to the knowledge flow and hence also for flows between the home and the target countries" (1980: 131-132).

Consistent with Hypothesis 1, we argue that when endogenous uncertainty is combined with more efficient learning in hierarchy (i.e, high PD), partner buyouts should ensue. As a result, when partners are culturally distant and the investing firm is from a culture that is high in power

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distance, we expect there to be added incentive to internalize the target firm in order to learn about growth opportunities more efficiently.

Hypothesis 2: When partners are more culturally distant and the established firm is ranked high in power distance, partner buyouts are more likely.

RESEARCH DESIGN

Sample

We drew a sample of minority equity collaborations and joint ventures involving dedicated biotechnology firms (DBFs) from the *North Carolina Biotechnology Center (NCBC) Actions Database*. This database includes detailed information regarding over 4,000 relationships and transactions among firms in the biotechnology industry since 1978. In particular, the NCBC database includes the following transaction characteristics: a) whether the transaction involved an exchange of equity via a minority investment or a joint venture, b) the transaction date, c) the identity and number of partners involved, d) the type of partners involved (i.e., DBF, established firm, government, or university), e) each party's home country, f) the technological subfield, and g) a general description of each transaction. All transactions were cross-validated with a similar database, *Bioscan*. In the event that the transaction dates differed across sources, we used the earlier of the two dates.

In studying the NCBC Actions database and comparing with Bioscan we collected information on 618 equity collaborations. This original sample was reduced for three theoretical reasons. First, our compiled data were restricted to transactions involving only two parties, a target DBF domiciled in the United States and established firms having core businesses outside of biotechnology. We believe it is easier to identify the integrated manufacturer as the holder of

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the call option to acquire, a belief consistent with Hurry et al. (1992). This is particularly reasonable in cases where established firms take a minority equity stake in a DBF. These cases constitute 83.8 percent of our final sample. Determining who holds the call option is more challenging in joint ventures, where both parties contribute capital and knowledge to a jointly owned and controlled entity.[6] We control for likelihood that joint ventures may be bought out by the DBF by including a joint venture dummy variable and by modeling joint venture buyouts by the DBF firm as a competing event.

Second, we restricted our sample to include only four broad subfields: a) therapeutics, b) diagnostics, c) agriculture (ag/bio), and d) supplier/specialty chemical. These subfields account for a large majority of all firms dedicated to biotechnology (Dibner, 1992). This focus on the largest subfields was necessary because of our need to have a critical mass of public firms to generate stock market indices for each subfield for our measure of exogenous uncertainty.

Finally, we focus on equity collaborations with DBFs domiciled in the United States. This enabled us to better control for exogenous events specific to country boundaries. Given these constraints on our database we identified 248 equity collaborations initiated between 1978 and 1995. Of these, we were unable to obtain the precise starting dates of 30 transactions, despite supplementing our search using Lexis/Nexus and SEC Schedule 13D filings.

We made considerable effort to verify the outcome of each partnership. If the December 1995 issue of *Bioscan* listed the equity partnership as ongoing, the transaction was coded as right-censored. Otherwise, a systematic search was undertaken to understand the nature of the transaction termination. NCBC and *Bioscan* data were supplemented with a search of Ernst & Young Biotechnology Industry Reports, Predicast's F&S Index of Corporate Change,

Lexis/Nexis, and SEC Schedule 13D filings. From this effort we were able to verify the timing and outcome of 173 equity partnerships constituting our final sample.

Of the 173 transactions in our final sample, 23 were terminated by partner buyout by established firms, 39 were dissolved, 21 were terminated by other means (6 joint ventures were acquired by the DBF partner, 5 joint ventures were acquired by third parties, 10 DBFs were acquired by a third party), and 90 were right censored; that is, they were still in effect at the end of 1995.[7] Table 1 provides a breakdown of the number of established firms from each country that have initiated equity collaborations with U.S. biotechnology firms. Here, we also list the outcome of these equity collaborations for each country. While equity investments are most prominently undertaken by firms in a few countries, there seems to be a clear difference in the outcomes of these collaborations. U.S firms have a high percentage of partnership dissolutions and third-party buyouts. Japanese firms and those from the United Kingdom have a significant proportion of partnerships maintained, as do firms from Switzerland, Germany, and Sweden. While these trends show clear differences in country propensities regarding equity collaboration outcomes, it is unclear whether these patterns are statistically robust when controlling for cultural factors, firm-specific factors, and those relating to the value and exogenous uncertainty regarding the technology. Furthermore, Table 1 does not consider the timing of the outcome event. For example, while it is clear that a greater percentage of Japanese firms maintained their equity stake than do U.S. firms, it does not help us understand whether Japanese firms maintained their equity relationships longer than U.S. firms.

Insert Table 1 about here

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Model and Method

We selected a competing-risk, discrete-time event history analysis to test our hypotheses. Event history models are especially appropriate for analyzing longitudinal data when the dependent variable is a discrete event and the timing of the event's occurrence is of particular interest. Competing risk is a special form of event history analysis that is used when the dependent variable has two or more outcomes and the occurrence of any one outcome removes the subject from the risk of the other outcome(s). Buyouts are one of several ways in which a partnership may be terminated. Other forms of termination include (a) dissolution of the partnership, (b) acquisition of a biotechnology firm or joint venture by a third party, and (c) acquisition of a joint venture by the biotechnology partner (rather than acquisition by the established firm). Although we do not develop explicit hypotheses regarding these other forms of termination, they do represent relevant "competing hazards" in that they preclude subsequent occurrences of partner buyouts. To model the competing hazards, the hazard rate function is defined as

$$(1) \quad h_j(t) = \lim_{s \to 0} P_j(t, t + s)/s$$

where $h(t)$ is the hazard function associated with either partner buyout ($j=1$), partnership dissolution ($j=2$); or other termination ($j=3$). $P_j(t, t+s)$ is the probability that event type j occurs in the interval between t and $t+s$, given that the partnership is at risk at time t.

Cox's (1975) partial likelihood method for parameter estimation allows us to incorporate time dependence into the model, without specifying its form. The general form for the Cox proportional hazards models estimated in this study is:

$$(2) \quad \log h_j(t) = a_j(t) + \beta_j X(t) + \lambda_j Y$$

where $a_j(t)$ may be any function of time, $X(t)$ and Y are vectors of time dependent and time invariant explanatory variables, and β_j and λ_j are vectors of estimable parameters. We used TDA version 5.7 to simultaneously estimate the competing hazards model (Rohwer, 1994) with Cox's partial likelihood method. We do not provide estimates for the baseline hazard function, $a_j(t)$, since partial likelihood estimation discards this function.[8]

The three events – buyout, dissolution, and other termination – were updated monthly. The sample includes 9,843 monthly periods. The cultural variables were not time varying, but many control variables were updated monthly.

Culture Variables

Hypothesis 1 is tested by multiplying Hofstede's (1980) well-known measures of *uncertainty avoidance* and *power distance* to each country in our sample. Hypothesis 2 also suggests a multiplicative function involving power distance and cultural distance. Our test considers two alternative measures of cultural distance. First, following Kogut and Singh (1988), we measured *Hofstede's cultural distance* (HCD) as a composite index based on the each of the four cultural dimensions identified by Hofstede (1980).

We also used a second measure of cultural distance is generated from a study by Ronen and Shenkar (1985), who synthesized country clusters into nine groupings of countries with similar work-related attitudes and values. The "Anglo" cluster involves Australia, Canada, Ireland, New Zealand, South Africa, United Kingdom, and United States. All other countries in the study were grouped into the other eight clusters. Using this data, we constructed a measure of cultural distance such that when the established firm fell in the Anglo cluster, *Ronen's cultural distance* (RSCD) was coded "0", otherwise it was coded "1".

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Control Variables

Clearly, cultural factors may not dominate partner buyout decisions. We argued earlier that *exogenous* forces partially dictate how uncertain future payoffs are and whether a buyout option is in-the-money. Other forces specific to the industry, the investing firm, and partner relationship may also bear upon the buyout decision. In this section, we describe our attempts to control for the factors found to be important by previous researchers.

Kogut (1991) argued that exogenous forces determine whether a buyout option is in-the-money. He argued that when industry sales deviated positively from industry forecasts, joint venture partners would seek to acquire the joint venture. His annual measures, shipment growth and deviation from expected growth, are meant to capture the *certainty* to which joint ventures operating in an industry have appreciated in value. Our measures of exogenous variables are in the same spirit, but are measured differently. Whereas Kogut's study spanned several industries and uses annual measures, ours concentrates only on biotechnology, and we consequently focus on measuring exogenous forces within technological subfields on a monthly basis. Sales measures are unreasonable in this industry because most firms have no revenues from sales. Like Folta (1998), we measure subfield value and subfield (exogenous) uncertainty using stock market indices generated from publicly traded firm in concentrating in particular biotechnology subfields. These measures were constructed from stock prices that were gathered from the Center for Research in Security Prices data base, and are described briefly below, but in more detail in Folta (1998).

Differences in the expected value of growth opportunities across the four subfields (Therapeutic, Diagnostic, Ag/Bio, and Supplier / Specialty Chemical) with four stock indices that were created from weekly returns of nine U.S. biotechnology firms specializing in the respective

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subfields. The *subfield value* of firm j was measured as the value of the monthly biotechnology index for subfield m (when $j \in m$). These indices are weighted equally. Weekly values of the indices were then averaged within each month to get monthly index values for each of the four subfields. Subfield value was transformed by taking its natural logarithm to correct for positive skewness.

Exogenous uncertainty was measured as the 26-week standard deviation of the log of weekly returns for each of the four biotechnology subfield indices. The 26-week measure was chosen because it provides enough history to produce a reliable measure of volatility, without assuming constant variance over a longer period of time. Exogenous uncertainty was converted to a monthly measure by averaging the weekly standard deviations within any given month.

Substantial literature has confirmed the importance of industry structure on the choice of governance mode.[9] We use average subfield R&D expenditures divided by average total expenses to control for such effects. Conventionally, the relationship of R&D expense is said to encourage integrative modes, such as acquisition, in order to provide adequate administrative control for coping with higher degrees of human and dedicated capital specific to a transaction. Using this logic, we might expect a positive relationship between R&D expense and partner buyout.

Park and Ungson (1997) did not control for exogenous forces, but did find that a series of dummy variables related to the partnership influenced the buyout decision. They found that partners with the same SIC code were less likely to acquire their partners, partners having a prior relationship were more likely to end in acquisition, partnerships involving technology transfer were less likely to end in acquisition, and partnerships involving multiple products were more likely to end in acquisition. We test for some of these same effects, but not all. By definition,

our sample includes partners from different SIC codes and partnerships involving technology transfer.

Park and Ungson (1997) have highlighted the important moderating role that prior relationships have on the effect of cultural differences on partnership dissolution. While they did not test for whether this same effect holds for partner buyouts, it may be reasonable to expect prior relationships to moderate either the degree of endogenous uncertainty or the relative rate of learning in collaboration versus hierarchy. We did not include prior relationships in our formal presentation because to the extent that cultural dimensions influence the choice of prior relationships with the partner, including a measure of prior transactions in the model would confound our ability to interpret the results. In runs not reported, we did, include a dummy measure for prior relationships, consistent with the measure employed by Park and Ungson, but found no significant relationship in any of our models. Surprisingly, only 7.0 percent of the partnerships had a prior relationship, a number significantly below Park and Ungson's 26.0 percent in the electronics industry. Apparently, it is more common to initiate a relationship with equity transactions in the biotechnology industry.

Target firms having more commercial partners may not be attractive buyout candidates because commercial opportunities to exploit their technology may be siphoned off by others. To approximate the declining marginal threat of preemptive bidding or acquisition by each additional partner, we used the natural logarithm of the target firm's number of current commercial alliances. The *number of partners* was taken during the year of the event. In the event of right-censored cases, the measure was taken in the last year of the observation window. Bioscan provided this information.

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If the transaction was a *joint venture* an indicator variable was classified as a "1", and "0" if it was a minority equity investment. Joint ventures are thought to provide a real option that is more proprietary than is the case for minority investments.

