Selection in Strategic Alliance Activity: Effects on Firm Performance in the Computing Industry

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An analysis of the impact of alliance activity during the period 1989–1993 on the performance of organizations in the US computing industry reveals that: (1) the distribution of alliance activity is skewed to firms with greater market power, capacity, as well as greater technical, commercial, social and organizational capital; (2) self-selection is significant in explaining the effects of alliance activity on firm performance; and, (3) controlling for self-selection alliances creates value for the firms choosing them but they do so at a lower rate of return than do the firms' core activities alone. We establish that without such controls, the effects of alliance activity are greatly underestimated.
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Strategic alliances among organizations have grown dramatically during the past two decades (Harrigan, 1986; Gomes-Casseres, 1996; Vanhaverbeke and Noorderhaven, 2002; Larrson *et al.*, 2003). For example, the number of public alliance announcements in the US grew from 100 in 1984 to more than 3,000 in 1994. There are many explanations for such growth, most of which relate to the benefits stemming from the firms' ability to utilize alliance activity to access complementary assets in a flexible, focused, and fast manner. In fact, prior studies have found strong correlations between the amount of alliance activity and firm performance measures, such as innovation (e.g. Kelly and Rice, 2002).

As strategic alliances among organizations have multiplied, a substantial body of research on strategically important inter-organizational ties has developed. Researchers have been exploring a broad range of questions through a variety of sociological, organizational, and economic perspectives. Much of that research focuses on the implications of strategic alliances on the performance of firms engaging in such relationships (e.g. Gulati *et al.*, 2000; Kale *et al.*, 2002). The results are mainly positive: alliance activity benefits the partners (e.g. McConnell and Nantell, 1985; Koh and Venkatraman, 1991; Mohanram and Nanda, 1996; Park and Kim, 1997; Das *et al.*, 1998; Kale *et al.*, 2002). Yet, this observation brings into question the absence of near unanimous participation in strategic alliances among firms. Ahuja (2000) provides one possible explanation: not all firms have the same opportunities and abilities to develop alliances. This paper adds to this explanation by suggesting that not all firms have the same incentives – benefits and costs – to do so.

The theoretical basis by which firm heterogeneity can lead to differentiated performance is the focus of the resource-based view of the firm (e.g. Penrose, 1959; Wernerfelt, 1984; Barney, 1986, 1989, 1991, 2001; Amit and Schoemaker, 1993; Teece *et al.*, 1997). Most often, the heterogeneity of firms is directly related to their

performance. However, the path–dependency concept (Dierickx and Cool, 1989) may also explain how heterogeneity leads to differentiated performance. In this paper, we explore how heterogeneity may lead to the decision to engage in alliance activity. Subsequently, we examine how that decision – in and of itself – affects firm performance. To address the latter question, we need to separate the decision's effect on a firm's performance from characteristics that affect both its decision and its performance. We can then address the theoretical issue of what drives a firm's performance – characteristics such as resources, strategic decisions, or both.

In this paper we consider the performance differences between firms that select alliance activity and those that do not. We do so by distinguishing between the decision to engage in alliance activity and the effect of alliance activity on firm performance, using a self-selection model. We then estimate how alliance activity affects firm performance, contingent on the choice to engage in such activity.

No previous study has controlled for self-selection in examining the performance implications of alliance activity. In fact, most of the research that documents the positive benefit of alliances is based on samples of firms that are engaged in alliance activity. For example, event-studies of the effects of alliance announcements on partner stock prices are by design biased in terms of self-selection; the sample only includes firms that had an alliance announcement. Although an event study may in fact show that an alliance created value in isolation from other explanations, it does not prove that similar firms could not have achieved comparable performance levels without an alliance. Hence, by considering firms that did not engage in alliance activity alongside firms that did engage in such activity, we enhance and refine the examination of the impact alliance formation has had on alliance partner performance.

Our research focuses on an industry with a significant amount of alliance activity – the computing industry between 1989 and 1993. We found many firms that chose to engage in alliance activity as well as many that did not. We then focused on two performance outcomes – market value and accounting returns – in order to provide a more comprehensive picture of both immediate and expected future returns from alliance activity. Because we wanted to examine how alliances affect firm performance rather than the factors that make a given alliance perform better, we concentrated on independent variables that were firm- and context-specific, rather than alliance-specific.

The results of our analysis bear out the supposition that self-selection is important for understanding the effect of an alliance on a firm's performance. Alliance activity has significant effects on firm performance when controlled for self-selection. We

establish that alliances create value for the organizations choosing them, but they do so at a lower rate of return than those organizations' core activities. Without controlling for self-selection, however, we found that alliances do not significantly affect performance.

In the Theory section below, we construct testable hypotheses. This is followed by descriptions of the data used to test the hypotheses, the empirical methods used, and the results. We end the paper with a discussion of our findings and their limitations.

Theory Development

Alliances and Self-Selection

Consistent with earlier definitions of strategic alliances (e.g. Yoshino and Rangan, 1995), we define a strategic alliance as ''an alliance in which independent organizations share the benefits of partnership and participate continuously in one or more key strategic areas such as technology or marketing.'' Thus, an alliance can take the form of a non-traditional contract (e.g. joint R&D, manufacturing, marketing, or shared distribution), or it can be an equity arrangement (e.g. minority investment or joint venture). Both technology alliances and marketing alliances span key strategic areas in the computing industry. Firms do well in this industry either because they have the most innovative product or because their product is commercialized more effectively.

The issue of self-selection is important because firms make strategic decisions – such as engaging in an alliance – not randomly but based on needs, opportunities, and incentives. When researchers compare alternative strategic choices without taking self-selection into account, they implicitly assume that organizations randomly choose strategies. If this assumption does not hold and if researchers cannot incorporate the complete set of performance-affecting factors into models that compare strategic choices, then empirical findings supporting a particular decision's effects may be biased (Masten, 1993; Shaver, 1998). For example, when only high-performing firms choose to enter into alliances, such activity alone may be a misleading indicator of performance if selection is not controlled. Alliance activity will appear to explain firm performance instead of the true cause – the underlying firm and industry characteristics that produced both the decision to initiate a strategic alliance and the level of firm performance that would have occurred without the alliance. Thus, in order to assess the performance effects of the strategic choice to engage in alliance activity, we must understand the role self-selection plays.

The approach we have chosen to account for the role of self-selection has several advantages. First, it allows the investigation of two related questions:

''Which firms select alliances?'' and ''What effect does alliance activity have on performance, while controlling for the type of firms that select it?'' If the focus is on the latter question, as it is in this paper, then our method of controlling for self-selection also addresses some potential data ambiguity problems by filtering out possible biases in the data.

How Firm Capital Influences Incentives and Opportunities to Ally

The choice of alliance activity is a function a firm's range of opportunities to ally (Ahuja, 2000) and its net incentives to ally. Opportunities and incentives are a function of the characteristics of the firm in its context (e.g. industry). We define firm capital as this relevant set of context-dependent firm characteristics.

Firm Capital

Ahuja (2000) describes three forms of firm capital that influence opportunities for firms considering alliance activity – social, technical, and commercial. Resources that are valuable, rare, inimitable, and not able to be substituted (Barney, 1991; Peteraf, 1993) are likely to enhance firm performance. Social capital is based on a firm's past inter-firm relationships. Technical capital is based on its innovative capabilities. Commercial capital is based on the firm's stock of complementary assets (Teece, 1986) for successfully bringing a product to market. Each form of capital is important in the context of the computing industries. For example, social capital attracts partners seeking legitimacy and trustworthy relationships in a volatile industry with significant entry barriers. Technical capital attracts partners seeking to learn innovative techniques and seeking to market innovative products in an industry where innovation supports premium pricing. Commercial capital attracts partners who want to get their products to the market in an industry where windows of opportunity are short and first-mover advantages can be significant.

To these three forms of capital that affect a firm's decision to engage in alliances, we add three more – market power, capacity, and organizational capital. Market power is based on the firm's market share, its bargaining power in the value-chain, and its ability to affect market prices. Capacity is based on the firm's available slack – its underutilized cash resources and its capabilities. Organizational capital is based on the firm's expertise in management, specifically in managing change, multi-party interactions (not necessarily multi-firm), learning processes, acquisition evaluations, and complexity. Each of these forms of capital is important in the context of the computing industries. For example, market power attracts partners seeking access to current industry standard-bearers and brands. This is amplified in an industry where network externalities can generate significant market power in the hands of a few firms (e.g. Microsoft, Intel, IBM). Capacity attracts partners seeking scale and cash in an industry where often there are early high fixed-cost investments that need to be recouped through product volume. Organizational capital attracts partners seeking effective and flexible project management in an industry that is complex, unpredictable, and full of untested firms.

