BUILDING A FOREIGN SALES BASE:
THE ROLES OF CAPABILITIES AND ALLIANCES FOR
ENTREPRENEURIAL AND ESTABLISHED SEMICONDUCTOR FIRMS

Michael J. Leiblein
Fisher College of Business
Ohio State University
Columbus, OH 43210
USA
Tel.: (614) 292-0071
Fax.: (614) 292-7062
E-mail: leiblein.1@osu.edu

Jeffrey J. Reuer
INSEAD
Boulevard de Constance
77305 Fontainebleau Cedex
FRANCE
Tel.: (33) 1 60 72 44 73
Fax: (33) 1 60 74 55 00
E-mail: jeffrey.reuer@insead.fr

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This study examines how technological capabilities and international collaborative linkages jointly and interactively shape entrepreneurial and established firms’ abilities to build a foreign sales base in a highly-competitive, global industry. The empirical evidence for a sample of North American semiconductor firms indicates that both technological capabilities and international collaboration aid firms’ development of foreign sales, yet the effects differ substantially across small and large competitors.
INTRODUCTION

A large body of research suggests that firms can exploit their capabilities by expanding internationally and thereby obtain benefits such as growth, scale economies, additional options, and reduced risk (see Caves, 1996 for a review). However, the process of globalization can also be a difficult undertaking for firms, particularly those facing various resource constraints. These challenges can be acute in high-tech industries in which small start-ups compete against established global rivals, entrepreneurial firms’ capabilities may be unevenly developed across the value chain, and building global share quickly may be important to a firm’s survival and success due to high fixed costs, short product life-cycles, and network externalities.

Strategic alliances have been portrayed by many scholars as important tools at firms’ disposal for addressing these challenges. Just as international strategy research has identified a number of advantages that can accrue to firms exploiting their capabilities by expanding abroad, the literature has similarly attached a host of corporate outcomes to strategic alliances. Among them are the following: overcoming various resource constraints and other barriers to international expansion (Contractor & Lorange, 1988); acquiring country-, partner-, or task-specific knowledge (Hamel, 1991; Inkpen & Beamish, 1997; Khanna, Gulati, & Nohria, 1998); improving the firm’s strategic positioning (Harrigan, 1988; Kogut, 1988); accelerating corporate restructuring (Doz, 1992); and hedging risks in dynamic environments (Kogut, 1991).

Much research over the last decade or so has explored alliance outcomes such as these on a purely conceptual level. Recent empirical studies have also indirectly considered the parent firm performance implications of alliances. This work has been done by constructing reduced-form statistical models of firms’ market entry decisions (e.g., Hennart, 1991) and by studying the factors enhancing or reducing joint venture survival (e.g., Barkema, Bell, & Pennings, 1996). However, comparatively little empirical research has directly investigated the specific benefits that parent firms obtain, or fail to derive, from engaging in inter-firm collaboration. Indeed, as “lists” of alliance motivations have lengthened over the years, the question remains as to whether or not alliances truly deliver upon their various proposed benefits. Moreover, even if alliances yield certain benefits to collaborators on a general level, a further question is whether alliances can be more or less helpful to
parent firms with different capability profiles. Research is therefore needed to better understand the specific outcomes of collaboration, the combined importance of collaboration and internal capabilities, and how relevant contingencies magnify or attenuate the proposed benefits that alliances offer parent firms. This work is important to advancing theory in the alliance literature, subjecting received wisdom to empirical analysis, and probing the boundary conditions of existing theory. Further, the implications of inter-firm collaboration are also of direct relevance to firms’ corporate development activities.