Insert Table 2 about here

RESULTS

Table 2 provides descriptive statistics and correlations for the variables. Because of concerns of multicollinearity between Uncertainty Avoidance and the Cultural Distance variables, as well as the small number of events, we opted to present three full models relating to our hypotheses.

Table 3 presents the full (columns 2, 4, 6) and reduced (columns 1, 3, 5) models with the parameter estimates for the hazard of partner buyout. To ascertain the degree of model fit, likelihood ratio tests were performed on the incremental and full models. Each test produced a chi-square statistic well above the critical value ($p < 0.001$), indicating that the overall fit is good. The hypotheses for the individual interaction coefficients are tested under one-tail t-tests. In each of the full models, the hypothesized interaction is positive and significant. These findings are consistent with our expectations.

Insert Table 3 about here

In model 2, the positive coefficient on the interaction ($p < 0.05$) between Uncertainty Avoidance and Power Distance is consistent with the expectations offered in hypothesis 1. It suggests that established firms from cultures higher in UA and PD should be more likely to buy out their partners.

In models 4 and 6, both the positive coefficient on the interaction ($p < 0.10$) between Hofstede's Cultural Distance and Power Distance as well as the positive coefficient on the interaction ($p < 0.01$) between Ronen's Cultural Distance and Power Distance are consistent with the expectations offered in hypothesis 2. It suggests that when partners that are more culturally distant and established investors are higher in Power Distance there is an increased likelihood of partner buyout.

Since the remaining variables in the models have no hypotheses related to them, we use a two-tailed test to assess the significance of relationships. The only variable that demonstrated a significant effect was Target Firm's Number of Partners. As was expected, it was negatively related to the likelihood of partner buyout. This variable should approximate how proprietary the buyout option is. The more partners a target partner has, the less proprietary is the option. The variables relating to exogenous uncertainty, subfield value, and subfield R&D expense were not significant. Neither was the indicator variable distinguishing joint ventures from minority investments.

Table 3 also includes the competing hazard results for partnership dissolution in columns 7-10. These results indicate that Uncertainty Avoidance and Ronen's Cultural Distance is negatively related to the likelihood of dissolution. The latter result is consistent with those found by Park and Ungson (1997) in studying the electronics industry. They did not examine the effect of Uncertainty Avoidance. Furthermore, in comparison with the findings for the partner acquisition models, these findings demonstrate that national culture attributes influence partner dissolution differently.[10]

Consistent with previous studies, we focused mainly on aggregate measures of cultural distance. However, Hofstede (1980) suggests that partner differences for power distance,

uncertainty avoidance, masculinity, and individuality may represent important areas of conflict among partners. In addition, recent research suggests that absolute measures of cultural "distance" may obfuscate directional differences among individual cultural attributes (O'Grady & Lane, 1996). As a result, we also tested measures of cultural distance that are specific to individual attributes. These variables are calculated the same way as illustrated in equation 3, however, they only apply to a single attribute.

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Insert Table 4 about here
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Table 4 reports the parameter estimates for cultural distance measures that are specific to Hofstede's individual attributes of national culture.[11] We provide only the full models including the interaction. In model 1, the positive coefficient for the interaction between Power Distance and Cultural Distance/Partner Differences in Power Distance is consistent with hypothesis 2. Also consistent with Hypothesis 2 is the positive coefficient for the interaction between Power Distance and Cultural Distance/Partner Differences in Uncertainty Avoidance. The interactions in models 3 and 4 involving differences in Individuality and Masculinity, respectively, were not significant. These findings support our *a priori* expectation focus on Uncertainty Avoidance and Power Distance, and also support the arguments by Hofstede that these two dimensions of national culture have the greatest bearing on organizational phenomena.

Given that partner differences in Uncertainty Avoidance and Power Distance seem to be the two dimensions of national culture which best explain organizational phenomenon, we created a cultural difference measure incorporating both of those dimensions. The model is illustrated in column 5 of Table 4. The positive and significant interaction ($p < 0.05$) is consistent with expectations for hypothesis 2.

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DISCUSSION

The role of national culture on governance choice has been frequently studied. However, these studies have largely focused on the initial governance decision or partnership termination, giving little attention specifically to partner buyouts. This oversight is consequential, given the high incidence of acquisition of joint venture and equity partners. By explicitly considering the role of national culture on partner buyouts, we extend a growing body of literature that examines the incremental nature of investments in joint ventures and partner firms in knowledge-intensive industries. Although we are the not the first to characterize equity collaborations are compound options, our study is the first to attempt to theoretically explain the role of national culture on partner buyout. Partner buyout represents the exercise of the first stage option, while future discretionary investments represent the exercise of the second stage option. Real option theory suggests that firms should choose to invest incrementally in the face of endogenous uncertainty. It also suggests that firms will be more likely to commit to the next stage when they can learn more by committing, thereby reducing endogenous uncertainty.

We have built upon option theory to suggest that partner buyouts will be influenced by three factors: exogenous variables, endogenous uncertainty, and the rate of learning inside versus outside the firm. Our central argument is that attributes of national culture bears upon these latter two factors. Specifically, we argue that both uncertainty avoidance and cultural distance increases endogenous uncertainty. This is likely due to the inability to perceive the potential for opportunistic behavior by partners, or information asymmetry between partners. As a result of such uncertainty, established firms will shy away from aggressive commitment to growth opportunities, they will invest incrementally. Firms from cultures that are high in power distance are expected to transition to hierarchical governance because it is in hierarchies that they operate

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and learn most efficiently about growth opportunities. Thus, it is the combination of high endogenous uncertainty and the ability (or prospects) to learn more efficiently after internalizing the partner that leads to partner buyout.

Our empirical findings are consistent with the expectations noted above. Uncertainty avoidance and cultural distance are argued to contribute to endogenous uncertainty, while power distance is argued to impact the relative rate of learning in hierarchy relative to collaborations. Established firms from high UA home country cultures are more likely to buy out partners when they are also high in PD. Partners that are culturally distant are more likely to buy out partners when they are also high in PD. These findings suggest that it is the combination of endogenous uncertainty and efficient learning at the next stage that promote commitment via partner buyout. They are robust to different measures of cultural distance emanating from work by Hofstede (1980) and Ronen and Shenkar (1985). Distance measures using Hofstede's dimensions of Uncertainty Avoidance and Power Distance seem to mostly explain endogenous uncertainty.

Upon examination of country values for UA, Japan is among the world's most uncertainty avoidant cultures (about 1.5 standard deviations above the mean; see Hofstede, 1980: 315). According to our research findings, Japanese firms might be expected to exhibit high levels of anxiety with respect to both endogenous uncertainty and exogenous uncertainty. Therefore, Japanese firms will place greater intrinsic and extrinsic value on maintaining the equity collaboration. Indeed, our findings suggest that firms high in UA (including those from Japan) are less likely to acquire their collaboration partners and less likely to dissolve the partnership. These findings support those of Hurry et al. (1992) and Chang (1995) who found that Japanese firms were more likely than U.S. firms to retain their holdings in international joint ventures.

A Framework for Understanding Intentions of Foreign Partners

Using Hofstede's dimensions of Uncertainty Avoidance and Power Distance there is potential to create a broad framework by which future studies can examine partner buyout decisions in particular, and sequential investment more generally. In Table 5 we located countries based on only two measures: Uncertainty Avoidance and Power Distance. Since these measures are specific to the established firm, and not the relationship between partners, we can develop a general framework of tendencies toward partner buyout. Since firms domiciled in France and Japan are high in both Uncertainty Avoidance and Power Distance, we expect them to be most likely to buy out their partners. The second most likely group to buy out partners consists of firms high in Uncertainty Avoidance and medium in Power Distance: Germany, Italy, and Switzerland. Finally, firms from countries that are medium in both PD and UA (Australia, Canada, the United Kingdom, or the United States) may also demonstrate a notion for partner buyouts, although to a lesser extent. Established firms from other countries are less likely to exhibit a tendency to buy out their partners either because there is low power distance or low uncertainty avoidance.

Insert Table 5 about here

Of course, cultural distance is not depicted in Table 5. According to our theoretical expectations, even established firms from uncertainty avoidance cultures may display a tendency to buy out partners if they are culturally distant. The expectations presented in Table 5 can be altered to reflect cultural distance. For example, France and Japan are especially likely candidates for buyouts of U.S. partners because they are high on all three cultural attributes: Power Distance, Uncertainty Avoidance, and Cultural Distance. The framework can be extended

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to partnerships not involving United States target firms. For example, the tendency for Japanese firms to acquire Japanese partners may be muted somewhat because of a lack of cultural distance. At the same time, because of high cultural distance, firms from Australia, Canada, the United Kingdom, and the United States may demonstrate an increased tendency for acquiring Japanese partners. We believe that these propositions are very deserving of more attention in samples involving multiple industries and entry into multiple countries.

We should note several limitations of this study. Although our sampling methodology was comprehensive for nearly the entire life of the biotechnology industry, the number of partner buyout events is small. Nevertheless, we managed to attain statistical significance for our key variables and stability across a number of models containing firm-level and/or industry-level control variables. A larger sample would allow disaggregation of joint ventures and minority equity partnerships. Our study focused on a single industry, and sub-segments within that industry. While these segments are distinct from one another, future research should attempt to verify the expected relationships in other industries, including both R&D intensive and more stable industries.

Parkhe (1991) suggests that formal training programs can enhance cultural understanding and may moderate the relationship between cultural variables and the duration of global alliances. These integrating mechanisms may have an important influence on the relative rate of learning in joint ventures versus acquisition, and hence, may play a role in the buyout decision. Unfortunately, since we lacked data on the extent of cross-cultural training programs, we could not examine this issue. However, we believe that our theoretical framework offers an interesting new opportunity to ascertain how integrating mechanisms may influence the relatively unexplored phenomena of partner buyouts.

Previous research has demonstrated that companies use collaborations when partnering with culturally distant partners. Thus, our sample of equity collaborations may reflect some restricted range of cultural distance. Indeed, means scores of cultural distance varied significantly when we examined a broader sample of transactions involving both equity collaborations (0.64) and outright acquisitions (.036). Thus, our study, and any study examining the effect of national culture on partner buyout will suffer from such a bias. This will tend to weaken the results for cultural distance. We have demonstrated, however, that even though we have sampled culturally distant partners, power distance acts to moderate the partner buyout decision.

Overall, our study suggests that cultural attributes of the investing firm and cultural differences between the investing and target firms play a significant role in predicting the rate at which partner buyouts occur. It suggests that firms find value in flexibility in the presence of endogenous uncertainty, and are quicker to exercise when buyout enhances the potential rate of learning. The hypotheses developed here and the results we found offer some promising new directions for future empirical research.

ENDNOTES

[1] Other evidence of partner buyouts include Kogut (1989), who found that 24.0 percent of joint ventures were acquired by a partner within seven years, and Mikkelson and Ruback (1985), who discovered that 13.6 percent of firms having initiated minority investments either acquired or attempted to acquire their partner within three years of taking an initial equity stake.

[2] We are not without precedent in defining the scope of this research to encompass both joint ventures and minority investments (e.g., Hennart, 1991; Pisano, 1989).

[3] For Williamson (1985), the ownership advantage of the firm results from its superior mechanisms for coping with opportunism.

[4] Although Hofstede is largely famous for his 1980 IBM national culture study, he and his colleagues later found several links between national culture and organizational culture (Hofstede, 1991; Hofstede, Neuijen, Ohayv, & Sanders, 1990). In particular, the organizational culture dimensions of *need for authority* and *need for security* correlated strongly with *power distance* and *uncertainty avoidance*, respectively. Therefore, we restrict our analysis to only power distance and uncertainty avoidance – cultural dimensions that capture both national and organizational traits.

[5] We are grateful to a reviewer who emphasized that cultural distance and uncertainty avoidance are not equated to endogenous uncertainty. Indeed, they are merely constructs that contribute to endogenous uncertainty. As pointed out on pages 6-7, endogenous uncertainty may be represented by many factors.