Increasing the Opportunities for Alliance Activity

Opportunities for a firm to engage in alliance activities may be broadened by increasing the firm's own awareness of possible deals and partners and by making the firm appear a more attractive potential partner to other firms seeking fast, flexible access to particular capital resources. A firm may also conclude from looking at its own capital resources that pursuing an alliance may be in its own best interest. When exposed to an industry's technologies, as well as to the industry's players and their relationships, a firm can become aware of who can create value for it and how that value can be created (Cohen and Levinthal, 1990). Such exposure also provides a strong basis for more accurate evaluations of technologies, markets, resources, and potential acquisition targets.

Increasing the Incentives for Alliance Activity

The incentives for alliance activity are enhanced by increasing the expected rewards and by decreasing the costs of such activity. Dyer and Singh (1998) observe the benefits of inter-firm cooperation and point out that ''a firm's critical resources may extend beyond firm boundaries and may be a source of relational rents and competitive advantage, '' (pp. 660–661). Several event-type studies indicate significant alliance-related benefits where alliance announcements have generated cumulative excess returns for the firms involved (e.g. McConnell and Nantell, 1985; Koh and Venkatraman, 1991; Mohanram and Nanda, 1996; Park and Kim, 1997; Das et al., 1998; Kale et al., 2002).

Specific benefits derived from alliance activity may include sharing of risks and costs (e.g. Hagedoorn, 1993; Bloch, 1995); accessing complementary resources (e.g. Baranson, 1990; Gilbert, 1991); accessing new markets (e.g. Gross and Neuman, 1989); offering clients a more complete product through one combined provider (e.g. Kulkosky, 1989); creating real options in uncertain markets and technologies (e.g. Bowman and Hurry, 1993; Chi, 2000); fostering innovation (e.g. Teece, 1992; Shan et al., 1994); enhancing partner learning (e.g. Kogut, 1988, 1989), creating legitimacy (e.g. Baum and Oliver, 1991, 1992); increasing the ability to collude (e.g. Dixon, 1962;

Mead, 1967); and, providing a means of performing due diligence on a potential acquisition target (e.g. Bleeke and Ernst, 1995; Hagedoorn and Sadowski, 1999).

Even when the costs of access to a resource or opportunity are similar across alternatives to alliance activity – such as through internal ventures, contracts on the spot market, or acquisitions – an alliance may still be the desired organizational choice when benefits unique to the alliance form exist. These benefits may include the creation of greater option value than that offered by an alternative such as contracting (which provides no such rights), and hierarchies (that imply the obligation to exercise the right. As well, alliances enable extensive learning about the technology of a partner in situations where that partner may not be acquired. Dyer and Singh (1998) use resource-based theory of the firm to support the proposition that some strategic assets (Amit and Schoemaker, 1993) are *only* generated in an alliance.

There are also potential costs to strategic alliances. Multiple economic hazards arise in alliance activity, and these may be costly. Examples of such potential costs include the effects of moral hazard (e.g. Ouchi, 1984); adverse selection (e.g. Barney and Ouchi, 1986); prisoners' dilemma (e.g. Parkhe *et al.*, 1993); rent misappropriation, including hold-up (e.g. Yan and Gray, 1994); resource misappropriation (Gulati *et al.*, 1994); and negative spillovers. Several studies have found lower rates of return in industries with relatively greater alliance activity than in industries with less alliance activity (e.g. Berg and Friedman, 1981; Duncan, 1982).

On the plus side, however, alliance activity can mitigate some transaction hazards. When alliances are used as options on uncertain technologies, costs are delayed and potentially saved when unfolding events disfavor the technology. As well, Mahoney's (2001) contention that some costs are *only* mitigated by certain governance forms can be applied here. There may be circumstances where alliances – through their flexibility, speed, and learning in resource access – reduce transaction costs (Williamson, 1975, 1979) in ways that other governance forms cannot.

Technical capital provides a basis for generating new value through innovation; it also provides the expertise to filter out potential partners that do not have the necessary technical assets and that might waste a firm's resources. Commercial capital provides a basis for the value created by getting a product to market sooner and more efficiently; it may also prevent costs due to possible strategic production hold-ups. Social capital provides a basis for valuable legitimization and for increased information flow among interested firms. It also mitigates many transaction hazards because of the added cost of damaged reputation and trust that privately exploiting such

hazards would then entail. For example, a firm may be less likely to hold its partner up or to misappropriate a partner's knowledge resources. If caught, it risks losing out on future opportunities because of subsequently reduced social status in the industry.

Market power provides a basis for privately valuable rent reallocation through manipulation of prices and through leverage against other value-chain members. It may also mitigate the possibility of costly partner behavior because with such power comes the implied threat of much more significant retaliation. Capacity provides a basis for value through increased resource utilization. It also raises the possibility of retaliatory dumping of supply when a partner in the same industry considers defecting from the alliance. Organizational capital provides a basis for value through more efficient management of a project, more effective learning from a partner and more accurate valuation of potential future acquisition targets; it may also mitigate potential hazards because these are more likely to be discovered, avoided, and preemptively addressed by seasoned managers.

Self-Selection into Alliance Activity

As suggested earlier, the greater the firm capital, the greater the opportunities and incentives for engaging in alliance activity. Yet, as we will show below, the type of firm capital matters as well. For example, if a firm has a substantial amount of technical capital, but little or no other firm capital (such as social capital, commercial capital, market power, or capacity), we suggest that it opt for an alliance in order to complement its own firm capital. Thus, relatively small but innovative firms are likely to choose alliance activity. More common, however, is the appeal of strategic alliances to larger firms with relatively greater levels of most forms of firm capital. They may conclude that alliances offer them opportunities and incentives to further leverage their firm capital. Hence, the first hypothesis follows.

H1. *The organizations most likely to self-select alliance activity will have greater incentives and opportunities to do so; they will hold greater firm capital – greater technical capital, commercial capital, social capital, market power, capacity, and organizational capital.*

We have suggested that alliance activity can be attractive in the context of the computing industry and that firms with greater capital are more likely to dominate such activity. We now explore the effects of alliances on firm performance, given self-selection. We focus on two standard types of measures of firm performance: accounting returns measures such as the return-on-assets ratio (ROA), and market measures such as market value.

By examining performance effects through both measures we can better appreciate the total impact of alliance activity. Furthermore, these two types of measures are commonly reported and widely understood. Accounting returns ratios provide a current measure of performance related to a historic basis for that return (e.g. an asset base or an equity base). Market value provides a future-looking measure of performance based on expected cash flows resulting from current strategic decisions and positioning. Together they produce a measure of a relative immediate impact and an expected future impact of a strategic decision.

Market Performance Effects of Alliance Activity Controlling for Self-Selection

As the market value of a firm reflects the expected stream of discounted future cash flows, we proceed to explore whether alliance activity results in increases in cash flow, reductions in the risk associated with future cash flows, or a beneficial combination of the two.

Market value benefits based on increased long-term net cash flow occur in three ways. The first way is through the creation of a new resource set based on the shared strategic assets of each firm in the alliance, where the combination produces new value or synergy. This is effectively the creation of new factors within the partners' value-chain of activities (Dyer-Singh's ''relational resources''). The second way is through leverage of existing resources. This can occur either through the improved utilization of one or more partners' resources or through the increased bargaining power and market power of the coalition. An example of the former is where one partner's products can gain access to a new market segment through another partner's distribution channels. An example of the latter is decreased supplier costs due to volume discounts provided to the coalition of partners. The third way alliances can enhance cash flow is more subtle: when one or both partners benefit by the information sharing and other spillovers that flow among partners. An example is the due diligence advantage that alliance activity may provide to one partner considering acquiring another (e.g. Bleeke and Ernst, 1995). Another example is unintended technology transfer that may occur from one partner to another. A further example is the legitimacy a more established partner effectively lends to a less-established partner (e.g. Baum and Oliver, 1991, 1992).

In all three of the ways to increase cash flow described above, none is obviously offset by increased risk. Moreover, alliance activity also has the potential to decrease risk. Increased market power and increased information flow are obvious ways alliances can reduce risk because they can buffer competitive volatility and reduce information asymmetries.