In this paper, we analyze the combined impact of firm capabilities and strategic alliances on the foreign sales developed by entrepreneurial and established North American semiconductor firms. As the following section discusses, many studies throughout the alliance literature’s development suggest or imply a link between alliances and firm growth or size, but there has been no systematic empirical research that considers the joint impact of inter-firm collaboration and firm capabilities, or potential interactions that might arise from firms’ use of alliances to leverage internal capabilities to build a foreign sales base. In response to recent calls for research on the different strategies employed by large and small firms (e.g., Chen and Hambrick, 1995: 477; Dean, Brown, and Bamford, 1998: 726), we also examine how the effects of technological capabilities and alliances differ at the margin for entrepreneurial competitors versus their larger, more established counterparts.

The analysis is carried out in the semiconductor industry, a competitive context with truly global product demand. Currently, upwards of two-thirds of worldwide semiconductor demand resides outside the United States (ICE, 1996). More importantly, heightened competitive pressures stemming from global scale and scope advantages, shrinking product life cycles, and the need to bring together geographically-dispersed design and production skills have made international expansion a competitive priority for industry participants, which exhibit substantial heterogeneity in technological capabilities and alliance usage patterns. For these reasons, the semiconductor industry presents an attractive research context in which to analyze how firm capabilities and cross-border alliances together influence firms’ foreign sales.

The following section provides background theoretical material and develops five hypotheses regarding the determinants of the firm’s ability to build a foreign sales base. This section is followed
by a discussion of the research methods employed, and we then present findings for a sample of 85 North American semiconductor firms. The empirical evidence reveals that firms’ technological capabilities and the formation of collaborative linkages are jointly associated with greater foreign sales. The results also indicate that significant differences exist between large and small firms’ technological capabilities and alliance usage patterns. Further, the effects of technological capabilities and inter-firm collaboration on foreign sales differ across these two classes of competitors. Contrary to expectations, we find no evidence to suggest that firms benefit any more from international alliances in the presence of advanced technological capabilities. The paper concludes with a discussion of the implications of these findings and directions for future research.

**THEORY AND HYPOTHESES**

**Firm Capabilities**

One of the long-standing themes in international management research is that foreign firms are competitively disadvantaged relative to local firms due to foreign firms’ unfamiliarity with local market conditions, customs, and so forth. This ‘liability of foreignness’ can be a source of significant risk for firms engaging in international expansion (e.g., Zaheer & Mosakowski, 1997) and implies that the firm must possess compensating advantages such as distinctive capabilities to viably compete in foreign markets.

The general proposition that firms’ capabilities affect the success of expansion cuts across other theoretical perspectives. For instance, Penrose’s (1995) theory of firm growth highlights the importance of under-utilized resources in prompting corporate expansion. Related research on the resource-based view of the firm (Wernerfelt, 1984; Barney, 1986; Dierickx & Cool, 1989) points to firm capabilities as fundamental to the firm’s success in competing in domestic or international markets. Based on the predictions of these literatures, we expect that firms’ capabilities will be important to their capacity to penetrate foreign markets.

Since the degree to which any capability will retain its value across different geographic markets is industry specific, it is necessary to identify capabilities that are broadly applicable across geographic markets. In the semiconductor industry, a key measure of product performance is processing speed, which is tightly linked to the firm’s technological capability. Products
incorporating more advanced technologies can read, process, and output data more quickly than products using less sophisticated technologies. Further, more advanced technologies typically increase production yield and reduce costs (Dick, 1991; Gruber, 1994). Given the intense price- and product performance-based competition in this industry, firms with more advanced technological capabilities will likely enjoy greater success in building a foreign sales base.

Hypothesis 1: The firm’s technological capability will positively influence its foreign sales base.

International Strategic Alliances

The international business and strategy literatures have also long held that cross-border alliances provide a means of growing into new markets. Stopford and Wells (1972), for instance, document how firms use joint ventures to access localized resources in exchange for some control in order to facilitate entry into attractive foreign markets. International expansion similarly appears in Contractor and Lorange’s (1988) summary and taxonomy of international joint venture formation motives. More recent empirical studies confirm that geographical and market expansion opportunities figure significantly into firms’ international alliance formation decisions (e.g., Glaister & Buckley, 1996; Millington & Bayliss, 1995). Other research suggests that inter-firm collaboration can be instrumental to firms seeking growth, whether domestic or foreign (e.g., Hagedoorn & Schakenraad, 1994; Mitchell & Singh, 1996; Powell, Koput, & Smith-Doerr, 1996; Stearns, Hoffman, & Heide, 1987).