[6] Either partner may *hold* the option to acquire the joint venture. Who is most likely to *exercise* the option in the case of joint ventures turns not only on the strategic intentions of the partners, but the relative competitive strengths of the partners--the partner possessing unique complementary resources being the more likely to acquire the weaker partner's stake (Hurry, 1993). Integrated firms investing in biotechnology have downstream skills in marketing and distribution, and regulatory savvy (Arora & Gambardella, 1990). Although dedicated biotechnology firms (DBFs) have important R&D capabilities, they frequently lack the cash needed to invest in acquisitions. Furthermore, most integrated manufacturers of pharmaceuticals, chemicals, and agriculture have a major goal of acquiring technical knowledge in biotechnology, while only a handful of DBF's aspire to become fully integrated (Office of Technology Assessment, 1991). In our sample we found that six joint ventures were acquired by the integrated partner and six joint ventures that were acquired by the DBF. Our focus on the established firm as the holder also rests on our theoretical interest in understanding when firms are more likely to commit to internalizing technical knowledge to capitalize on emerging technologies, and not downstream skills.

[7] Although the rate of acquisition (6.9 percent) by year three appears somewhat below rates found in studies noted on page 3, to make our rate comparable we must also include acquisitions by the DBF partner and allow for a three year window for the event to take place. In making that adjustment we find that 10.0 percent of the total sample (14.8 percent of joint ventures and 8.9 percent of minority investments) was terminated by acquisition by one of the partners within 36

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months. This, then, is consistent with previous studies.

[8] The Cox method uses only information about the relative order of duration times, instead of the exact timing of events. Hence, the Cox method involves some loss of information, potentially inhibiting model estimation. This same feature makes the Cox model an attractive one when one has no prior expectations about time dependence. Another reason to question the validity of the Cox partial likelihood model for our data is that our number of events is relatively few. Although partial likelihood models are asymptotically efficient when the sample size is large (Efron, 1977), when the sample size is small, the precision of the partial likelihood estimates can be much less than that for maximum likelihood estimates (Coleman, 1981). We estimated a second model using maximum likelihood. Maximum likelihood methods require specification of a baseline hazard function. We chose the exponential specification because it is the parametric equivalent to the Cox method. The results from that estimation produced a pattern of relations identical to those found via the Cox estimation, with slightly less significance. This supplemental analysis provided evidence for the robustness of the results reported in this paper.

[9] We also examined the effect of industry structure using **number of rivals** active in each of the 123 product areas for each year throughout the publication of Bioscan (1987-1995). We did not include this variable in the formal presentation because it had no substantive impact on the model, and there was substantial colinearity with other variables in the model (R&D Expense and Subfield Value).

[10] We also examined whether dissolution was influenced by an interaction between cultural distance and power distance, and uncertainty avoidance and power distance. Log likelihood ratio tests indicated no such interaction existed.

[11] Weber, Shenkar, and Raveh (1996) also used distance measures for Hofstede's individual culture attributes, but focused on the impact on mergers and acquisition, not partner buyouts.

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Table 1: Cultural Measures and Outcomes of Equity Collaborations by Country of Corporate Headquarters

| Country | Cultural Measures | | | | Outcomes of Equity Collaborations Actual (Percent) | | | | | |
	UA	PD	Hofstede's Cult. Distance	Ronen's Cultural Category	Partner Buyout	Partnership Dissolution	3rd Party Buyout	Partnerships Maintained	Total	# of Establish -ed Firms
Australia	51	36	0.026	Anglo	1 (100%)	0 (0%)	0 (0%)	0 (0%)	1	1
Canada	48	39	0.138	Anglo	0 (0%)	1 (50%	1 (50%)	0 (0%)	2	1
Denmark	23	18	1.745	Nordic	1 (50%)	1 (50%)	0 (0%)	0 (0%)	2	2
France	86	68	1.617	Latin Europe	2 (40%)	0 (0%)	0 (0%)	3 (60%)	5	2
Germany	65	35	0.630	Germanic	0 (0%)	0 (0%)	2 (28.6%)	5 (71.4%)	7	2
Ireland	35	28	0.530	Anglo	1 (50%)	1 (50%)	0 (0%)	0 (0%)	2	1
Italy	75	50	0.650	Latin Europe	1 (50.0%)	0 (0%)	0 (0%)	1 (50.0%)	2	2
Japan	92	54	3.104	Far East	3 (13.6%)	3 (13.6%)	1 (4.6%)	15 (68.2%)	22	17
Norway	50	31	1.667	Nordic	0 (0%)	1 (100%)	0 (0%)	0 (0%)	1	1
Sweden	29	31	1.859	Nordic	1 (12.5%)	2 (25.0%)	1 (12.5%)	4 (50.0%)	8	4
Switzerland	58	34	0.528	Germanic	3 (17.7%)	1 (5.8%)	3 (17.2%)	10 (58.8%)	17	3
United Kingdom	35	35	0.083	Anglo	0 (0%)	1 (7.1%)	0 (0%)	13 (92.9%)	14	3
United States	46	40	0.000	Anglo	10 (11.1%)	28 (31.1%)	13 (14.5%)	39 (43.3%)	90	34
Total					23 (13%)	39 (23%)	21 (12%)	90 (52%)	173	73

Table 2: Descriptive Statistics and Correlation Matrix[a]

		Mean	S.D	1	2	3	4	5	6	7	8	9	10	11
1.	Uncertainty Avoidance	53.143	18.157											
2.	Hofstede's Cultural Distance	0.632	1.078	0.786 *										
3.	Ronen's Cultural Distance	0.343	0.475	0.653 *	0.795 *									
4.	Power Distance	40.804	8.141	0.823 *	0.572 *	0.268 *								
5.	UA * PD	2290.158	1283.659	0.964 *	0.794 *	0.573 *	0.918 *							
6.	Hofstede's CD * PD	30.817	57.567	0.869 *	0.977 *	0.728 *	0.711 *	0.893 *						
7.	Ronen's CD * PD	15.023	22.129	0.835 *	0.879 *	0.940 *	0.568 *	0.807 *	0.876 *					
8.	Exogenous Uncertainty	0.3191	0.103	-0.035 *	-0.006	-0.004	-0.027 *	-0.029 *	-0.014	-0.013				
9.	Subfield Value	5.736	1.095	0.050 *	0.050 *	0.099 *	0.026 *	0.052 *	0.056 *	0.106 *	0.098 *			
10.	Subfield R&D Expense	41.423	11.846	0.135 *	0.188 *	0.201 *	0.052 *	0.133 *	0.186 *	0.205 *	0.107 *	0.328 *		
11.	Target's # of Partners	3.118	1.625	-0.030 *	-0.177 *	-0.040 *	-0.128 *	-0.112 *	-0.173 *	-0.086 *	-0.003	-0.021 *	-0.076 *	
12.	Joint Venture	0.170	0.375	0.067 *	0.035 *	0.072 *	0.053 *	0.058 *	0.039 *	0.073 *	-0.035 *	-0.109 *	-0.084 *	0.164 *

* Pearson correlations are significant at $p < 0.05$.
[a] Correlations are calculated using pooled cross-sectional and time-series data covering 173 equity partnerships and 9,843 one-month periods.

Table 3: Partial Likelihood Estimates for Hazard of Partner Buyout and Partnership Dissolution

Variable Name	Partnership Acquisition						Partnership Dissolution			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(0)
Uncertainty Avoidance	-0.0278 (0.0197)[a]	-0.0338 (0.0356)					-0.0179† (0.0102)			
Hofstede's Cultural Distance			0.1899 (0.2100)	-0.7904 (0.6699)				-0.2919 (0.1823)		
Ronen's Cultural Distance					0.6992 (0.4355)	-2.7992* (1.5773)			-0.8394* (0.4066)	
Power Distance	-0.0660 (0.0420)	-0.0996* (0.0392)	-0.0262 (0.0246)	-0.0510* (0.0254)	-0.0215 (0.0210)	-0.0902** (0.0306)				-0.0315 (0.0195
UA * PD		0.0012*♦ (0.0006)								
Hofstede's CD * PD				0.0219†♦ (0.0136)						
Ronen's CD * PD						0.0903**♦ (0.0388)				
Exogenous Uncertainty	-2.0209 (2.2834)	-1.8379 (2.2631)	-2.3513 (2.2945)	-1.8959 (2.3054)	-2.3481 (2.2896)	-1.8051 (2.2970)	2.6796† (1.5885)	3.1736 (1.6273)	3.2658* (1.6409)	2.5622 (1.5882)
Subfield Value	-0.0581 (0.1951)	-0.0775 (0.2020)	-0.0612 (0.1962)	-0.0666) (0.1976)	-0.0736 (0.1954)	-0.1045 (0.1988)	0.1934 (0.1637)	0.2007 (0.1631)	0.2183 (0.1638)	0.2045 (0.1634)
Subfield R&D Expense	-0.0131 (0.0165)	-0.0217 (0.0174)	-0.0143 (0.0170)	-0.0175 (0.0172)	-0.0154 (0.0168)	-0.0220 (0.0174)	0.0148 (0.0164)	0.0140 (0.0162)	0.0151 (0.0164)	0.0124 (0.0162)
Target Firm's # of Partners	-0.4819** (0.1627)	-0.3797* (0.1678)	-0.4524** (0.1659)	-0.4213** (0.1632)	-0.4567** (0.1637)	-0.3884* (0.1622)	-0.4584*** (0.1291)	-0.4982*** (0.1303)	-0.4851*** (0.1310)	-0.4775*** (0.1289)
Joint Venture	0.6862 (0.5065)	0.6543 (0.5057)	0.6032 (0.5020)	0.6359 (0.5008)	0.6449 (0.4986)	0.6671 (0.4954)	0.1343 (0.4955)	0.0792 (0.4911)	0.0966 (0.4917)	0.1550 (0.4976)
Log-likelihood Ratio	-326.70***	-324.72***	-326.98***	-325.86***	-325.14***	-322.93***	327.52***	328.21***	327.20***	328.52***

[a] Standard error in parentheses
† $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$
♦ One-tailed t-test for hypothesized relations

Table 4: Partial Likelihood Estimates for Hazard of Partner Buyout

Variable Name	(1)	(2)	(3)	(4)	(5)
Cultural Distance – Partner Differences in PD	-0.4271 (0.6234)[a]				
Cultural Distance – Partner Differences in UA		-1.3022 (0.7499)			
Cultural Distance – Partner Differences in Individuality			-0.1099 (0.8065)		
Cultural Distance – Partner Differences in Masculinity				-0.5841 (0.5007)	
Cultural Distance – Partner Differences in (PD + UA)					-0.4084 (0.3592)
Power Distance	-0.0594 (0.0251)	-0.0531 * (0.0252)	-0.0323 (0.0305)	-0.0404 (0.0263)	-0.0647 * (0.0269)
Differences in PD * PD	0.0201 *♦ (0.0116)				
Differences in UA * PD		0.0295 *♦ (0.0137)			
Differences in Individuality * PD			0.0042 ♦ (0.0157)		
Differences in Masculinity * PD				0.0183 ♦ (0.0145)	
Differences in (PD + UA) * PD					0.0127 *♦ (0.0064)
Exogenous Uncertainty	-1.9168 (2.2621)	-1.6697 (2.2915)	-2.2012 (2.2884)	-2.0129 (2.3173)	-1.7917 (2.2811)
Subfield Value	-0.1443 (0.2066)	-0.0984 (0.2014)	-0.0560 (0.1964)	-0.0664) (0.1960)	-0.1110 (0.2019)
Subfield R&D Expense	-0.0195 (0.0173)	-0.0204 (0.0174)	-0.0140 (0.0169)	-0.0143 (0.0170)	-0.0212 (0.0175)
Target Firm's # of Partners	-0.3839 * (0.1659)	-0.3882 * (0.1635)	-0.4597 ** (0.1659)	-0.4460 ** (0.1641)	-0.3734 * (0.1652)
Joint Venture	0.5012 (0.5013)	0.5850 (0.5028)	0.6206 (0.5059)	0.6045 (0.5009)	0.5825 (0.4993)
Log-likelihood Ratio	-323.94 ***	-324.71 ***	-327.43 ***	-326.88 ***	-324.14 ***

[a] Standard error in parentheses

† $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

♦ One-tailed t-test for hypothesized relations

Table 5: Countries in Sample Located by Power Distance and Uncertainty Avoidance*

	High Power Distance	Medium Power Distance	Low Power Distance
High Uncertainty Avoidance	France Japan	Germany Italy Switzerland	
Medium Uncertainty Avoidance		Australia Canada United Kingdom United States	Ireland Norway
Low Uncertainty Avoidance			Denmark Sweden

* The darker the background the more likely firms from these countries are to buy out their partners.