Building new resources and leveraging existing ones (i.e. diversifying firm activities) also decreases risk. Additionally, alliances can be an effective means of holding options on technologies, markets, or acquisitions. Most obviously, by sharing the costs of commitments with a partner, a firm can reduce its exposure to the risks of such commitments.

We have outlined how alliance activity can enhance market value by both increasing cash flow and decreasing risk. That said, it is difficult to estimate for any specific scenario what the net outcome of an alliance will be: risk reductions can be costly and opportunities for increased cash flows can be risky. We can, however, state two important conclusions. First, alliance activity has the potential to both increase cash flows and decrease risk without obvious offsetting detriments. Second, we expect that in general, the firms that select alliance activity do so in large part because they expect to experience an increase in their market value.

Firms, therefore, are more likely to engage in alliance activity when they foresee the potential for a combination of increased cash flow and decreased risk with an overall beneficial outcome. The second hypothesis follows.

H2. *Controlling for self-selection, the performance of organizations engaging in alliance activity (as measured by market value) improves, compared to organizations that do not engage in such activity.*

Accounting Performance Effects of Alliance Activity Controlling for Self-Selection

Measures of accounting returns increase any time a firm takes an action that results in a greater positive percentage change in the numerator – net income – than in the denominator – typically assets or equity. We note that increased market value implies only that expected increases in income will exceed the perceived incremental expenses and hence that future cash flows will be enhanced. In the case of alliances, however, the extra investments needed may involve obtaining large additional assets – assets that may be used for the life of the alliance, perhaps financed through a loan and then sold. This possibility would greatly affect accounting returns, such as the return-on-assets ratio (ROA), but not market value. Balance-sheet assets would increase for the life of the alliance, and immediate measures such as ROA would be negatively affected. Future-focused market measures would not be affected because they better account for the temporary nature of the expense and the specific assets held.

We hypothesize that alliance activities increase expected market value, but we cannot determine, in

general, whether accounting performance measures will present as optimistic a snapshot at every given point in time in the life of an alliance. We argue, nonetheless, that because alliance activity is selfselected, firms will more likely choose alliances that will benefit them – as seen as increases in both market value and accounting returns. This is because firms' decision makers are likely to consider the impact of a prospective alliance on accounting measures of performance since that measure is commonly used for evaluation and personal rewards. We also argue that firms likely choose alliances because this governance form provides access to resources (e.g. tangible assets, intangible assets, and capabilities) at a lower cost, with greater flexibility, and with greater appropriability than other forms. Thus, under an assumption of two firms pursuing a similar set of projects generating similar appropriable gross benefits, the firm that has more alliances would have a lower asset base than the non-allying firm because firms are sharing assets. As well, we may also expect to see an increase in the numerator of an accounting performance measure – net income – due to synergies created by bringing together the strategic assets of multiple firms even when the denominator is fixed. By considering these additional insights on how alliance activity will be selected – and the expected performance of allying firms relative to non-allying firms – we now assert that accounting returns ratio measures should present a picture similar to that of the market value measures. The final hypothesis follows.

H3. *Controlling for self-selection, the accounting-based return-on-assets and return-on-equity performance measures of organizations engaging in alliance activity will improve, compared to organizations that do not engage in such activity.*

Methods and Measures

Data

The sample we use to test our hypotheses consists of the full population of US firms in the areas of (1) computer programming, data processing, software, and systems, (2) computer equipment and peripherals and (3) computer semiconductors, circuit boards, and components (SICs 737, 357 and 367 respectively) in COMPUSTAT that had more than U$10,000 in revenues over the years 1989–1993. There were 1,047 firms recorded, 287 of which had at least one strategic alliance in research and development or marketing and distribution, as recorded in the ITSA database.[1] We coded announcements as strategic alliances rather than as standard contracts or acquisitions or other inter-firm contacts following ITSA's categorization, and we compared these determinations with the contents of the announcements themselves. The ITSA database consists of summaries of

selected US press releases from a wide range of relevant periodicals, such as the *Wall Street Journal*, *Financial Times*, and *Business Week*. All computing industry alliances publicly announced in the US between Jan. 1, 1981 and May 30, 1994 appear in the ITSA database.

There is a potential bias towards larger firms in databases such as ITSA, which are composed of media announcements. Such media are more likely to report on larger, more widely held firms than small ones. Additionally, larger firms are more likely to issue press releases to those media because of interest by their stakeholders. The first step of our self-selection methodology is designed to accommodate such biases in the database so that the main results, gleaned during the second stage of our analysis, will be unaffected.

Self-Selection Methodology

The model that corrects the self-selection effect follows Heckman (1979) and Greene (1981):

$$Y = \beta'X + \delta C + \varepsilon \tag{1}$$

$$C^* \Gamma'W + u \tag{2}$$

where:

$$C = 1 \text{ if } C^* > 0, \text{ and } C = 0 \text{ if } C^* \tag{3}$$

For our purposes, in equation (1) Y is a vector of firm performance measures, X is a matrix of explanatory and control variables influencing firm performance; C is a vector of *0–1* dummy variables for alliance activity, and ε is the error vector. In the selection process of equation (2), a matrix of explanatory variables, W, accounts for alliance activity, while u is the error vector.

Selection correction is necessary because of the ex-ante indeterminacy of whether <u>OLS</u> will over or underestimate δ. Ineffective firms may disproportionately choose alliances in order to compensate for their shortcomings and may thus give the appearance that alliance activity is detrimental to performance. Then again, effective firms may disproportionately choose alliances in order to leverage their factors; this gives the appearance that alliance activity is overly beneficial to performance since such firms would perform relatively well in either case.

Heckman's two-stage estimation method provides a way to control for self-selection. A standard maximum likelihood probit model estimates equation (2), after which OLS estimates equation (1). The variable that adjusts for the self-selection bias, **LAMBDA**, which is calculated from the probit model, is included in the regressors of equation (1). **LAMBDA** accounts for the correlation between $\square$ and u; it is the ratio of the standard normal density function

to the cumulative distribution function (see Greene, 1990). The heteroscedasticity introduced by using **LAMBDA** in equation (1) is adjusted for in its estimation through methods explained by Greene (1990, pp. 744–748).

There are two concerns when using this methodology. The first is an identification problem. To reduce this problem, we selected variables so that most of the explanatory variables differed between the first stage probit model and the second stage selection model (see Maddala, 1983). For example, in the yearly data, only the time dummy variables, the R&D intensity variable and the size control variable appeared in each stage; four additional variables appeared in the first stage, and 23 others (not including the alliance measures) appeared in the second stage. The second concern is sensitivity to alternative specifications. The consistency of the results between the averaged and the yearly models and the alternative performance measures of each reveals that this concern apparently is not problematic either.

Variable Definition and Operationalization

In the first stage of the self-selection methodology – the probit analysis – the main variables explain the choice to engage in alliance activity in general, including both firm and context-related factors. In the second stage of the self-selection methodology – the corrected regression – the variables control for reasons other than strategic alliance activity that firm performance would vary, again including both firm and contextual factors [see Table 1 for Variable Definitions and Explanations].

Note that in the five-year data, we control for regression-to-the-mean by including the average level of the item that is the basis for the implied yearly change that is the dependent measure (e.g. we use *Average Market Value 1989–1993* to control for regression-to-the-mean in a regression on the dependent variable *Implied Yearly Change in Market Value 1989–1993*). In the yearly data, we control for anchor effects and trend effects by including the average level of the item and the implied yearly change over the five-year period of the item, respectively, when regressing on the yearly level of the item (e.g. we use *Average Market Value 1989–1993* to control for anchor effects and *Implied Yearly Change in Market Value 1989–1993* to control for trend effects in a regression on the dependent variable *Market Value*). Table 2 summarizes the use of the variables and which direction of effect the three hypotheses predict.

Results

Several issues emerge from the analysis of the descriptive statistics and their graphical representa-tion. Fig. 1, following Table 2, depicts the extreme skew in the distribution of alliances in the population showing only the 287 firms with any alliance activity between 1989 and 1993. A handful of the full sample 1047 firms accounted for almost half of all alliance activity. For this reason, it is important to use the full population of firms; results from a sample from such a database could be misleading if it contained a few of these very active firms by chance.

The descriptive statistics (see Table 3) show relatively large variance around the means, as well as some significant missing data in some variables, such as R&D intensity measures. The mean accounting returns are disappointing, with negative values for ROA and ROE. These may be partially explained by the high mean R&D intensity and relatively small mean firm size – supporting the possibility that a significant proportion of the population is new and has to pay R&D entry costs that hurt accounting measures of performance in the short run. A simple *t*-test for differences in the means, assuming unequal variances, of the allying versus the non-allying firms yields some significant results. (see Table 4) The firms with alliance activity had significantly higher revenues, lower research intensity, higher market value, and more cash and capital expenditures, but the accounting measures revealed no statistically significant differences.