The reasons why alliances may be positively related to organizational growth in general, and the development of foreign sales in particular, are many. First, researchers have observed that firms’ alliance formation propensities are especially high early in industry or product life cycles when growth opportunities are substantial. Auster (1992) notes that firms tend to engage in international technological linkages in emerging industries, more commitment-intensive joint ventures in growth industries, and other direct investments in more mature industries. Eisenhardt and Schoonhoven (1996) report that semiconductor firms’ usage of product development alliances is highest in emerging markets. The formation of alliances can also be important to the growth or even survival of firms in industry contexts subject to standards battles (Axelrod, Mitchell, Thomas, Bennett, & Bruderer, 1995; Cool & Gabel, 1992).
Second, alliances are vehicles that allow the firm to respond quickly to demand conditions in host countries. Anand and Kogut (1997) study the timing of FDI into the U.S. and conclude that alliance investments can be explained in part by the ‘pull’ of local demand. Alliances enable the firm to acquire local knowledge when entry rates of foreign competitors would otherwise be low, and this knowledge may allow the firm to enter the market before growing rivalry dissipates rents (Mitchell, Shaver, & Yeung, 1994). Doz (1992) argues that alliances are useful as vehicles for corporate transformation because it often takes too long for firms to alter resources, skills, and perspectives when markets shift quickly.

Third, alliances can be viewed as transitional investments that can open doors to future, often unanticipated, expansion opportunities. Hagedoorn (1993) catalogues a number of motives for technology partnering that relate to market access and the search for new prospects. In an exploratory study using policy-capturing methods to uncover executives’ cognitive models, Tyler and Steensma (1995) note that increased exposure to related markets enhances executives’ evaluations of technological collaborative opportunities. The view that joint ventures are akin to financial call options also implies that firms have an underlying expansion motivation as they sequentially invest in market opportunities under conditions of uncertainty (Kogut, 1991). Mitchell and Singh (1992) present evidence of firms using pre-entry alliances as stepping stones to gain information about emerging markets before expanding on a stand-alone basis into new subfields of an industry. These arguments all lead us to specify the following hypothesis:

**Hypothesis 2:** The firm’s international alliance formation activity will positively influence its foreign sales base.

**Firm Capabilities and International Strategic Alliances**

The previous hypothesis considers the impact of international collaboration on foreign sales independently of the firm’s internal resources, yet the presence or absence of key capabilities may influence the benefits the firm derives from alliances. Anand and Kogut (1997) provide evidence that foreign firms’ joint ventures into the U.S. result from not only the ‘pull’ of local demand, but also the ‘push’ of technological capabilities. This suggests that firms with advanced technological capabilities may be better able to capitalize on inter-firm collaboration than firms’ lacking such capabilities.
Firms lacking key capabilities may prove to be less attractive partners and may also have weaker bargaining power, form less favorable associations, and occupy less attractive positions in emerging patterns of alliances (Doz & Hamel, 1998; Hamel & Prahalad, 1994). Moreover, firms possessing better technological capabilities can use alliances to quickly leverage their expertise on a worldwide basis with limited investments.

**Hypothesis 3:** The interaction between the firm’s international alliance formation activity and its technological capability will positively influence its foreign sales base.