No. 93-101   Gordon M. Phillips, and Robert J. Weiner
"Information and Normal Backwardation as Determinants of Trading Performance: Evidence from the North-Sea Oil Forward Market." 1994. The Economic Journal.

No. 93-102   Stephen R. Goldberg and Frank L. Heflin
"The Association Between the Level of International Diversification and Risk."

No. 93-103   John A. Carlson
"Risk Aversion, Foreign Exchange Speculation and Gambler's Ruin."

No. 93-104   John A. Carlson, Aasim M. Husain, and Jeffrey A. Zimmerman
"Penalties and Exclusion in the Rescheduling and Forgiveness of International Loans."

No. 93-105   Kent D. Miller
"Industry and Country Effects on Manager's Perceptions of Environmental Uncertainties."
1993. Journal of International Business Studies, 24: 693-714.

No. 93-106   Stephen R. Goldberg and Joseph H. Godwin
"Foreign Currency Translation Under Two Cases-Integrated and Isolated Economies."

No. 93-107   Kent D. Miller
"A Comparison of Managers' Uncertainty Perceptions and Country Risk Indices."

No. 93-108   Jon D. Haveman
"The Effect of Trade Induced Displacement on Unemployment and Wages."

No. 93-109   Jon D. Haveman
"Some Welfare Effects of Dynamic Customs Union Formation."

No. 93-110   John A. Carlson and Insook Kim
"Central Banks' Expected Profits From Intervention."

No. 94-001   Casper G. De Vries, Phillip A. Stork, and Kees G. Koedijk
"Between Realignments and Intervention: The Belgian Franc in the European Monetary System."

No. 94-002   Casper G. de Vries and K. U. Leuven
"Stylized Facts of Nominal Exchange Rate Returns."

No. 94-003   Kent D. Miller
"Operational Flexibility Responses to Environmental Uncertainties."

No. 94-004   Kent D. Miller
"Economic Exposure and Integrated Risk Management."

No. 94-005   Kent D. Miller
"Diversification Responses to Environmental Uncertainties."

No. 94-006   John M. Hannon, Ing-Chung Huang, and Bih-Shiaw Jaw
"International Human Resource Strategy and Its Determinants: The Case of Multinationals and Their Subsidiaries in Taiwan."

No. 97-001   Jeffrey J. Reuer
              "Shareholder Wealth Effects of Joint Venture Termination: A Transaction Cost Analysis."

No. 97-002   Jon Haveman and David Hummels
              "What Can We Learn from Bilateral Trade? Gravity and Beyond."

No. 97-003   Douglas Bowman, John U. Farley, and David C. Schmittlein
              *"Cross-National Empirical Generalization of a Supplier Selection and Usage Model for Foreign
              Exchange Services."*

No. 97-004   Kent D. Miller
              "Measurement of Perceived Environmental Uncertainties: Response and Extension."

No. 97-005   John A. Carlson, C. O. Osler
              "Rational Speculators and Exchange Rate Volatility."

No. 97-006   Marie Thursby, Kala Krishna, and Suddhasatwa Roy
              "Procompetitive Market Access," Forthcoming, <u>Business and Economics for the 21st Century,</u> Vol. 1.

No. 97-007   John A. Carlson
              "Currency Boards, Expectations and Inflation Persistence."

No. 97-008   Jon Haveman, Usha C. Nair, and Jerry G. Thursby
              "The Effects of Protection on the Pattern of Trade: A Disaggregated Analysis," Forthcoming, <u>Business
              and Economics for the 21st Century,</u> Vol. 1.

No. 97-009   George Horwich
              "Economic Lessons of the Kobe Earthquake."

No. 98-001   John J. McConnell, Kenneth A. Carow, and Gayle R. Erwin
              *"Financing Publicly Traded U.S. Corporations in Public and Private Security Markets, 1970-1997:
              Where, How, How Much, With What, When, and Why."*

No. 98-002   Timothy N. Cason, Tatsuyoshi Saijo, and Takehiko Yamato
              *"Voluntary Participation and Spite in Public Good Provision Experiments: An International
              Comparison."*

No. 98-003   Jon D. Haveman, Janet S. Netz, and Vivian Lei
              "International Integration and Growth: A Survey and Empirical Investigation."

No. 98-004   Keith V. Smith, Nabil T. Khoury, and Peter I. MacKay
              "Comparing Working Capital Practices in Canada, the United States, and Australia: A Note."

No. 98-005   John A. Carlson and Neven T. Valev
              "Expectations Formation and Inflation Persistence."

No. 98-006   John A. Carlson and Carol L. Osler
              "Determinants of Currency Risk Premiums."

No. 98-007   Jon D. Haveman, Usha Nair-Reichert, and Jerry Thursby
              *"Trade Reduction, Diversion and Compression: Empirical Regularities in the Effect of Protective
              Measures."*

No. 98-008   Kale Krishna, Suddhasatwa Roy, and Marie Thursby
              "Can Subsidies for MARs be Procompetitive?"

No. 99-001   Gabriele Camera and Johannes Winkler
              "Stores, Prices and Currency Substitution"

The Effect of National Culture on Partner Buyouts
in Cross-Border Biotechnology Alliances

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99-006

THE EFFECT OF NATIONAL CULTURE ON PARTNER BUYOUTS IN CROSS-BORDER BIOTECHNOLOGY ALLIANCES

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THE EFFECT OF NATIONAL CULTURE ON PARTNER BUYOUTS IN CROSS-BORDER BIOTECHNOLOGY ALLIANCES

ABSTRACT

This study examines how national culture influences the likelihood and rate of buyouts among R&D equity alliances and joint ventures in the biotechnology industry. We hypothesize that the interaction of specific national culture attributes and cultural differences between alliance partners bear upon: a) the amount of endogenous uncertainty surrounding the potential integration of the target firm and b) the marginal rate of learning in hierarchical versus collaborative governance. Applying a competing hazard model to a sample of 173 joint ventures and minority equity collaborations in the biotechnology industry, we found that investing firms from high power distance and high uncertainty avoidance countries are more likely to buy out their alliance partners. Furthermore, greater cultural distance between alliance partners increases the likelihood of partner buyout when investing firms are from high power distance countries.

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As knowledge-intensive industries become increasingly global, high tech firms are confronted with the strategic challenges, opportunities, and risks associated with cross-border alliances. Indeed, considerable managerial and scholarly attention has been paid to not only the benefits of such alliances, but also on the transactional difficulties wrought by alliance partners from different national cultures. However, most of these efforts have focused on the choice of initial governance mode (e.g., Erramilli, 1996; Kogut & Singh, 1988; Shane, 1993). The present study is motivated in three respects. First, it is becoming clear that governance decisions may involve a strategy to sequentially invest equity in an alliance partner over time (Chang, 1995; Penner-Hahn, 1998). Second, partnerships often terminate with acquisition (Folta, 1998; Hurry, Kogut, 1991; Miller & Bowman, 1992) as opposed to other forms of termination, such as dissolution or third party buyouts. Third, little research to date has explicitly examined whether national culture characteristics influence patterns of sequential investment and the particular mode of alliance termination.

This paper is an attempt to fill the gaps noted above by examining the role of national culture on the likelihood and rate of buyouts among R&D equity alliances and joint ventures in the biotechnology industry. Partner buyouts are a relatively common occurrence in other knowledge-intensive industries. For example, Park and Russo (1996) found that 16.2 percent of joint ventures in the electronics industry were acquired within three years of founding, while Choi (1991) has found that 13.6 percent of minority investments ended in acquisition within one year of initiation.[1] Yet, despite their frequency, very few studies have explicitly treated partner buyouts as a distinct form of partnership termination. This is unfortunate because Park and Russo (1996) and Park and Ungson (1997) argue that termination by acquisition and termination by dissolution may be driven by entirely different factors.

Like our study, Kogut (1991) examined the partner buyout decision through an option theory lens. Whereas his study examines the role of exogenous factors on buyouts, our focus is on endogenous uncertainty and the impact of national culture. To date, only Park and Ungson (1997) have examined the role of national culture on the partner buyout decision. They reveal some evidence that cultural distance increases the likelihood of buyout of the joint venture, even after controlling for other important factors such as organizational and operational differences between partners, the type of transaction, and the incidence of prior transactions between partners. Unfortunately, since their focus was termination by dissolution, they do not develop any *a priori* theoretical arguments about the determinants of buyouts. Neither do they offer any empirical evidence regarding the effects of dimensions of culture other than cultural distance.

There are other reasons to believe that national culture may play an important role in the partner buyout decision. Chang (1995) and Hurry et al. (1992) found that sequential investment patterns were found to differ across U.S. and Japanese venture capital firms. Relative to U.S. firms, Japanese firms exhibit incremental approaches to expansion. Subsequent to news indicating venture success, Japanese venture capital firms tended to upgrade a venture investment to a joint venture or acquisition, while U.S. firms tended to sell their ownership stake. Chang (1995) questions whether the sequential investment pattern holds for western firms, reasoning that cultural and institutional background of non-western firm favor an incremental and evolutionary approach to investment. Although he does not test this proposition, he encourages study of the matter.

Hofstede (1980) defined national culture as the collective programming of the human mind. His dimensions of culture are well known and include uncertainty avoidance, power distance, masculinity-femininity, and individualism and vary considerably across countries.

Understanding which cultural dimensions bear upon the decision to buy out a partner may shed light on several important issues. For instance, investing firms in knowledge-intensive industries would benefit from knowing how target firms from different cultures tend to respond to sequential investment behavior by partners. This *ex ante* knowledge may prove helpful in negotiating the terms of R&D equity collaborations. Similarly, collaborating firms would be advised to understand whether foreign partners are likely to consider them an acquisition candidate. At a broader level, national culture may have significant implications for understanding the level and type of commitment firms make in emerging, high tech industries.

We explicitly examine the effects of national culture on the rate of partner buyout across twelve different countries. Our hypotheses are developed using aggregate measures of cultural distance by Hofstede (1980) and Ronen and Shenkar (1985), as well as more specific dimensions of culture relating to the investing firm. Using a time varying model, we test these hypotheses on a sample of minority investments and joint ventures in the biotechnology industry. In the past two decades, the biotechnology industry has grown explosively, largely due to the recognition that biotechnology could disrupt old markets, create new products, and cheapen current manufacturing process. Virtually every developed country has targeted leadership in biotechnology as a national goal (Office of Technology Assessment, 1991).

BACKGROUND

Following Kogut (1991), we characterize R&D equity collaborations as a two-stage compound option; whereby investing firms holding a limited equity stake in a target firm can track knowledge development and (market and technological) opportunities in industries. Such equity collaborations allow firms to maintain strategic flexibility to respond to industry trends

that are difficult to predict. Following the initial equity investment, exercise of the first stage of the option is represented by the full acquisition of a target partner. In the case of R&D partnerships where an investing firm has taken a minority equity stake, partner buyout refers to the acquisition of the R&D supplier/partner. Partner buyout for joint ventures refers to the acquisition of the joint venture by one of the parents.[2] Exercise of the second stage growth option is represented by making further discretionary investments in research or commercial opportunities resulting from the first stage commitment. In this view, equity collaborations may be initiated as a way to manage endogenous and exogenous uncertainty. Exogenous and endogenous uncertainty have different effects on the decision to commit additional capital (Dixit & Pindyck, 1994; Rivoli & Salorio, 1996).