In the analyses that follow, two items are worth noting. First, the number of observations changes for each model specification due to missing data. (Some reduction in observations occurs because when the dependent is for changes, it is only available for the changes between 1989 and 1993 – four sets of changes – so the number of observations is proportionally reduced.) Second, multicollinearity is tested for in each performance model using variance inflation factors, and it is found to be well within limits.

The probit estimate shows significant and positive correlation of firm size (*Average Logarithm of Revenues 1989–1993*) and one slack measure (*Cash in 1988*) with alliance activity (*Indicator of Any Alliance Activity 1989–1993*) for the five-year data. For the yearly data, firm size (*Logarithm of Revenues*), and two slack measures (*Cash in Previous Year* and *Slack Measure in Previous Year*) show significant and positive correlation with alliance activity (*Indicator of Any Alliance Activity in Year*). These results (see the left columns of Tables 5 and 6) support **H1**, implying that capital-advantaged firms are positively related to the choice of alliance activity for the firm. In the yearly data, the control – *Computing Industries Sales Growth in Previous Year* – was also significant but negatively correlated with alliance activity.

The *Indicator of Any Alliance Activity 1989–1993* is significantly positively correlated with market value changes (*Year's Change in Market Value*) and levels (*Market Value*) yearly, and market value change over

Table 1 Variable Definition

Variable Name	Definition	Basis	Type
Indicator of Any Alliance Activity 1989–1993	The dependent dummy variable for the probit analysis of the five-year data.	Based on the alliance activity as indicated in the ITSA database.	Dependent in probit, Explanatory in self-selection.
Indicator of Any Alliance Activity in Year	The dependent dummy variable for the probit analysis of the yearly data.	Based on the alliance activity as indicated in the ITSA database.	Dependent in probit, Explanatory in self-selection.
LAMBDA (self-selection control)	The self-selection control variable resulting from the probit analysis of the alliance activity dummy variable; it only appears in the selection-corrected regression models.		Control
Implied Yearly Change in Market Value 1989–1993	Market value is in inflation – adjusted 1988 dollars. The implied yearly change over the five years is the slope of the line connecting the first year and last year points.	Note that all items that measure changes are based on non-missing data. Sourced from COMPUSTAT data on the firm during these years.	Dependent
Average Market Value 1989–1993	Market value is in inflation – adjusted 1988 dollars. Mean of non-missing 1989 to 1993 values inclusive.	Sourced from COMPUSTAT data on the firm during these years.	Dependent
Market Value	Market value is in inflation – adjusted 1988 dollars. The item is measured in the year of interest; where alliance activity is measured.	Sourced from COMPUSTAT data on the firm during these years.	Dependent
Year's Change in Market Value	Market value is in inflation – adjusted 1988 dollars. A year's change is the value of the current year less the value in the previous year (inflation-adjusted when necessary).	Note that all items that measure changes are based on non-missing data. Sourced from COMPUSTAT data on the firm during these years.	Dependent
Implied Yearly Change in Return on Assets 1989–1993	Assets are the sum of current assets, net property, plant and equipment and other non-current assets. Returns are income before extraordinary items. The implied yearly change over the five years is the slope of the line connecting the first year and last year points.	Note that all items that measure changes are based on non-missing data. Sourced from COMPUSTAT data on the firm during these years.	Dependent
Average Return on Assets 1989–1993	Assets are the sum of current assets, net property, plant and equipment and other non-current assets. Returns are income before extraordinary items. Mean of non-missing 1989 to 1993 values inclusive.	Sourced from COMPUSTAT data on the firm during these years.	Dependent
Return on Assets	Assets are the sum of current assets, net property, plant and equipment and other non-current assets. Returns are income before extraordinary items. The item is measured in the year of interest; where alliance activity is measured.	Sourced from COMPUSTAT data on the firm during these years.	Dependent
Year's Change in Return on Assets	Assets are the sum of current assets, net property, plant and equipment and other non-current assets. Returns are income before extraordinary items. A year's change is the value of the current year less the value in the previous year.	Note that all items that measure changes are based on non-missing data. Sourced from COMPUSTAT data on the firm during these years.	Dependent

Table 1   (continued)

Variable Name	Definition	Basis	Type
Implied Yearly Change in Return on Equity 1989–1993	Returns are income before extraordinary items. The implied yearly change over the five years is the slope of the line connecting the first year and last year points.	Note that all items that measure changes are based on non-missing data. Sourced from COMPUSTAT data on the firm during these years.	Dependent
Average Return on Equity 1989–1993	Returns are income before extraordinary items. Mean of non-missing 1989 to 1993 values inclusive.	Sourced from COMPUSTAT data on the firm during these years.	Dependent
Return on Equity	Returns are income before extraordinary items. The item is measured in the year of interest; where alliance activity is measured.	Sourced from COMPUSTAT data on the firm during these years.	Dependent
Year's Change in Return on Equity	Returns are income before extraordinary items. A year's change is the value of the current year less the value in the previous year.	Note that all items that measure changes are based on non-missing data. Sourced from COMPUSTAT data on the firm during these years.	Dependent
Slack Measure in 1988	This is one proxy for the firm's levels of opportunity and ability to engage in alliance activity; it is a measure of the firm's potential commercial capital and capacity. It measures how much room there is to make more efficient use of a number of primary value-chain activities by letting them be accessed by a partner. It is also a measure of the firm's incentive to ally, to make better use of its excess capacity. Measure taken in 1988.	A composite measure of slack following Reuer and Leiblein's (2000) calculation from three accounting ratios – accounts receivable, inventory, and selling & general administration expense items, all relative to sales; we normalize each ratio to the 3-digit SIC average and then sum them together for 1988. Sourced from COMPUSTAT.	Independent
Slack Measure in Previous Year	(see above for definition). Measure taken year prior to alliance activity recorded.	(see above for basis)	Independent
Cash in 1988	This is another proxy for the firm's level of ability, opportunity and incentive to engage in alliance activity; it can afford investment in a new venture and possibly even its acquisition in the future. Measure taken in 1988.	The firm's cash, in millions of 1988 dollars, indicated on the balance sheet. Sourced from COMPUSTAT.	Independent
Cash in Previous Year	(see above for definition). Measure taken year prior to alliance activity recorded.	(see above for basis)	Independent
Capital Expenditures in 1988	This is a proxy for the firm's level of opportunity, ability and incentive; it is a measure of the firm's commercial capital – its recent investment in new productive resources that can be exploited in an alliance. Measure taken in 1988.	The firm's reported capital expenditures in 1988 dollars in 1988. Sourced from COMPUSTAT.	Independent
Capital Expenditures in Previous Year	(see above for definition). Measure taken year prior to alliance activity recorded.	(see above for basis)	Independent

Table 1 **(continued)**

Variable Name	Definition	Basis	Type
Average Logarithm of Revenues 1989–1993	This is a proxy for the firm's market power. Revenue size also correlates with a firm's bargaining leverage in the supply chain and with its ability to influence market price. Controls for firm size (Buzzell and Gale, 1987).	The average of the firm's natural logarithm of revenues in millions of 1988 dollars, averaged over the five years 1989 to 1993. Sourced from COMPUSTAT.	Independent
Logarithm of Revenues	(see above for definition). Measure taken year that alliance activity recorded.	(see above for basis)	Independent
Average R&D Intensity 1989–1993	This is a proxy for the firm's technical capital – its ongoing commitment to research and development that can be leveraged by an alliance. Controls for firm R&D (Buzzell and Gale, 1987).	The average of the firm's R&D expenditure relative to its sales for each year, averaged over the five years 1989 to 1993. Sourced from COMPUSTAT.	Independent
R&D Intensity	(see above for definition). Measure taken year that alliance activity recorded.	(see above for basis)	Independent
Computing Industries Sales Growth in 1988	A control for the general attractiveness of related diversification opportunities that alliances may provide (e.g., Shaver, 1998). Measure taken in 1988.	Measures the percent growth of revenues between 1987 and 1988, inflation-adjusted, over the three SIC codes, 357, 367, 737, as indicated in COMPUSTAT.	Control
Computing Industries Sales Growth in Previous Year	(see above for definition). Measure taken year prior to alliance activity recorded.	(see above for basis)	Control
Sales Growth in 1988	A way to control for firm performance trends in the probit model without involving the dependent variable directly (e.g., Shaver, 1998). Measure taken in 1988.	Measures the percent growth of revenues between 1987 and 1988, inflation-adjusted for the firm, as indicated in COMPUSTAT.	Control
Sales Growth in Previous Year	(see above for definition). Measure taken year prior to alliance activity recorded.	(see above for basis)	Control
Dummy for each Year	Period effects control.	0–1 variable for each year, 5 in all.	Control
Dummy for each 4-digit SIC	Industry effects control.	0–1 variable for each recorded 4-digit SIC, 20 in all.	Control