**Competitor Status**

Hypothesis 3 underscores the importance of identifying contingencies that may strengthen or dampen the effects of our theoretical variables as suggested by prior research. Our specific interest in investigating competitor status as another potentially important contingency is motivated by the observation that small and large firms differ in important respects in their overall resource profiles and competitive approaches (e.g., Porter, 1980; Hambrick, MacMillan, & Day, 1982; Woo & Cooper, 1981, 1982). For instance, larger firms tend to possess scale, experience, brand name advantages, and greater slack resources (e.g., Hambrick, MacMillan, & Day, 1982; Singh, 1990; Woo & Cooper, 1981). By contrast, smaller firms frequently enjoy advantages in areas such as production flexibility (Feigenbaum & Karnani, 1991) and risk-seeking behavior (Woo, 1987). They also employ quicker decision-making processes and initiate competitive moves more frequently than larger rivals (Chen & Hambrick, 1995).

Despite the need to give attention to the competitive strategies employed by small and large firms, there is little empirical research on this topic (Chen & Hambrick, 1995: 477). This observation is particularly relevant to the international literature given the rapid expansion of “born globals,” a phenomenon contrasting traditional process theories resting on risk aversion and incrementalism (Johanson & Vahlne, 1977; Oviatt & McDougall, 1997). The differences in entrepreneurial and established firms’ resource profiles and competitive approaches suggests that competitor status may be an important moderator of general relationships observed in international business research in general and international alliance research more specifically.
The moderating effects of competitor status can be considered in view of differences in entrepreneurial and established firms’ general resources and capabilities across value chain activities. For instance, the tendency of small firms to lack slack resources, brand equity, distribution capacity, and developed marketing skills suggests that upstream technological capabilities will be critical for small firms seeking to develop foreign sales. By contrast, larger firms tend to possess a broader repertoire of capabilities across the value chain that can serve as compensating advantages when expanding overseas.

It is also probable that the efficacy of international collaborative relationships will differ across entrepreneurial and established firms. For instance, established firms’ legitimacy, experience, slack financial resources, and breadth of skills across the value chain indicate greater capacity to manage a portfolio of international alliances from a position of enhanced bargaining power (Doz & Hamel, 1998; Hamel & Prahalad, 1994). Smaller firms’ lack of managerial skills and supporting resources suggests that they will benefit less from an alliance at the margin. These considerations lead us to posit the following two hypotheses:

**Hypothesis 4:** The positive influence that technological capability has on the firm’s foreign sales base will be greater for smaller firms than larger firms.

**Hypothesis 5:** The positive influence that international alliance formation activity has on the firm’s foreign sales base will be greater for larger firms than smaller firms.

**METHODOLOGY**

*Model Specification*

The main statistical models used to test our hypotheses took the following form:

\[
\text{Foreign Sales} = \beta_0 + \beta_1 \text{Firm Tenure} + \beta_2 \text{Domestic Sales} + \beta_3 \text{International Marketing} + \beta_4 \text{International Production} + \beta_5 \text{International Acquisitions} + \beta_6 \text{Technological Capability} + \beta_7 \text{International Alliances} + \beta_8 \text{Technological Capability} \times \text{International Alliances} + \epsilon.
\]

H1: $\beta_6 + \beta_8 \times \text{International Alliances} > 0$  
H2: $\beta_7 + \beta_8 \times \text{Technological Capability} > 0$  
H3: $\beta_8 > 0$

The hypotheses under the regression equation summarize the expected relations developed in the previous section. Since the overall impact of technological capability consists of both a direct and an alliance-moderated effect on international sales, the total effect of technological capability on
foreign sales is given by the partial derivative of equation (1) with respect to technological capability, that is, $\beta_6 + \beta_8$ *International Alliances. Similarly, the total effect of international alliance activity is given by its partial derivative (i.e., $\beta_7 + \beta_8$ *Technological Capability). To test the moderating effects of competitor status that are reflected in hypotheses 4 and 5, we also examined two additional interaction terms, namely between firm size and technological capability and between firm size and international alliances.