Exogenous uncertainty cannot be reduced by the actions of the firm. In the case of emerging technology industries, *exogenous uncertainty* exists when, for example, the technological trajectory of the industry is indeterminate, industry infrastructure is lacking, and/or when key legislation affecting the industry is pending. Given these conditions, the premature acquisition of firms developing emerging technologies may impose considerable risks because the investing firm gives up the *option of waiting* for new information that might affect the desirability or timing of the investment. The ability to delay irreversible investment expenditures until exogenous uncertainty is resolved can be an important source of flexibility in a project and profoundly affect subsequent decisions to invest (McDonald & Siegel, 1986).

By contrast, *endogenous uncertainty* can be decreased by actions of the firm. Potential sources of endogenous uncertainty for the investing firm include: expansion into unfamiliar international markets, integration of firms from diverse cultures, initiation of R&D projects that take time to develop, or inability to assess the target firm's knowledge. This form of uncertainty

is primarily resolved by learning; that is, actually performing the activities associated with a given project. Previous research suggests that greater endogenous uncertainty increases the value of information, and thus, increases incentives to invest in knowledge generation or acquisition (McCardle, 1985). In the presence of endogenous uncertainty, the key characteristic that makes the investment in knowledge so attractive is the ability to temporarily or permanently suspend further equity investment if the expected value of the completed projects declines due to exogenous shocks. Roberts and Weitzman (1981) have shown that if learning is enhanced by moving to the next stage of the project, there is an incentive to speed up the rate of commitment.

We argue that it is the combination of endogenous uncertainty and enhanced learning by moving to the next stage that motivates the decision to commit incrementally. This staged investment approach takes on value when internalizing the partner increases the rate of learning about the project. In this sense, exercising the buyout of a partner is comparable to the exercise of a call option on equities that pay dividends. In the presence of dividends (that come in the form of learning advantages) there may be an incentive to exercise the partner buyout option early. If the target turns out to have skills that are relevant for the partner but cannot be easily transferred across firm boundaries after a brief interchange, a buyout may be the only viable alternatives. Relative to arm's-length contracts, internalization facilitates transfer of technological capabilities because the acquirer can tap into its repository of social knowledge that structures cooperative action. According to Kogut and Zander (1992), this difference in the marginal efficiency of technology transfer constitutes the ownership advantage of the firm.[3] Internalizing the partner firm may increase the efficiency of knowledge transfer, thus enabling the firm to reduce future R&D costs so that growth opportunities can be exercised at a lower cost.

In sum, there are at least three important factors which need consideration when examining determinants of partner buyouts: (1) the level of exogenous uncertainty, (2) the level of endogenous uncertainty, and (3) the relative rate of learning inside versus outside firm boundaries. Unless endogenous uncertainty (2) is present, the relative rate of learning inside versus outside the firm (3) will have no consequence. This implies an interaction effect. In this paper, we focus explicitly on the expected interaction between endogenous uncertainty and learning. In the presence of endogenous uncertainty firms will invest sequentially when such commitment yields information about future opportunities. *Firms that learn more efficiently in hierarchies are candidates to buy out their partners.*

In the next section we describe our main thesis: that national culture traits and cultural differences between partners should contribute to endogenous uncertainty and rates of learning in hierarchy, and therefore, should bear upon the buyout decision.

HYPOTHESES

When valuable, but unexplored technology is resident in a target firm, investing firms differ in terms of how learning activities are to be organized. Consistent with previous research (e.g., Adler, 1991; Hofstede, 1991; Olie, 1994; Osborn & Hagedoorn, 1997; Powell, Koput & Smith-Doerr, 1996), we argue that the cultural attributes of among investing firms are principal determinants of how firms choose to organize learning activities. We motivate our hypotheses using two of Hofstede's (1980) dimensions of national culture: *power distance* and *uncertainty avoidance*. We believe that these two dimensions are the most relevant in the study of partner buyouts for several reasons. First, as noted by Hofstede, "Of the four dimensions of national culture, power distance and uncertainty avoidance in particular affect our thinking about

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organizations. Organizing always demand the answering of two questions: (1) Who has the power to decide what? And (2) What rules or procedures will be followed to attain the desired ends?" (1991: 140).[4] In contrast, Hofstede believes that while his other two dimensions, masculinity and individualism, broadly reflect the values of the national culture, they imply little about administrative practices within organizations. Consistent with the importance placed on power distance and uncertainty avoidance inside organizations, these two dimensions have been the most pervasive in research examining the behaviors of multinational corporation as evidenced by the work of Erramilli (1996), Gatignon and Anderson (1988), Kogut and Singh (1988), and Shane (1993). Finally, Hofstede (1991) argues that various combinations of power distance and uncertainty avoidance correspond directly to each of Mintzberg's (1983) preferred authority configurations and coordinating mechanisms, thereby capturing both national and organizational traits. It seems that power distance and uncertainty avoidance are the most distinctive cultural dimensions which influence organizational structure and functioning (Hoecklin, 1995).

We argue that power distance of a national culture will influence the degree to which the investing firm can learn in hierarchy. Also, uncertainty avoidance and cultural distance are argued to contribute to endogenous uncertainty in the equity partner relationship.[5]

Power Distance and Learning Inside versus Outside the Firm

As noted, Kogut and Zander (1992) point to the important differences in learning efficiency across governance modes. They argue that it is more efficient to transfer complex knowledge within the boundaries of a firm because learning processes are a function of shared values and assumptions. If national culture embodies social knowledge and organizing principles, it

therefore bears upon the expected efficiency of learning subsequent to partner buyout. Firms from certain cultures may learn more efficiently when internalized, while the marginal rate of learning in hierarchy may be lower for firms from other cultures. Hall (1976) argued that cultures vary greatly in the processing of information and patterns of communication.

One cultural attribute that should influence the rate of learning in hierarchies relative to collaborations is power distance (PD). Power Distance is defined as "the extent to which members of a society accept that power in institutions and organizations is distributed unequally" (Hofstede, 1985: 348-349). As applied to organizations, control, decision making, and authority are likely to be highly centralized (Hofstede, 1980). Acquiring firms from cultures characterized as high PD operate most comfortably in hierarchy. In such countries, we expect the marginal rate of learning or technology transfer to be highest in hierarchy. Indeed, Hofstede (1991) discusses the implications of culture in an important learning context—in schools. In high PD cultures, such as Japan, learning is structured and hierarchical. By contrast, learning is loose and more unstructured in low PD cultures.

One might expect that firms from high PD cultures will move directly to outright acquisition, and avoid the first stage equity collaboration. Consistent with this expectation, Shane (1993) found that the higher the PD, the greater the likelihood of hierarchical control in transactions. More recently, Erramilli (1996) found that firms from countries with higher PD are more likely to seek majority ownership in foreign subsidiaries.

In the absence of endogenous uncertainty, firms from high PD cultures will acquire outright. However, in the presence of endogenous uncertainty, they will invest incrementally, beginning with the first stage equity collaboration. Several cultural attributes influence endogenous uncertainty.

Uncertainty Avoidance, Cultural Distance, and Endogenous Uncertainty

The study of national culture on governance modes has predominantly focused on transaction cost explanations, where the cultural attributes or partner differences in national culture are expected to moderate the ability of managers to perceive the potential for opportunistic behavior by partners (Harrigan, 1985). As noted earlier, these transaction costs were found to be a key determinant for dissolution of equity partnerships and joint ventures and have been carefully articulated in the literature. Building on previous research, we argue that *uncertainty avoidance* (UA) and *cultural distance* (CD) are two important contributors to endogenous uncertainty.

Uncertainty avoidance (UA) is defined as the "degree to which the members of a society feel uncomfortable with uncertainty and ambiguity, which leads them to support beliefs promising certainty and to maintain institutions protecting conformity" (Hofstede, 1985: 348-349). In an organizational context, having high levels of UA leads managers to make less risky decisions and develop coping mechanisms to control uncertainty, such as developing complex systems of rules and regulations and following structured, ritual behavior (Hofstede, 1980).

Uncertainty avoidance was shown to be an important predictor of foreign market entry modes. For instance, Kogut and Singh (1988) found that multinational corporations from cultures high in UA are more likely to choose joint ventures or greenfield entry modes over full acquisitions. These authors attribute this result to the fact that the uncertainty associated with integrating the management teams of both subsidiary and parent firms is untenable. Therefore, these firms are more comfortable with either a greenfield investment or establishing an equity partnership with the host county target. Shane (1993) found that firms from high UA societies favor licensing over acquisition-type entry modes.

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Given their proclivity toward risk avoidance, it is not surprising that firms from high UA cultures prefer staged investment to outright commitment. At the same time, we expect firms from high UA cultures to benefit from a transition toward hierarchy because of the added structure in place to control opportunistic behavior. When firms are from cultures that are also high in power distance, we expect there is added incentive to internalize the target firm in order to learn about growth opportunities more efficiently. Our proposition that high PD, high UA cultures are quicker to internalize appears consistent with arguments made by Hurry et al. (1992) and Chang (1995), who asserted that Japanese firms, relative to U.S. firms, were more likely to eventually acquire target firms. By contrast, U.S. firms are more likely to sell their equity positions in target firms following the target firm's initial public offering. Indeed, according to Hofstede (1980), the Japanese are ranked significantly higher on both PD and UA compared to the United States.

Hypothesis 1: When established firms are from cultures ranked high in uncertainty avoidance and high in power distance, partner buyouts are more likely.

In the passage above, we argued that established firms from cultures with higher power distance learn more efficiently from their partners, and that the marginal incentive to acquire their partners is highest when the relationship is confronted with endogenous uncertainty. While uncertainty avoidance is one dimension that accentuates endogenous uncertainty, cultural distance (CD) between the partners may also influence the amount of endogenous uncertainty. Cultural distance is defined as the degree to which the home country culture of an investing firm is dissimilar from that of the host country market and firms operating therein. When there is more cultural distance between partners, the ability to effectively observe and predict opportunism among partners is hindered (Kogut, 1988), leading to higher potential transaction

costs. Here, transaction costs represent communication and control costs embodied in cultural differences.

A large body of work has focused on initial governance choice and found cultural differences lead firms to shy away from hierarchy (Kogut and Singh, 1988; Gatignon and Anderson, 1988; Shane 1993). Other researchers have attended to the role of cultural distance on the stability of existing partnerships, finding that it contributes to a higher rate of partnership dissolution (Harrigan, 1985; Barkema, Bell, & Pennings, 1996; Barkema, Shenkar, Vermeulen, & Bell, 1997; Park and Ungson, 1997). More relevant to our study, Olie (1994) and Elsass and Veiga (1994) argued that the blending of diverse cultures tends to be a challenging obstacle to successful mergers. Indeed, cultural differences between firms was found to predict stress, negative attitudes toward merger, and the lack of cooperation between firms subsequent to merger (Weber, Shenkar, & Raveh, 1996).

These findings suggest that for existing partnerships, cultural differences raise the degree of endogenous uncertainty facing partnerships, and the endogenous uncertainty facing prospects for successful mergers of the firms. The successful transfer of knowledge among culturally distant partners is an indeterminate process. This view is captured clearly by Luostarinen, who defined cultural distance as "the sum of factors creating, on the one hand, a need for knowledge, and on the other hand, barriers to the knowledge flow and hence also for flows between the home and the target countries" (1980: 131-132).

Consistent with Hypothesis 1, we argue that when endogenous uncertainty is combined with more efficient learning in hierarchy (i.e, high PD), partner buyouts should ensue. As a result, when partners are culturally distant and the investing firm is from a culture that is high in power

distance, we expect there to be added incentive to internalize the target firm in order to learn about growth opportunities more efficiently.

Hypothesis 2: When partners are more culturally distant and the established firm is ranked high in power distance, partner buyouts are more likely.