Table 2 List of Variables and Predictions

VARIBLE	5 YEAR AVE	YEARLY	HYPOTHESIS	PREDICTION	NOTE
Indicator of Any Alliance Activity 1989–1993	X		2,3	+	*DepVar in first stage Probit
Indicator of Any Alliance Activity in Year		X	2,3	+	*DepVar in first stage Probit
LAMDA (self-selection control)			2,3	NP	
Implied Yearly Change in Market Value 1989–1993	X			DepVar	*also IndepVar in Yearly Analysis (NP)
Average Market Value 1989–1993	X	X		NP	
Market Value		X		DepVar	
Year's Change in Market Value		X		DepVar	
Implied Yearly Change in Return on Assets 1989–1993	X			DepVar	*also IndepVar in Yearly Analysis (NP)
Average Return on Assets 1989–1993	X	X		NP	
Return on Assets		X		DepVar	
Year's Change in Return on Assets		X		DepVar	
Implied Yearly Change in Return on Equity 1989–1993	X			DepVar	*also IndepVar in Yearly Analysis (NP)
Average Return on Equity 1989–1993	X	X		NP	
Return on Equity		X		DepVar	
Year's Change in Return on Equity		X		DepVar	
Computing Industries 1988 Sales Growth	X			NP	
Computing Industries Sales Growth in Previous Year		X		NP	
Slack Measure in 1988	X		1	+	
Slack Measure in Previous Year		X	1	+	
Cash in 1988	X		1	+	
Cash in Previous Year		X	1	+	
Capital Expenditures in 1988	X		1	+	
Capital Expenditures in Previous Year		X	1	+	
Average Logarithm of Revenues 1989–1993	X		1	+	
Logarithm of Revenues		X	1	+	
Average R&D Intensity 1989–1993	X		1	+	
R&D Intensity		X	1	+	
Sales Growth in 1988	X			NP	
Sales Growth in Previous Year		X		NP	
Dummy for each Year		X		NP	
Dummy for each 4-digit SIC	X	X		NP	

NP = no prediction

the full 5-year period (*Implied Yearly Change in Market Value 1989–1993*), *only* when self-selection is controlled for (see Tables 6 and 5, respectively). The results support **H2**. The **LAMBDA** variable is negatively and significantly correlated, implying that without control for self-selection the impact of alliance activity on market value would be underestimated. This implication is supported by the much smaller and non-significant effect of alliance activity

in the regular OLS regression where self-selection is not controlled.

Contributing to relatively lower 5-year period market value change is average firm size over that time (*Average Logarithm of Revenues 1989–1993*) and average market value (*Average Market Value 1989–1993*). Larger firms experienced worse performance. Note that without self-selection control, average firm size
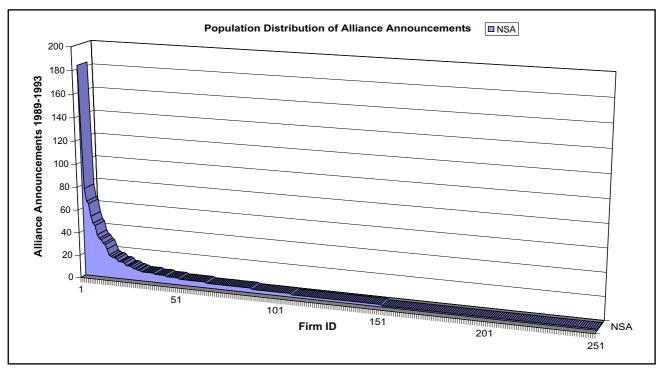
Figure 1 Distribution of R&D and Marketing & Distribution Type Alliance Announcements in the Population of Computing Industry Firms 1989–1993

contributes to relatively *higher* 5-year period market value change. (Also note that the industry dummy variables, not shown, together substitute for the constant term in this regression as well as all others in the second stage of the analysis.)

Contributing positively to the yearly market value changes is the firm's previous sales growth (*Sales Growth in Previous Year*); firm size (*Logarithm of Revenues*) contributes negatively. Consistent with the 5-year average analysis, larger firms fared worse and firms on a growth trend fared better. Contributing positively to yearly market levels is the 5-year average level (*Average Market Value 1989–1993*); the 5-year average change (*Implied Yearly Change in Market Value 1989–1993*) contributes negatively. Not surprisingly, yearly levels were positively correlated to average levels; regardless, higher yearly levels came to firms generally relatively in decline, which is a result that is consistent with regression-to-the-mean.

The alliance activity measure is significantly correlated with accounting returns measures as well. However, it is in the *opposite* direction from what was predicted. The alliance activity measure (*Indicator of Any Alliance Activity 1989–1993*) is significantly negatively correlated with ROA and ROE changes (*Implied Yearly Change in Return on Assets 1989–1993* and *Implied Yearly Change in Return on Equity 1989–1993*, respectively) over the 5-year period, after controlling for self-selection (see Table 5). In the yearly data, the *Indicator of Any Alliance Activity in Year* is significantly negatively correlated with yearly ROA changes and levels (*Year's Change in Return on Assets*

and *Return on Assets*, respectively), after controlling for self-selection (see Table 6). The results oppose **H3**, implying that firms reduce their immediate accounting returns when engaging in alliance activity. **LAMBDA** is positively and significantly correlated, implying that without the self-selection control, the impact of alliance activity on asset returns would be underestimated. The implication is supported in the regular OLS regressions that are not controlled for self-selection; they do not show significant alliance activity effects on performance.

Firm size (*Average Logarithm of Revenues 1989–1993*) and average accounting returns (*Average Return on Assets 1989–1993, Average Return on Equity 1989–1993*) contributed to relatively better 5-year average accounting returns changes (*Implied Yearly Change in Return on Assets 1989–1993, Implied Yearly Change in Return on Equity 1989–1993*, respectively). Larger firms with better performance experienced greater accounting performance increases. In the yearly data, *Logarithm of Revenues and Sales Growth in Previous Year* contributed to relatively better *Return on Assets and Year's Change in Return on Assets*. Larger firms with better growth performance experienced greater increases and levels of asset returns performance.

Consistent with the yearly market value performance levels, the 5-year average level of accounting returns contributed positively and the 5-year average change contributed negatively to yearly accounting returns performance levels. Yearly levels (*Return on Assets, Return on Equity*) were positively correlated with

Table 3 Descriptive Statistics

VARIABLE	MEAN	STDEV	MIN	MAX	N
5 YEAR–AVERAGED DATA					
Indicator of Any Alliance Activity 1989–1993	0.24	0.43	0.00	1.00	1047
Implied Yearly Change in Market Value 1989–1993	23.82	289.32	−5099.63	3008.46	723
Average Market Value 1989–1993	279.70	1689.19	0.16	41241.57	889
Implied Yearly Change in Return on Assets 1989–1993	−2.06	37.69	−483.44	595.63	886
Average Return on Assets 1989–1993	−38.59	628.93	−20210.00	240.34	1044
Implied Yearly Change in Return on Equity 1989–1993	−12.51	448.14	−11215.68	4456.04	886
Average Return on Eguity 1989–1993	−38.70	784.25	−20210.00	2745.00	1045
Computing Industries 1988 Sales Growth	5.13	2.26	3.46	8.69	1047
Slack Measure in 1988	0.00	1.88	−2.88	16.91	650
Cash in 1988	41.43	280.54	0.01	6123.00	628
Capital Expenditures in 1988	30.12	242.60	0.01	5390.00	612
Average Logarithm of Revenues 1989–1993	3.01	2.07	−4.56	10.95	1047
Average R&D Intensity 1989–1993	44.76	403.90	0.00	10939.06	878
Sales Growth in 1988	65.30	563.95	−89.74	8417.63	630
YEARLY DATA					
Indicator of Any Alliance Activity in Year	0.20	0.40	0.00	1.00	5235
Market Value	357.34	2136.03	0.10	59296.88	3085
Year's Change in Market Value	32.75	727.64	−20516.84	9325.34	2193
Average Market Value 1989–1993	279.70	1689.19	0.16	41241.57	4445
Return on Assets	−22.69	342.23	−20210.00	1241.11	3819
Year's Change in Return on Assets	−3.80	116.01	−2764.71	1800.00	2767
Average Return on Assets 1989–1993	−38.59	628.93	−20210.00	240.34	5220
Return on Equity	−27.75	1068.32	−56089.79	9088.24	3821
Year's Change in Return on Equity	−21.70	1228.62	−56049.50	10074.65	2765
Average Return on Equity 1989–1993	−38.70	784.25	−20210.00	2745.00	5225
Computing Industries Sales Growth in Previous Year	3.10	5.98	−4.44	22.63	5235
Slack Measure in Previous Year	0.00	1.91	−2.88	25.32	3556
Cash in Previous Year	39.07	228.27	0.01	6123.00	3463
Capital Expenditures in Previous Year	26.90	232.75	−0.07	6167.31	3380
Logarithm of Revenues	3.20	2.19	−7.04	11.06	3559
R&D Intensity	37.82	485.91	0.00	15848.95	2907
Sales Growth in Previous Year	65.38	1352.78	−99.76	72230.10	3381