While our interest lies in developing a parsimonious model to assess the impact of technological capabilities and international alliances on the firm’s foreign sales base, we also included a number of control variables. In order to account for the duration of time the firm has had to cultivate a foreign sales presence, we incorporated a measure of firm tenure in the semiconductor industry. In addition, we introduced measures of international marketing headquarters, international production sites, and international acquisitions to control for an organization’s ability to gather information on local market conditions, to establish local distribution, to overcome local content concerns, and to signal commitment to a particular region via wholly-owned operations. We also controlled for firm size to account for the effects that access to greater financial and managerial resources may have on a firm’s foreign sales base.

Measures and Data

Foreign Sales

Two measures were created to capture a firm’s foreign sales base. We first specified a firm’s foreign sales as the log of the revenue generated by sales of semiconductor products excluding North America in 1996. This measure is attractive in that it provides an absolute measure of the firm’s foreign market penetration. We also tested our models using a measure of foreign sales intensity, which is the percentage of a firm’s 1996 total semiconductor revenue generated in foreign markets. The advantage of this latter measure is that comparisons can be readily made across firms of different scale. Foreign sales data were collected from an internal report describing foreign semiconductor revenue provided by Dataquest, a leading consulting firm in the semiconductor industry.
Explanatory Variables

Following prior empirical research conducted on the semiconductor industry (e.g., Eisenhardt and Schoonhaven, 1996, West & Iansiti, 1998), the measure of technological capability used in this paper is derived from the minimum feature size at which a firm is capable of manufacturing a product. Feature size represents the line-width with which information is etched onto a semiconductor circuit. Smaller line-widths result in lower overall production cost and greater product performance. Technological improvements tend to result in quantifiable, discrete reductions in feature size. In 1988, state-of-the-art technology enabled firms to produce products with 1.0 micron feature sizes. Since then, newer generations of technology have been introduced that incorporate 0.8, 0.7, 0.5, 0.35, 0.25, and 0.18 micron technology. In order to exploit the relationship between feature size and a given generation of technology, we defined our measure of technological capability to be equal to ‘one’ for firms using first generation 1.0 micron technology, ‘two’ for firms using second generation 0.8 micron technology, and so on. Firms that had not adopted 1.0 micron technology as of 1996 were coded as using generation 0 technology. Data on firms’ stated technological capabilities in 1996 were obtained from the 1997 edition of Integrated Circuit Engineering’s Profiles of IC Manufacturers and Suppliers.

The firm’s international alliance activity was proxied as the number of licensing agreements, codevelopment agreements, minority equity positions, and equity joint ventures formed with a foreign partner during the 1991-1995 timeframe. Information on collaborative linkages enacted in any given year were obtained from yearly editions of ICE’s Profiles of IC Manufacturers and Suppliers. This information was then supplemented by announcement searches conducted for each of the firms in our sample using the relevant editions of the DIALOGUE / Predicasts F&S Index of American Corporations and Industries, European Corporations and Industries, and International Corporations and Industries.

Control Variables

We introduced five control variables to account for factors other than our theoretical variables that might affect firms’ foreign sales base. Our first two control variables account for the possibility that a firm’s industry experience and domestic scale affects its ability to develop a foreign sales base.
We defined firm tenure as the number of years that had passed since the firm was first founded or, for large electronic conglomerates, the year the firm first began selling semiconductors or integrated circuits. Firm size was proxied as the log of the firm’s average domestic sales for 1994 and 1995. Our final three control variables accommodate other investments that have a direct impact on the firm’s presence in the foreign markets. Two variables, international marketing and international production, represent simple counts of the number of marketing headquarters and number of production sites that the firm maintained in foreign markets in 1996. The third variable, international acquisitions, was derived in a similar fashion as our measure of international alliances, that is, by counting the number of foreign firms acquired by the focal firm from 1991 to 1995. Data on firms’ date of founding, entry into the semiconductor industry, domestic sales, and international marketing and production sites were collected from the ICE reports.