RESEARCH DESIGN

Sample

We drew a sample of minority equity collaborations and joint ventures involving dedicated biotechnology firms (DBFs) from the *North Carolina Biotechnology Center (NCBC) Actions Database*. This database includes detailed information regarding over 4,000 relationships and transactions among firms in the biotechnology industry since 1978. In particular, the NCBC database includes the following transaction characteristics: a) whether the transaction involved an exchange of equity via a minority investment or a joint venture, b) the transaction date, c) the identity and number of partners involved, d) the type of partners involved (i.e., DBF, established firm, government, or university), e) each party's home country, f) the technological subfield, and g) a general description of each transaction. All transactions were cross-validated with a similar database, *Bioscan*. In the event that the transaction dates differed across sources, we used the earlier of the two dates.

In studying the NCBC Actions database and comparing with Bioscan we collected information on 618 equity collaborations. This original sample was reduced for three theoretical reasons. First, our compiled data were restricted to transactions involving only two parties, a target DBF domiciled in the United States and established firms having core businesses outside of biotechnology. We believe it is easier to identify the integrated manufacturer as the holder of

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the call option to acquire, a belief consistent with Hurry et al. (1992). This is particularly

reasonable in cases where established firms take a minority equity stake in a DBF. These cases

constitute 83.8 percent of our final sample. Determining who holds the call option is more

challenging in joint ventures, where both parties contribute capital and knowledge to a jointly

owned and controlled entity.[6] We control for likelihood that joint ventures may be bought out by

the DBF by including a joint venture dummy variable and by modeling joint venture buyouts by

the DBF firm as a competing event.

Second, we restricted our sample to include only four broad subfields: a) therapeutics, b)

diagnostics, c) agriculture (ag/bio), and d) supplier/specialty chemical. These subfields account

for a large majority of all firms dedicated to biotechnology (Dibner, 1992). This focus on the

largest subfields was necessary because of our need to have a critical mass of public firms to

generate stock market indices for each subfield for our measure of exogenous uncertainty.

Finally, we focus on equity collaborations with DBFs domiciled in the United States. This

enabled us to better control for exogenous events specific to country boundaries. Given these

constraints on our database we identified 248 equity collaborations initiated between 1978 and

1995. Of these, we were unable to obtain the precise starting dates of 30 transactions, despite

supplementing our search using Lexis/Nexus and SEC Schedule 13D filings.

We made considerable effort to verify the outcome of each partnership. If the December

1995 issue of *Bioscan* listed the equity partnership as ongoing, the transaction was coded as

right-censored. Otherwise, a systematic search was undertaken to understand the nature of the

transaction termination. NCBC and *Bioscan* data were supplemented with a search of Ernst &

Young Biotechnology Industry Reports, Predicast's F&S Index of Corporate Change,

Lexis/Nexis, and SEC Schedule 13D filings. From this effort we were able to verify the timing and outcome of 173 equity partnerships constituting our final sample.

Of the 173 transactions in our final sample, 23 were terminated by partner buyout by established firms, 39 were dissolved, 21 were terminated by other means (6 joint ventures were acquired by the DBF partner, 5 joint ventures were acquired by third parties, 10 DBFs were acquired by a third party), and 90 were right censored; that is, they were still in effect at the end of 1995.[7] Table 1 provides a breakdown of the number of established firms from each country that have initiated equity collaborations with U.S. biotechnology firms. Here, we also list the outcome of these equity collaborations for each country. While equity investments are most prominently undertaken by firms in a few countries, there seems to be a clear difference in the outcomes of these collaborations. U.S firms have a high percentage of partnership dissolutions and third-party buyouts. Japanese firms and those from the United Kingdom have a significant proportion of partnerships maintained, as do firms from Switzerland, Germany, and Sweden. While these trends show clear differences in country propensities regarding equity collaboration outcomes, it is unclear whether these patterns are statistically robust when controlling for cultural factors, firm-specific factors, and those relating to the value and exogenous uncertainty regarding the technology. Furthermore, Table 1 does not consider the timing of the outcome event. For example, while it is clear that a greater percentage of Japanese firms maintained their equity stake than do U.S. firms, it does not help us understand whether Japanese firms maintained their equity relationships longer than U.S. firms.

Insert Table 1 about here

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Model and Method

We selected a competing-risk, discrete-time event history analysis to test our hypotheses. Event history models are especially appropriate for analyzing longitudinal data when the dependent variable is a discrete event and the timing of the event's occurrence is of particular interest. Competing risk is a special form of event history analysis that is used when the dependent variable has two or more outcomes and the occurrence of any one outcome removes the subject from the risk of the other outcome(s). Buyouts are one of several ways in which a partnership may be terminated. Other forms of termination include (a) dissolution of the partnership, (b) acquisition of a biotechnology firm or joint venture by a third party, and (c) acquisition of a joint venture by the biotechnology partner (rather than acquisition by the established firm). Although we do not develop explicit hypotheses regarding these other forms of termination, they do represent relevant "competing hazards" in that they preclude subsequent occurrences of partner buyouts. To model the competing hazards, the hazard rate function is defined as

$$(1) \quad h_j(t) = \lim_{s \to 0} P_j(t, t + s)/s$$

where $h(t)$ is the hazard function associated with either partner buyout ($j=1$), partnership dissolution ($j=2$), or other termination ($j=3$). $P_j(t, t+s)$ is the probability that event type j occurs in the interval between t and $t+s$, given that the partnership is at risk at time t.

Cox's (1975) partial likelihood method for parameter estimation allows us to incorporate time dependence into the model, without specifying its form. The general form for the Cox proportional hazards models estimated in this study is:

$$(2) \quad \log h_j(t) = a_j(t) + \beta_j X(t) + \lambda_j Y$$

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where $a_j(t)$ may be any function of time, $X(t)$ and Y are vectors of time dependent and time invariant explanatory variables, and β_j and λ_j are vectors of estimable parameters. We used TDA version 5.7 to simultaneously estimate the competing hazards model (Rohwer, 1994) with Cox's partial likelihood method. We do not provide estimates for the baseline hazard function, $a_j(t)$, since partial likelihood estimation discards this function.[8]

The three events – buyout, dissolution, and other termination – were updated monthly. The sample includes 9,843 monthly periods. The cultural variables were not time varying, but many control variables were updated monthly.

Culture Variables

Hypothesis 1 is tested by multiplying Hofstede's (1980) well-known measures of *uncertainty avoidance* and *power distance* to each country in our sample. Hypothesis 2 also suggests a multiplicative function involving power distance and cultural distance. Our test considers two alternative measures of cultural distance. First, following Kogut and Singh (1988), we measured *Hofstede's cultural distance* (HCD) as a composite index based on the each of the four cultural dimensions identified by Hofstede (1980).

We also used a second measure of cultural distance is generated from a study by Ronen and Shenkar (1985), who synthesized country clusters into nine groupings of countries with similar work-related attitudes and values. The "Anglo" cluster involves Australia, Canada, Ireland, New Zealand, South Africa, United Kingdom, and United States. All other countries in the study were grouped into the other eight clusters. Using this data, we constructed a measure of cultural distance such that when the established firm fell in the Anglo cluster, *Ronen's cultural distance* (RSCD) was coded "0", otherwise it was coded "1".

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Control Variables

Clearly, cultural factors may not dominate partner buyout decisions. We argued earlier that *exogenous* forces partially dictate how uncertain future payoffs are and whether a buyout option is in-the-money. Other forces specific to the industry, the investing firm, and partner relationship may also bear upon the buyout decision. In this section, we describe our attempts to control for the factors found to be important by previous researchers.

Kogut (1991) argued that exogenous forces determine whether a buyout option is in-the-money. He argued that when industry sales deviated positively from industry forecasts, joint venture partners would seek to acquire the joint venture. His annual measures, shipment growth and deviation from expected growth, are meant to capture the *certainty* to which joint ventures operating in an industry have appreciated in value. Our measures of exogenous variables are in the same spirit, but are measured differently. Whereas Kogut's study spanned several industries and uses annual measures, ours concentrates only on biotechnology, and we consequently focus on measuring exogenous forces within technological subfields on a monthly basis. Sales measures are unreasonable in this industry because most firms have no revenues from sales. Like Folta (1998), we measure subfield value and subfield (exogenous) uncertainty using stock market indices generated from publicly traded firm in concentrating in particular biotechnology subfields. These measures were constructed from stock prices that were gathered from the Center for Research in Security Prices data base, and are described briefly below, but in more detail in Folta (1998).

Differences in the expected value of growth opportunities across the four subfields (Therapeutic, Diagnostic, Ag/Bio, and Supplier / Specialty Chemical) with four stock indices that were created from weekly returns of nine U.S. biotechnology firms specializing in the respective

subfields. The *subfield value* of firm j was measured as the value of the monthly biotechnology index for subfield m (when $j \in m$). These indices are weighted equally. Weekly values of the indices were then averaged within each month to get monthly index values for each of the four subfields. Subfield value was transformed by taking its natural logarithm to correct for positive skewness.

Exogenous uncertainty was measured as the 26-week standard deviation of the log of weekly returns for each of the four biotechnology subfield indices. The 26-week measure was chosen because it provides enough history to produce a reliable measure of volatility, without assuming constant variance over a longer period of time. Exogenous uncertainty was converted to a monthly measure by averaging the weekly standard deviations within any given month.

Substantial literature has confirmed the importance of industry structure on the choice of governance mode.[*] We use average subfield R&D expenditures divided by average total expenses to control for such effects. Conventionally, the relationship of R&D expense is said to encourage integrative modes, such as acquisition, in order to provide adequate administrative control for coping with higher degrees of human and dedicated capital specific to a transaction. Using this logic, we might expect a positive relationship between R&D expense and partner buyout.

Park and Ungson (1997) did not control for exogenous forces, but did find that a series of dummy variables related to the partnership influenced the buyout decision. They found that partners with the same SIC code were less likely to acquire their partners, partners having a prior relationship were more likely to end in acquisition, partnerships involving technology transfer were less likely to end in acquisition, and partnerships involving multiple products were more likely to end in acquisition. We test for some of these same effects, but not all. By definition,

our sample includes partners from different SIC codes and partnerships involving technology transfer.

Park and Ungson (1997) have highlighted the important moderating role that prior relationships have on the effect of cultural differences on partnership dissolution. While they did not test for whether this same effect holds for partner buyouts, it may be reasonable to expect prior relationships to moderate either the degree of endogenous uncertainty or the relative rate of learning in collaboration versus hierarchy. We did not include prior relationships in our formal presentation because to the extent that cultural dimensions influence the choice of prior relationships with the partner, including a measure of prior transactions in the model would confound our ability to interpret the results. In runs not reported, we did, include a dummy measure for prior relationships, consistent with the measure employed by Park and Ungson, but found no significant relationship in any of our models. Surprisingly, only 7.0 percent of the partnerships had a prior relationship, a number significantly below Park and Ungson's 26.0 percent in the electronics industry. Apparently, it is more common to initiate a relationship with equity transactions in the biotechnology industry.

Target firms having more commercial partners may not be attractive buyout candidates because commercial opportunities to exploit their technology may be siphoned off by others. To approximate the declining marginal threat of preemptive bidding or acquisition by each additional partner, we used the natural logarithm of the target firm's number of current commercial alliances. The *number of partners* was taken during the year of the event. In the event of right-censored cases, the measure was taken in the last year of the observation window. Bioscan provided this information.

If the transaction was a *joint venture* an indicator variable was classified as a "1", and "0" if it was a minority equity investment. Joint ventures are thought to provide a real option that is more proprietary than is the case for minority investments.

Insert Table 2 about here

RESULTS

Table 2 provides descriptive statistics and correlations for the variables. Because of concerns of multicollinearity between Uncertainty Avoidance and the Cultural Distance variables, as well as the small number of events, we opted to present three full models relating to our hypotheses.

Table 3 presents the full (columns 2, 4, 6) and reduced (columns 1, 3, 5) models with the parameter estimates for the hazard of partner buyout. To ascertain the degree of model fit, likelihood ratio tests were performed on the incremental and full models. Each test produced a chi-square statistic well above the critical value ($p < 0.001$), indicating that the overall fit is good. The hypotheses for the individual interaction coefficients are tested under one-tail t-tests. In each of the full models, the hypothesized interaction is positive and significant. These findings are consistent with our expectations.