Notes: descriptive statistics of time and industry dummy variables not shown

Table 4 t-Tests of Mean Differences (Assuming Unequal Variances) for Firms With and Without Alliance Activity

	No Alliance Activity		Some Alliance Activity		2-tailed t-test results
	MEAN	STDEV	MEAN	STDEV	
N (count)	810		287		
Average Revenues 1989–1993	76.41	318.86	888.24	4434.74	*P < .01*
Average Logarithm of Revenues 1989–1993	2.68	1.92	3.81	2.48	*P < .01*
Average R&D Intensity 1989–1993	52.45	455.88	16.92	24	*P < .05*
Average Sales Growth 1988–1992	84.97	702.27	47.8	230.27	NS
Average Slack Measure 1988–1992	0.05	1.67	0.03	1.79	NS
Average Cash 1988–1992	12.12	48.16	105.57	410.43	*P < .01*
Average Capital Expenditures 1988–1992	7.73	65.7	72.57	414.12	*P < .05*
Average Market Value 1989–1993	126.07	558.62	872.38	3502.62	*P < .01*
Average Return on Assets 1989–1993	−22.79	77.25	−92.7	1315.77	NS
Average Return on Equity 1989–1993	−31.05	527.15	−64.77	1330.29	NS

average levels (*Average Return on Assets 1989–1993, Average Return on Equity 1989–1993*, respectively), and negatively correlated with positive trends in the levels (*Implied Yearly Change in Return on Assets 1989–1993, Implied Yearly Change in Return on Equity 1989–1993*, respectively).

Table 5   Analysis of 5-Year-Average Data, where Probit is Basis for Selection Models Following Rightward

Empirical Analysis	Probit model coefficients	Selection model coefficients		OLS model coefficients	Selection model coefficients		OLS model coefficients	Selection model coefficients		OLS model coefficients
Dependent Variable	Indicator of Any Alliance Activity in 1989–1993	Implied Yearly Change in Market Value 1989–1993	Implied Yearly Change in Market Value 1989–1993	Implied Yearly Change in Market Value 1989–1993	Implied Yearly Change in Return on Assets 1989–1993	Implied Yearly Change in Return on Assets 1989–1993	Implied Yearly Change in Return on Assets 1989–1993	Implied Yearly Change in Return on Equity 1989–1993	Implied Yearly Change in Return on Equity 1989–1993	Implied Yearly Change in Return on Equity 1989–1993
Explanatory Variables										
Constant	−2.18a									
standard error	0.25									
Computing Industries										
Sales Growth in 1988	2.50E-02									
standard error	2.89E-0.2									
Slack Measure in 1988	−2.23E-0.2									
standard error	6.90E-0.2									
Cash in 1988	5.99E-0.3b									
standard error	2.52E-0.3									
Capital Expenditures										
in 1988	−8.01E-0.4									
standard error	1.75E-0.3									
Average R&D Intensity										
1983–1993	−3.74E-0.5	−0.38	1.24E-02	1.51E-02	−6.94E-02b	0.13	−1.82E-03	1.09cd	5.46E-03	6.24E-03
standard error	2.61E-0.4	0.47	3.79E-02	0.03	3.41E-02	2.56E-03	3.00E-03	0.71	2.61E-02	0.03
Average Logarithm of										
Revenues 1989–1993	0.34a	−64.17b	−46.13	27.02a	3.33b	−0.64	−1.45cd	18.07	27.30c	1.36
standard error	5.25E-02	25.52	24.32	7.71	1.59	1.58	0.93	33.22	15.16	7.86

Sales Growth in 1988		−0.95			1.08E-03				7.87E-03	
standard error		3.22E-02			1.96E-03				0.71	
Average Market Value										
1989–1993				−6.13E-02a	−5.37E-02a					
standard error				9.29E-03	0.01					
Average Return on										
Assets 1989–1993						0.28a	8.36E-02a			
standard error						2.78E-02	0.03			
Average Return on Equity										
1989–1993									0.85a	0.62a
standard error									2.12E-02	0.03
Indicator of Any Alliance										
Activity 1989–1993		620.53a	738.17a	43.03cd	−18.77cd	−18.71cd	2.64	−87.94	−229.79c	−14.95
standard error		203.10	199.94	30.52	13.49	13.02	3.74	282.20	131.06	35.19
LAMDA (self-selection control)		−352.68a	−418.92a			9.42	13.68c		94.93	126.99c
standard error		118.36	116.27			7.97	7.62		167.11	76.99
Industry Dummies		YES	YES	YES	YES	YES	YES	YES	YES	YES
log-like	−221.85									
chi-sq	162.2a									
adjR²		0.03	0.17	0.11	0.00	0.18	0.00	−0.04	0.77	0.41
F		1.61b	4.83a	4.02a	1.03NS	5.28a	0.92NS	0.99NS	65.67a	22.46a
n	514	439	442	620	472	480	752	471	479	752

Notes: a, b, c indicate significance at the 0.01, 0.05 and 0.10 levels respectively

d indicates 1-tail test, 2-tail otherwise results of the 20 industry dummies not shown, but available upon request

Table 6 Analysis of Yearly Data, where Probit is Basis for Selection Models Following Rightward

Empirical Analysis	Probit model coefficients	Selection model coefficients		OLS model coefficients	Selection model coefficients		OLS model coefficients	Selection model coefficients		OLS model coefficients
Dependent Variable	Indicator of Any Alliance Activity in year	Implied Yearly Change in Market Value 1989–1993	Market value	Market Value	Implied Yearly Change on Return on Assets 1989–1993	Return on Assets	Return on Assets	Implied Yearly Change on Return on Equity 1989–1993	Return on Equity	Return on Equity
Explanatory Variables										
Computing Industries Sales Growth in Previous Year	−2.59E-02a									
standard error	6.01E-03									
Slack Measure in Previous Year	7.18E-02a									
standard error	1.97E-02									
Cash in Previous Year	2.10E-03a									
standard error	5.02E-04									
Capital Expenditure in Previous Year	−8.70E-04									
standard error	7.05E-04									
R&D Intensity	−5.42E-05	6.92E-04	−5.94E-04	3.35E-03	2.67E-04	−1.84E-04	−2.28E-04	0.01	1.79E-04	2.07E-03
standard error	1.50E-04	0.03	3.54E-02	0.03	2.47E-03	1.63E-03	2.00E-03	0.03	1.69E-02	0.02
Logarithm of Revenues	0.23a	−29.05cd	−17.05	9.42a	2.94b	4.88a	3.52a	11.58	−0.94	2.19
standard error	2.13E-02	20.96	19.92	11.43	1.29	0.88	0.68	13.80	8.19	4.46
Sales Growth in Previous Year		0.90b	8.35E-03	−1.49E-04	1.84E-01a	0.58c	5.81E-04	8.66E-02	5.16E-03	7.13E-04
standard error		3.69E-01	9.06E-02	0.01	2.01E-02	3.12E-03	1.00E-03	0.03	3.36E-02	0.01
Average Market Value 1989–1993			9.88E-01a	9.96E-01a						
standard error			1.08E-02	0.01						