Insert Table 3 about here

In model 2, the positive coefficient on the interaction ($p < 0.05$) between Uncertainty Avoidance and Power Distance is consistent with the expectations offered in hypothesis 1. It suggests that established firms from cultures higher in UA and PD should be more likely to buy out their partners.

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In models 4 and 6, both the positive coefficient on the interaction ($p < 0.10$) between Hofstede's Cultural Distance and Power Distance as well as the positive coefficient on the interaction ($p < 0.01$) between Ronen's Cultural Distance and Power Distance are consistent with the expectations offered in hypothesis 2. It suggests that when partners that are more culturally distant and established investors are higher in Power Distance there is an increased likelihood of partner buyout.

Since the remaining variables in the models have no hypotheses related to them, we use a two-tailed test to assess the significance of relationships. The only variable that demonstrated a significant effect was Target Firm's Number of Partners. As was expected, it was negatively related to the likelihood of partner buyout. This variable should approximate how proprietary the buyout option is. The more partners a target partner has, the less proprietary is the option. The variables relating to exogenous uncertainty, subfield value, and subfield R&D expense were not significant. Neither was the indicator variable distinguishing joint ventures from minority investments.

Table 3 also includes the competing hazard results for partnership dissolution in columns 7-10. These results indicate that Uncertainty Avoidance and Ronen's Cultural Distance is negatively related to the likelihood of dissolution. The latter result is consistent with those found by Park and Ungson (1997) in studying the electronics industry. They did not examine the effect of Uncertainty Avoidance. Furthermore, in comparison with the findings for the partner acquisition models, these findings demonstrate that national culture attributes influence partner dissolution differently.[10]

Consistent with previous studies, we focused mainly on aggregate measures of cultural distance. However, Hofstede (1980) suggests that partner differences for power distance,

uncertainty avoidance, masculinity, and individuality may represent important areas of conflict among partners. In addition, recent research suggests that absolute measures of cultural "distance" may obfuscate directional differences among individual cultural attributes (O'Grady & Lane, 1996). As a result, we also tested measures of cultural distance that are specific to individual attributes. These variables are calculated the same way as illustrated in equation 3, however, they only apply to a single attribute.

Insert Table 4 about here

Table 4 reports the parameter estimates for cultural distance measures that are specific to Hofstede's individual attributes of national culture.[11] We provide only the full models including the interaction. In model 1, the positive coefficient for the interaction between Power Distance and Cultural Distance/Partner Differences in Power Distance is consistent with hypothesis 2.

Also consistent with Hypothesis 2 is the positive coefficient for the interaction between Power Distance and Cultural Distance/Partner Differences in Uncertainty Avoidance. The interactions in models 3 and 4 involving differences in Individuality and Masculinity, respectively, were not significant. These findings support our *a priori* expectation focus on Uncertainty Avoidance and Power Distance, and also support the arguments by Hofstede that these two dimensions of national culture have the greatest bearing on organizational phenomena.

Given that partner differences in Uncertainty Avoidance and Power Distance seem to be the two dimensions of national culture which best explain organizational phenomenon, we created a cultural difference measure incorporating both of those dimensions. The model is illustrated in column 5 of Table 4. The positive and significant interaction (p < 0.05) is consistent with expectations for hypothesis 2.

DISCUSSION

The role of national culture on governance choice has been frequently studied. However, these studies have largely focused on the initial governance decision or partnership termination, giving little attention specifically to partner buyouts. This oversight is consequential, given the high incidence of acquisition of joint venture and equity partners. By explicitly considering the role of national culture on partner buyouts, we extend a growing body of literature that examines the incremental nature of investments in joint ventures and partner firms in knowledge-intensive industries. Although we are the not the first to characterize equity collaborations are compound options, our study is the first to attempt to theoretically explain the role of national culture on partner buyout. Partner buyout represents the exercise of the first stage option, while future discretionary investments represent the exercise of the second stage option. Real option theory suggests that firms should choose to invest incrementally in the face of endogenous uncertainty. It also suggests that firms will be more likely to commit to the next stage when they can learn more by committing, thereby reducing endogenous uncertainty.

We have built upon option theory to suggest that partner buyouts will be influenced by three factors: exogenous variables, endogenous uncertainty, and the rate of learning inside versus outside the firm. Our central argument is that attributes of national culture bears upon these latter two factors. Specifically, we argue that both uncertainty avoidance and cultural distance increases endogenous uncertainty. This is likely due to the inability to perceive the potential for opportunistic behavior by partners, or information asymmetry between partners. As a result of such uncertainty, established firms will shy away from aggressive commitment to growth opportunities, they will invest incrementally. Firms from cultures that are high in power distance are expected to transition to hierarchical governance because it is in hierarchies that they operate

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and learn most efficiently about growth opportunities. Thus, it is the combination of high endogenous uncertainty and the ability (or prospects) to learn more efficiently after internalizing the partner that leads to partner buyout.

Our empirical findings are consistent with the expectations noted above. Uncertainty avoidance and cultural distance are argued to contribute to endogenous uncertainty, while power distance is argued to impact the relative rate of learning in hierarchy relative to collaborations. Established firms from high UA home country cultures are more likely to buy out partners when they are also high in PD. Partners that are culturally distant are more likely to buy out partners when they are also high in PD. These findings suggest that it is the combination of endogenous uncertainty and efficient learning at the next stage that promote commitment via partner buyout. They are robust to different measures of cultural distance emanating from work by Hofstede (1980) and Ronen and Shenkar (1985). Distance measures using Hofstede's dimensions of Uncertainty Avoidance and Power Distance seem to mostly explain endogenous uncertainty.

Upon examination of country values for UA, Japan is among the world's most uncertainty avoidant cultures (about 1.5 standard deviations above the mean; see Hofstede, 1980: 315). According to our research findings, Japanese firms might be expected to exhibit high levels of anxiety with respect to both endogenous uncertainty and exogenous uncertainty. Therefore, Japanese firms will place greater intrinsic and extrinsic value on maintaining the equity collaboration. Indeed, our findings suggest that firms high in UA (including those from Japan) are less likely to acquire their collaboration partners and less likely to dissolve the partnership. These findings support those of Hurry et al. (1992) and Chang (1995) who found that Japanese firms were more likely than U.S. firms to retain their holdings in international joint ventures.

A Framework for Understanding Intentions of Foreign Partners

Using Hofstede's dimensions of Uncertainty Avoidance and Power Distance there is potential to create a broad framework by which future studies can examine partner buyout decisions in particular, and sequential investment more generally. In Table 5 we located countries based on only two measures: Uncertainty Avoidance and Power Distance. Since these measures are specific to the established firm, and not the relationship between partners, we can develop a general framework of tendencies toward partner buyout. Since firms domiciled in France and Japan are high in both Uncertainty Avoidance and Power Distance, we expect them to be most likely to buy out their partners. The second most likely group to buy out partners consists of firms high in Uncertainty Avoidance and medium in Power Distance: Germany, Italy, and Switzerland. Finally, firms from countries that are medium in both PD and UA (Australia, Canada, the United Kingdom, or the United States) may also demonstrate a notion for partner buyouts, although to a lesser extent. Established firms from other countries are less likely to exhibit a tendency to buy out their partners either because there is low power distance or low uncertainty avoidance.

Insert Table 5 about here

Of course, cultural distance is not depicted in Table 5. According to our theoretical expectations, even established firms from uncertainty avoidance cultures may display a tendency to buy out partners if they are culturally distant. The expectations presented in Table 5 can be altered to reflect cultural distance. For example, France and Japan are especially likely candidates for buyouts of U.S. partners because they are high on all three cultural attributes: Power Distance, Uncertainty Avoidance, and Cultural Distance. The framework can be extended

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to partnerships not involving United States target firms. For example, the tendency for Japanese firms to acquire Japanese partners may be muted somewhat because of a lack of cultural distance. At the same time, because of high cultural distance, firms from Australia, Canada, the United Kingdom, and the United States may demonstrate an increased tendency for acquiring Japanese partners. We believe that these propositions are very deserving of more attention in samples involving multiple industries and entry into multiple countries.

We should note several limitations of this study. Although our sampling methodology was comprehensive for nearly the entire life of the biotechnology industry, the number of partner buyout events is small. Nevertheless, we managed to attain statistical significance for our key variables and stability across a number of models containing firm-level and/or industry-level control variables. A larger sample would allow disaggregation of joint ventures and minority equity partnerships. Our study focused on a single industry, and sub-segments within that industry. While these segments are distinct from one another, future research should attempt to verify the expected relationships in other industries, including both R&D intensive and more stable industries.

Parkhe (1991) suggests that formal training programs can enhance cultural understanding and may moderate the relationship between cultural variables and the duration of global alliances. These integrating mechanisms may have an important influence on the relative rate of learning in joint ventures versus acquisition, and hence, may play a role in the buyout decision. Unfortunately, since we lacked data on the extent of cross-cultural training programs, we could not examine this issue. However, we believe that our theoretical framework offers an interesting new opportunity to ascertain how integrating mechanisms may influence the relatively unexplored phenomena of partner buyouts.

Previous research has demonstrated that companies use collaborations when partnering with culturally distant partners. Thus, our sample of equity collaborations may reflect some restricted range of cultural distance. Indeed, means scores of cultural distance varied significantly when we examined a broader sample of transactions involving both equity collaborations (0.64) and outright acquisitions (.036). Thus, our study, and any study examining the effect of national culture on partner buyout will suffer from such a bias. This will tend to weaken the results for cultural distance. We have demonstrated, however, that even though we have sampled culturally distant partners, power distance acts to moderate the partner buyout decision.

Overall, our study suggests that cultural attributes of the investing firm and cultural differences between the investing and target firms play a significant role in predicting the rate at which partner buyouts occur. It suggests that firms find value in flexibility in the presence of endogenous uncertainty, and are quicker to exercise when buyout enhances the potential rate of learning. The hypotheses developed here and the results we found offer some promising new directions for future empirical research.

ENDNOTES

[1] Other evidence of partner buyouts include Kogut (1989), who found that 24.0 percent of joint ventures were acquired by a partner within seven years, and Mikkelson and Ruback (1985), who discovered that 13.6 percent of firms having initiated minority investments either acquired or attempted to acquire their partner within three years of taking an initial equity stake.

[2] We are not without precedent in defining the scope of this research to encompass both joint ventures and minority investments (e.g., Hennart, 1991; Pisano, 1989).

[3] For Williamson (1985), the ownership advantage of the firm results from its superior mechanisms for coping with opportunism.

[4] Although Hofstede is largely famous for his 1980 IBM national culture study, he and his colleagues later found several links between national culture and organizational culture (Hofstede, 1991; Hofstede, Neuijen, Ohayv, & Sanders, 1990). In particular, the organizational culture dimensions of *need for authority* and *need for security* correlated strongly with *power distance* and *uncertainty avoidance*, respectively. Therefore, we restrict our analysis to only power distance and uncertainty avoidance – cultural dimensions that capture both national and organizational traits.

[5] We are grateful to a reviewer who emphasized that cultural distance and uncertainty avoidance are not equated to endogenous uncertainty. Indeed, they are merely constructs that contribute to endogenous uncertainty. As pointed out on pages 6-7, endogenous uncertainty may be represented by many factors.

[6] Either partner may *hold* the option to acquire the joint venture. Who is most likely to *exercise* the option in the case of joint ventures turns not only on the strategic intentions of the partners, but the relative competitive strengths of the partners--the partner possessing unique complementary resources being the more likely to acquire the weaker partner's stake (Hurry, 1993). Integrated firms investing in biotechnology have downstream skills in marketing and distribution, and regulatory savvy (Arora & Gambardella, 1990). Although dedicated biotechnology firms (DBFs) have important R&D capabilities, they frequently lack the cash needed to invest in acquisitions. Furthermore, most integrated manufacturers of pharmaceuticals, chemicals, and agriculture have a major goal of acquiring technical knowledge in biotechnology, while only a handful of DBF's aspire to become fully integrated (Office of Technology Assessment, 1991). In our sample we found that six joint ventures were acquired by the integrated partner and six joint ventures that were acquired by the DBF. Our focus on the established firm as the holder also rests on our theoretical interest in understanding when firms are more likely to commit to internalizing technical knowledge to capitalize on emerging technologies, and not downstream skills.