Average Return on Assets 1989–1993						0.79a	7.52E-01a			
standard error						2.25E-02	0.02			
Average Return or Equity 1989–1993									0.39a	0.39a
standard error									2.76E-02	0.03
Implied Yearly Change in Market Value 1989–1993		−3.22E-02a	−5.28E-03							
standard error		5.77E-02	0.06							
Implied Yearly Change in Return on Assets 1989–1993						−0.10a	1.81E-01a			
standard error						3.60E-02	0.04			
Implied Yearly Change in Return on Equity 1989–1993									−0.26a	−0.25a
standard error									2.88E-02	0.03
Indicator of Any Alliance Activity in Year		563.65a	439.97c	8.19	−22.65cd	−34.11a	−2.91	−143.34	22.45	−2.47
standard error		230.07	250.08	50.01	15.87	9.75	3.19	169.36	99.49	23.25
LAMBDA (self-selection control)		−261.04a	−251.22c		13.34cd	19.45a		81.32	−14.88	
standard error		131.03	141.63		9.06	5.55		96.67	56.83	
Time Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry Dummies		YES	YES	YES	YES	YES	YES	YES	YES	YES
log-like	−1042.09									
chi-sq	383.98a									
adjR²		0.01	0.88	0.89	0.03	0.50	0.46	−0.01	0.08	0.08
F		1.7b	536.10a	572.54a	3.67a	82.24a	72.77a	0.21NS	7.79a	8.22a
N	2493	1696	2140	2206	2066	2444	2583	2066	2443	2582

Notes: **a, b, c** indicate significance at the 0.01, 0.05 and 0.10 levels respectively
d indicates 1-tail test, 2-tail otherwise results of the 20 industry dummies not shown, but available upon request

Discussion and Conclusions

An analysis of all active publicly traded firms in the computing industry from 1989 to 1993 reveals that firms with greater measures of firm capital are more likely to engage in alliance activity. In addition, after controlling for self-selection, we found that alliance activity is likely to have a significant impact on firm performance as measured by the market value of the firm. We establish that a firm's performance is determined both by its strategic assets and by the strategic choices it makes when it allies itself with other firms.

Our empirical analysis contributes to the literature on the effect of strategic alliances on the value of individual firms. We analyze and control for self-selection, which is shown to be important in measuring the performance implications of alliance activity.

Four issues emerge from the analyses in this paper: (1) the significance of self-selection; (2) the apparent damping effect of firm size on performance, given its role in self-selection; (3) the negative impact of alliance activity on accounting returns when a positive impact was predicted; and (4) the limitations of the study.

The Significance of Self-Selection

Our empirical analysis highlights the need to control for self-selection when examining the effect of alliance activity on firm performance. Without such an adjustment, an OLS model would contain a specification error and likely lead to a significant underestimation of the impact of alliance activity. This observation is based on the comparison of the alliance dummy variable coefficient for the self-selection model with that coefficient in the standard OLS model. Alliances are not likely to benefit every firm, and depending on context, only certain firms will choose alliances. In the computing industry between 1989 and 1993, large firms with slack – the firms with greatest market power and capacity and with greatest technical, commercial, social, and organizational capital – dominated alliance activity. Controlling for such selection effects, firms that chose to partner generally experienced value creation but at return rates below the firms' average return rates.

Because of the importance of self selection it is worthwhile to examine not only what happened to firms that chose to engage in alliances, but also what would have happened to those that should have chosen to ally with others but did not. This latter issue can be considered by analyzing the effect of **LAMBDA** on firm performance. Consider alliances' effects on market value: It appears that the firms choosing alliance activity would have been worse off without such activity. This underscores the power of incentives where it comes to alliances; firms that

had more to gain through increased resource utilization, increased legitimacy, and opportunistic learning tended to choose alliance activity and to benefit from their choice. Several of the forms of firm capital measure these incentives. Slack, for instance, is not necessarily directly beneficial, yet it can attract partners and increase incentives to ally. Firms that generally under-perform because of their resource sets can use an alliance to enhance their resource utilization, thereby improving their performance.

The Damping Effect of Firm Size

In our analysis, firm size decreased the market-value performance measure and increased the accounting return ratio performance, but alliance activity had the opposite effect. Larger firms in alliances experienced better market value and worse accounting returns performance when compared to those that did not choose to ally - but to a lesser degree than smaller allying firms. Increasing firm size, in effect, damped the impact of alliance activity on performance measures. This finding is intuitively appealing given that firm size can dampen most impacts. Size implies greater diversity and slack, both of which tend to dissipate and absorb shocks.

The Negative Impact of Alliance Activity on Accounting Returns

The impact of alliance activity on accounting returns is opposite from that predicted; alliance activity had a negative and significant impact. There are several explanations for this result. One explanation is that cash flow patterns and factor holding patterns may negatively bias short-term performance measures. Alliance activity may resemble R&D investment in this manner: investments are made that reduce current accounting performance with the expectation that future benefits will more than compensate. An activity that has a simultaneously positive effect on cash flow – as implied by the increase in market value – and a negative effect on accounting return ratios may be one that diversifies a firm.

The Wernerfelt and Montgomery (1988) framework for determining returns from diversification entails viewing performance as a function of both a firm's factors and how the firm applies them. As a firm stretches to more distant applications, it gets lower value from factors specific to core activities. It then uses less firm specific factors, which have a relatively lower potential for creating value. Thus, while diversification creates value, it does so at a rate of return lower than that of a firm's core activities. Since market measures recognize any value creation that exceeds its accompanying risk, diversification that creates value appears as beneficial to firm performance. However, since accounting measures consider not only value creation but also what

investment underlies it, diversification activity that creates value at a lower rate of return than the core business appears as relatively detrimental to the firm. Large firms that appear to be pursuing alliance activity in our database are likely to have the ability to pursue any core business opportunity without aid. A large firm may be more likely to engage partners in order to pursue business opportunities outside its core activities – where the application is distant, and the firm applies less firm specific factors – which is, in effect, diversification.

We note that in the probit model of the yearly data, the variable *Computing Industries Sales Growth in Previous Year* was significant but negatively correlated with alliance activity. This implies that related diversification had a negative impact on the choice of alliance activity. Higher core-business returns reduced activity; that implies alliances are diversification (i.e. they are related more with non-core returns).

Limitations

Our analysis points to several important questions for future work. The generalizability of significant results is subject to a number of caveats. The industry we studied is not considered representative of the "old" economy. In addition, the time period of the analysis was marked by turbulent growth. It also is relatively short compared to the lifecycle of a typical industry. The measures used, meanwhile, are subject to financial market imperfections and accounting manipulations. Additionally, the database is likely biased toward the recording of larger firm activity. Nonetheless, it appears that alliance activity is self-selected and apparently entails future expected value creation but with early reduced accounting returns.

Our research could be used as the basis for future analysis of related topics, such as determining which characteristics of alliance activity drive certain results. For example, controls for alliance function type (e.g. R&D), partner characteristics (e.g. relative size), relationship characteristics (e.g. previous partner contact), or technology issues (e.g. scale of R&D projects) may provide additional insights. These lines of inquiry can further clarify how firms seek to realize more value from their factors given they self-select strategies to do so. Despite these limitations we believe that this study has contributed to the alliance literature by highlighting the role of self selection in evaluating the performance impact of alliances.

Note

1. The main sample is restricted to US firms for two reasons. The majority of firms traded on US exchanges are US firms in these SICs, and ITSA is biased towards more complete and accurate reporting of US firm activity given its sources are US publications. Additionally, it is more likely that US alliances will be more similar to each other than, for example, Japanese alliances, so for a study that considers general alliances, consistency is appreciated among the alliances. The main sample is also restricted to R&D and M&D alliances.

References

Ahuja, G. (2000) The duality of collaboration: inducements and opportunities in the formation of interfirm linkages. *Strategic Management Journal* **21**, 317–343.

Amit, R. and Schoemaker, P. (1993) Strategic assets and organizational rent. *Strategic Management Journal* **14**, 33–46.

Baranson, J. (1990) Transnational strategic alliances: why, what, where and how? *Multinational Business* **2**, 54–61.

Barney, J.B. (1986) Strategic factor markets: expectations, luck and business strategy. *Management Science* **32**, 1231–1241.

Barney, J.B. (1989) Asset stocks and sustained competitive advantage: a comment. *Management Science* **35**, 1511–1513.

Barney, J.B. (1991) Firm resources and sustained competitive advantage. *Journal of Management* **17**, 99–120.

Barney, J. (2001) Resource-based theories of competitive advantage: a ten-year retrospective on the resource-based view. *Journal of Management* **27**, 643–650.

Barney, J.B. and Ouchi, W.G. (1986) *Organizational Economics*. Josey-Bass, San Francisco.

Baum, J.A.C. and Oliver, C. (1991) Institutional linkages and organizational mortality. *Administrative Science Quarterly* **36**, 187–218.

Baum, J.A.C. and Oliver, C. (1992) Institutional embeddedness and the dynamics of organizational populations. *American Sociological Review* **57**, 540–559.

Berg, S.V. and Friedman, P. (1981) Impacts of domestic joint ventures on industrial rates of return: a pooled cross-section analysis, 1964–1975. *Review of Economics and Statistics* **63**, 293–298.

Bleeke, J. and Ernst, D. (1995) Is your strategic alliance really a sale? *Harvard Business Review* **73**(1), 97–103.

Bloch, F. (1995) Endogenous structures of association in oligopolies. *Rand Journal of Economics* **26**(3), 537–556.

Bowman, E. and Hurry, D. (1993) Strategy through the option lens: an integrated view of resource investments and the incremental-choice process. *Academy of Management Review* **18**(4), 760–782.

Buzzell, R.D. and Gale, B.T. (1987) *The PIMS Principles*. The Free Press, New York, NY.

Chi, T. (2000) Option to acquire or divest a joint venture. *Strategic Management Journal* **21**(6), 665–687.

Cohen, W.M. and Levinthal, D.A. (1990) Absorptive capacity: a new perspective on learning and innovation. *Administrative Science Quarterly* **35**, 128–152.

Das, S., Sen, P.K. and Sengupta, S. (1998) Impact of strategic alliances on firm valuation. *Academy of Management Journal* **41**(1), 27–41.

Dierickx, I. and Cool, K. (1989) Asset stock accumulation and sustainability of competitive advantage. *Management Science* **35**, 1504–1511.

Dixon, P.R. (1962) Joint ventures: what is their impact on competition?. *Antitrust Bulletin* **7**, 397–410.

Duncan, J.L., Jr. (1982) Impacts of new entry and horizontal joint ventures on industrial rates of return. *Review of Economics and Statistics* **64**, 339–342.

Dyer, J.H. and Singh, H. (1998) The relational view: cooperative strategy and sources of interorganizational competitive advantage. *Academy of Management Review* **23**(4), 660–679.

Gilbert, N. (1991) Strategic alliances spur small-business R&D. *Financier* **15**(6), 18–21.

Gomes-Casseres, B. (1996) *The Alliance Revolution; The New Shape of Business Rivalry*. Harvard University Press, Cambridge, MA.

Greene, W.E. (1981) Sample selection bias as a specification error: comment. *Econometrica* **49**, 795–798.

Greene, W.E. (1990) *Econometric Analysis*. MacMillan, New York, NY.

Gross, T. and Neuman, J. (1989) Strategic alliances vital in global marketing. *Marketing News* **23**(13), 1–2.

Gulati, R., Khanna, T. and Nohria, N. (1994) Unilateral commitments and the importance of process in alliances. *Sloan Management Review* **35**(3), 61–69.

Gulati, R., Nohria, N. and Zaheer, A. (2000) Strategic networks. *Strategic Management Journal* **21**, 203–215.

Hagedoorn, J. (1993) Understanding the rationale of strategic technology partnering: interorganizational modes of cooperation and sectoral differences. *Strategic Management Journal* **14**, 371–385.

Hagedoorn, J. and Sadowski, B. (1999) The transition from strategic technology alliances to mergers and acquisitions: an exploratory study. *The Journal of Management Studies* **36**(1), 87–107.

Harrigan, K.R. (1986) *Managing for Joint Ventures Success*. Lexington Books, Lexington, MA.

Heckman, J.J. (1979) Sample selection bias as a specification error. *Econometrica* **47**, 153–161.

Kale, P., Dyer, J. and Singh, H. (2002) Alliance capability, stock market response, and long term alliance success: the role of the alliance function. *Strategic Management Journal* **23**, 47–767.

Kelly, D. and Rice, M. (2002) Advantage beyond founding: the strategic use of technologies. *Journal of Business Venturing* **17**(1), 41–57.

Kogut, B. (1988) Joint ventures: theoretical and empirical perspectives. *Strategic Management Journal* **9**(4), 319–332.

Kogut, B. (1989) Why joint ventures die so quickly. *Chief Executive* **51**, 70–73.

Koh, J. and Venkatraman, N. (1991) Joint venture formations and stock market reactions: an assessment in the information technology sector. *Academy of Management Journal* **34**(4), 869–892.

Kulkosky, V. (1989) Strategic alliances buoy new technology boom. *Wall Street Computer Review* **6**(8), 18–24, 86.

Larrson, R., Brousseau, K.R., Driver, M.J. and Homqvist, M. (2003) International growth through cooperation: brand-driven strategies, leadership, and career development in Sweden. *The Academy of Management Executive* **17**(1), 7–21.

Maddala, G.S. (1983) *Limited Dependent and Qualitative Variables in Econometrics*. Cambridge University Press, Cambridge, MA.

Masten, S.E. (1993) Transaction costs, mistakes, and performance: assessing the importance of governance. *Managerial and Decision Economics* **14**, 119–129.

Mahoney, J.T. (2001) A resource-based theory of sustainable rents. *Journal of Management* **27**, 651–660.

McConnell, J.J. and Nantell, T.J. (1985) Corporate combinations and common stock returns: the case of joint ventures. *Journal of Finance* **XL**(2), 519–536.

Mead, W.J. (1967) The competitive significance of joint ventures. *Antitrust Bulletin* **12**, 819–849.

Mohanram, P. and Nanda, A. (1996) When do joint ventures create value?. *Academy of Management Proceedings '96*, 36–40.

Ouchi, W.G. (1984) *The M-Form Society: How American Teamwork Can Capture the Competitive Edge*. Addison-Wesley, Reading, MA.

Park, S.H. and Kim, D. (1997) Market valuation of joint ventures: joint venture characteristics and wealth gains. *Journal of Business Venturing* **12**, 83–108.

Parkhe, A., Rosenthal, E.C. and Chandran, R. (1993) Prisoner's dilemma payoff structure in interfirm strategic alliances: an empirical test. *Omega* **21**(5), 531–539.

Penrose, E.T. (1959) *The Theory of the Growth of the Firm*. John Wiley & Sons, New York.

Peteraf, M.A. (1993) The cornerstones of competitive advantage: a resource-based view. *Strategic Management Journal* **14**(3), 179–191.

Reuer, J.J. and Leiblein, M.J. (2000) Downside risk implications of multinationality and international joint ventures. *Academy of Management Journal* **43**(2), 203–214.

Shan, W., Walker, G. and Kogut, B. (1994) Interfirm cooperation and startup innovation in the biotechnology industry. *Strategic Management Journal* **15**(5), 387–394.

Shaver, J.M. (1998) Accounting for endogeneity when assessing strategy performance: does entry mode choice affect FDI survival? *Management Science* **44**(4), 571–585.

Teece, D.J. (1986) Profiting from technological innovation: implications for integration, collaboration, licensing and public policy. *Research Policy* **15**(6), 285–305.

Teece, D.J. (1992) Competition, cooperation, and innovation: organizational arrangements for regimes of rapid technological progress. *Journal of Economic Behaviour and Organization* **18**(1), 1–25.

Teece, D.J., Pisano, G. and Shuen, A. (1997) Dynamic capabilities and strategic management. *Strategic Management Journal* **18**(7), 509–533.

Vanhaverbeke, W. and Noorderhaven, N.G. (2002) Competition between alliance blocks: the case of the RISC microprocessor technology. *Organization Studies* **22**(1), 1–30.

Wernerfelt, B. (1984) A resource based view of the firm. *Strategic Management Journal* **5**, 171–180.

Wernerfelt, B. and Montgomery, C.A. (1988) Diversification, Ricardian rents, and Tobin's *q*. *RAND Journal of Economics* **19**(4), 623–632.

Williamson, O.E. (1975) *Markets and Hierarchies: Analysis and Antitrust Implications*. Free Press, New York, NY.

Williamson, O.E. (1979) Transaction-cost economics: the governance of contractual relations. *Journal of Law and Economics* **22**, 233–261.

Yan, A. and Gray, B. (1994) Bargaining power, management control, and performance in United States – China joint ventures: a comparative case study. *Academy of Management Journal* **37**, 1478–1517.

Yoshino, M. and Rangan, S. (1995) *Strategic Alliances: An Entrepreneurial Approach to Globalization*. Harvard Business School Press, Boston, MA.

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