[7] Although the rate of acquisition (6.9 percent) by year three appears somewhat below rates found in studies noted on page 3, to make our rate comparable we must also include acquisitions by the DBF partner and allow for a three year window for the event to take place. In making that adjustment we find that 10.0 percent of the total sample (14.8 percent of joint ventures and 8.9 percent of minority investments) was terminated by acquisition by one of the partners within 36

months. This, then, is consistent with previous studies.

[8] The Cox method uses only information about the relative order of duration times, instead of the exact timing of events. Hence, the Cox method involves some loss of information, potentially inhibiting model estimation. This same feature makes the Cox model an attractive one when one has no prior expectations about time dependence. Another reason to question the validity of the Cox partial likelihood model for our data is that our number of events is relatively few. Although partial likelihood models are asymptotically efficient when the sample size is large (Efron, 1977), when the sample size is small, the precision of the partial likelihood estimates can be much less than that for maximum likelihood estimates (Coleman, 1981). We estimated a second model using maximum likelihood. Maximum likelihood methods require specification of a baseline hazard function. We chose the exponential specification because it is the parametric equivalent to the Cox method. The results from that estimation produced a pattern of relations identical to those found via the Cox estimation, with slightly less significance. This supplemental analysis provided evidence for the robustness of the results reported in this paper.

[9] We also examined the effect of industry structure using **number of rivals** active in each of the 123 product areas for each year throughout the publication of Bioscan (1987-1995). We did not include this variable in the formal presentation because it had no substantive impact on the model, and there was substantial colinearity with other variables in the model (R&D Expense and Subfield Value).

[10] We also examined whether dissolution was influenced by an interaction between cultural distance and power distance, and uncertainty avoidance and power distance. Log likelihood ratio tests indicated no such interaction existed.

[11] Weber, Shenkar, and Raveh (1996) also used distance measures for Hofstede's individual culture attributes, but focused on the impact on mergers and acquisition, not partner buyouts.

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Table 1: Cultural Measures and Outcomes of Equity Collaborations by Country of Corporate Headquarters

Country	Cultural Measures				Outcomes of Equity Collaborations Actual (Percent)					
	UA	PD	Hofstede's Cult. Distance	Ronen's Cultural Category	Partner Buyout	Partnership Dissolution	3rd Party Buyout	Partnerships Maintained	Total	# of Establish-ed Firms
Australia	51	36	0.026	Anglo	1 (100%)	0 (0%)	0 (0%)	0 (0%)	1	1
Canada	48	39	0.138	Anglo	0 (0%)	1 (50%	1 (50%)	0 (0%)	2	1
Denmark	23	18	1.745	Nordic	1 (50%)	1 (50%)	0 (0%)	0 (0%)	2	2
France	86	68	1.617	Latin Europe	2 (40%)	0 (0%)	0 (0%)	3 (60%)	5	2
Germany	65	35	0.630	Germanic	0 (0%)	0 (0%)	2 (28.6%)	5 (71.4%)	7	2
Ireland	35	28	0.530	Anglo	1 (50%)	1 (50%)	0 (0%)	0 (0%)	2	1
Italy	75	50	0.650	Latin Europe	1 (50.0%)	0 (0%)	0 (0%)	1 (50.0%)	2	2
Japan	92	54	3.104	Far East	3 (13.6%)	3 (13.6%)	1 (4.6%)	15 (68.2%)	22	17
Norway	50	31	1.667	Nordic	0 (0%)	1 (100%)	0 (0%)	0 (0%)	1	1
Sweden	29	31	1.859	Nordic	1 (12.5%)	2 (25.0%)	1 (12.5%)	4 (50.0%)	8	4
Switzerland	58	34	0.528	Germanic	3 (17.7%)	1 (5.8%)	3 (17.2%)	10 (58.8%)	17	3
United Kingdom	35	35	0.083	Anglo	0 (0%)	1 (7.1%)	0 (0%)	13 (92.9%)	14	3
United States	46	40	0.000	Anglo	10 (11.1%)	28 (31.1%)	13 (14.5%)	39 (43.3%)	90	34
Total					23 (13%)	39 (23%)	21 (12%)	90 (52%)	173	73

Table 2: Descriptive Statistics and Correlation Matrix[a]

	Mean	S.D	1	2	3	4	5	6	7	8	9	10	11
1. Uncertainty Avoidance	53.143	18.157											
2. Hofstede's Cultural Distance	0.632	1.078	0.786 *										
3. Ronen's Cultural Distance	0.343	0.475	0.653 *	0.795 *									
4. Power Distance	40.804	8.141	0.823 *	0.572 *	0.268 *								
5. UA * PD	2290.158	1283.659	0.964 *	0.794 *	0.573 *	0.918 *							
6. Hofstede's CD * PD	30.817	57.567	0.869 *	0.977 *	0.728 *	0.711 *	0.893 *						
7. Ronen's CD * PD	15.023	22.129	0.835 *	0.879 *	0.940 *	0.568 *	0.807 *	0.876 *					
8. Exogenous Uncertainty	0.3191	0.103	-0.035 *	-0.006	-0.004	-0.027 *	-0.029 *	-0.014	-0.013				
9. Subfield Value	5.736	1.095	0.050 *	0.050 *	0.099 *	0.026 *	0.052 *	0.056 *	0.106 *	0.098 *			
10. Subfield R&D Expense	41.423	11.846	0.135 *	0.188 *	0.201 *	0.052 *	0.133 *	0.186 *	0.205 *	0.107 *	0.328 *		
11. Target's # of Partners	3.118	1.625	-0.030 *	-0.177 *	-0.040 *	-0.128 *	-0.112 *	-0.173 *	-0.086 *	-0.003	-0.021 *	-0.076 *	
12. Joint Venture	0.170	0.375	0.067 *	0.035 *	0.072 *	0.053 *	0.058 *	0.039 *	0.073 *	-0.035 *	-0.109 *	-0.084 *	0.164 *

* Pearson correlations are significant at $p < 0.05$.

[a] Correlations are calculated using pooled cross-sectional and time-series data covering 173 equity partnerships and 9,843 one-month periods.

Table 3: Partial Likelihood Estimates for Hazard of Partner Buyout and Partnership Dissolution

Variable Name	Partnership Acquisition						Partnership Dissolution			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(0)
Uncertainty Avoidance	-0.0278 (0.0197)[a]	-0.0338 (0.0356)					-0.0179† (0.0102)			
Hofstede's Cultural Distance			0.1899 (0.2100)	-0.7904 (0.6699)				-0.2919 (0.1823)		
Ronen's Cultural Distance					0.6992 (0.4355)	-2.7992* (1.5773)			-0.8394* (0.4066)	
Power Distance	-0.0660 (0.0420)	-0.0996* (0.0392)	-0.0262 (0.0246)	-0.0510* (0.0254)	-0.0215 (0.0210)	-0.0902** (0.0306)				-0.0315 (0.0195
UA * PD		0.0012*♦ (0.0006)								
Hofstede's CD * PD				0.0219†♦ (0.0136)						
Ronen's CD * PD						0.0903**♦ (0.0388)				
Exogenous Uncertainty	-2.0209 (2.2834)	-1.8379 (2.2631)	-2.3513 (2.2945)	-1.8959 (2.3054)	-2.3481 (2.2896)	-1.8051 (2.2970)	2.6796† (1.5885)	3.1736 (1.6273)	3.2658* (1.6409)	2.5622 (1.5882)
Subfield Value	-0.0581 (0.1951)	-0.0775 (0.2020)	-0.0612 (0.1962)	-0.0666) (0.1976)	-0.0736 (0.1954)	-0.1045 (0.1988)	0.1934 (0.1637)	0.2007 (0.1631)	0.2183 (0.1638)	0.2045 (0.1634)
Subfield R&D Expense	-0.0131 (0.0165)	-0.0217 (0.0174)	-0.0143 (0.0170)	-0.0175 (0.0172)	-0.0154 (0.0168)	-0.0220 (0.0174)	0.0148 (0.0164)	0.0140 (0.0162)	0.0151 (0.0164)	0.0124 (0.0162)
Target Firm's # of Partners	-0.4819** (0.1627)	-0.3797* (0.1678)	-0.4524** (0.1659)	-0.4213** (0.1632)	-0.4567** (0.1637)	-0.3884* (0.1622)	-0.4584*** (0.1291)	-0.4982*** (0.1303)	-0.4851*** (0.1310)	-0.4775*** (0.1289)
Joint Venture	0.6862 (0.5065)	0.6543 (0.5057)	0.6032 (0.5020)	0.6359 (0.5008)	0.6449 (0.4986)	0.6671 (0.4954)	0.1343 (0.4955)	0.0792 (0.4911)	0.0966 (0.4917)	0.1550 (0.4976)
Log-likelihood Ratio	-326.70***	-324.72***	-326.98***	-325.86***	-325.14***	-322.93***	327.52***	328.21***	327.20***	328.52***

[a] Standard error in parentheses

† $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

♦ One-tailed t-test for hypothesized relations

Table 4: Partial Likelihood Estimates for Hazard of Partner Buyout

Variable Name	(1)	(2)	(3)	(4)	(5)
Cultural Distance – Partner Differences in PD	-0.4271 (0.6234)*				
Cultural Distance – Partner Differences in UA		-1.3022 (0.7499)			
Cultural Distance – Partner Differences in Individuality			-0.1099 (0.8065)		
Cultural Distance – Partner Differences in Masculinity				-0.5841 (0.5007)	
Cultural Distance – Partner Differences in (PD + UA)					-0.4084 (0.3592)
Power Distance	-0.0594 (0.0251)	-0.0531 * (0.0252)	-0.0323 (0.0305)	-0.0404 (0.0263)	-0.0647 * (0.0269)
Differences in PD * PD	0.0201 **♦ (0.0116)				
Differences in UA * PD		0.0295 **♦ (0.0137)			
Differences in Individuality * PD			0.0042 ♦ (0.0157)		
Differences in Masculinity * PD				0.0183 ♦ (0.0145)	
Differences in (PD + UA) * PD					0.0127 **♦ (0.0064)
Exogenous Uncertainty	-1.9168 (2.2621)	-1.6697 (2.2915)	-2.2012 (2.2884)	-2.0129 (2.3173)	-1.7917 (2.2811)
Subfield Value	-0.1443 (0.2066)	-0.0984 (0.2014)	-0.0560 (0.1964)	-0.0664) (0.1960)	-0.1110 (0.2019)
Subfield R&D Expense	-0.0195 (0.0173)	-0.0204 (0.0174)	-0.0140 (0.0169)	-0.0143 (0.0170)	-0.0212 (0.0175)
Target Firm's # of Partners	-0.3839 * (0.1659)	-0.3882 * (0.1635)	-0.4597 ** (0.1659)	-0.4460 ** (0.1641)	-0.3734 * (0.1652)
Joint Venture	0.5012 (0.5013)	0.5850 (0.5028)	0.6206 (0.5059)	0.6045 (0.5009)	0.5825 (0.4993)
Log-likelihood Ratio	-323.94 ***	-324.71 ***	-327.43 ***	-326.88 ***	-324.14 ***

* Standard error in parentheses

† $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

♦ One-tailed t-test for hypothesized relations

Table 5: Countries in Sample Located by Power Distance and Uncertainty Avoidance*

	High Power Distance	Medium Power Distance	Low Power Distance
High Uncertainty Avoidance	France Japan	Germany Italy Switzerland	
Medium Uncertainty Avoidance		Australia Canada United Kingdom United States	Ireland Norway
Low Uncertainty Avoidance			Denmark Sweden

* The darker the background the more likely firms from these countries are to buy out their partners.

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