Sample

The sample was derived from a number of reports provided by the ICE and Dataquest consulting firms. The Dataquest reports provided data on the domestic and foreign semiconductor sales reported by 94 North American semiconductor manufacturers. These data were merged with information pertaining to 142 North American semiconductor manufacturers obtained from the annual editions of the Profiles reports published by the ICE (ICE, 1991-1996). Reconciliation of the two data sources reduced the final sample to 85 firms. In conformance with industry norms, we defined small firms to include those with worldwide sales of less than $200 million, medium-sized firms as those with worldwide sales between $200 million and $1 billion, and large firms as those with worldwide sales in excess of $1 billion. Following this procedure, 51 (60%) of the 85 firms in our sample were classified as small, 25 (29.4%) were classified as medium-sized, and 9 (10.6%) were classified as large. This distribution is similar to that presented in previous studies of the semiconductor industry (e.g., Angel, 1995).

Results

Table 1 presents descriptive statistics and a correlation matrix for the sampled firms. In 1996, the average firm had just less than twenty years of industry experience and generated approximately $715 million in worldwide sales. Foreign sales accounted for a significant portion of these revenues,
with the average firm deriving $350 million from foreign product markets. On a percentage basis, small firms derived slightly less of their revenue from foreign sales (44%) than either medium-sized (50%) or large firms (46%). The variance in large firms’ foreign sales intensities was lower than that exhibited by either small or medium-sized firms.

The sampled firms are rather heterogeneous in their technological capabilities, with the majority of firms utilizing 2nd, 3rd, 4th, or 5th generation technology. Only two firms in our sample had produced products incorporating 6th generation technology by 1996. Firms’ international alliance activity was similarly varied. While 30 percent of firms did not enter into a single international alliance during the 1991 to 1995 time frame, one firm entered into 66 international alliances during this period. As one would expect, the largest firms in our sample tend to have greater industry experience, more frequently operate their own international marketing headquarters, utilize more advanced manufacturing technology, and form a greater number of strategic alliances than either small- or medium-sized rivals.

As described in the measurement section, our two dependent variables, foreign sales and foreign sales intensity, represent an absolute and a relative measure of the firm’s penetration of international markets. The positive inter-correlation between these two constructs indicates that firms with large absolute foreign sales are likely to derive a higher percentage of their overall revenues from foreign sources. The correlation matrix also indicates that our measure for technological capability is positively related to both foreign sales (p<0.001) and foreign sales intensity (p = 0.061). The zero-order correlation between international alliance activity and foreign sales is positive and highly significant (p<0.001), but the correlation with foreign sales intensity does not reach significance at the 0.10 level (p = 0.164). Four of our five control variables – firm tenure, domestic sales, international marketing, and international production – are positively related to foreign sales (all p<0.001), but the control variables are not significantly correlated with foreign sales intensity.
The correlation matrix also reveals many significant relationships among the independent variables. For instance, firms with advanced technological capabilities tend to be active in forming international alliances (p<0.001) as well as building foreign marketing (p<0.001) and production (p<0.01) sites. The significant correlations among many of the independent variables indicate that multivariate analyses are needed to examine the partial effects of the theoretical variables on the firm’s foreign sales base. However, such inter-correlation also suggests the existence of potential multicollinearity problems for model estimation. We therefore tested for the presence of adverse effects due to multicollinearity by examining conditioning indices and variance decomposition proportions. The maximum conditioning index for the models incorporating solely direct effects was 11.57. Inclusion of the technological capability - international alliance interaction term raised the maximum value of this index to 19.06. Both of these values are well-below the accepted cutoff value of thirty (Belsley, Kuh, & Welsch, 1980: 112). Therefore, we conclude that multicollinearity does not pose a problem.

_Hypothesis Testing_

Table 2 presents results for the three regression models estimated to test H1 through H3. The first three models provide results for models estimated with absolute foreign sales as the dependent variable. The remaining models provide results for models estimated with foreign sales intensity as the dependent variable. Models I and IV provide information regarding the effects due solely to the control variables. Models II and V augment the baseline models by including the direct effects of technological capability and international alliances. Hierarchical F-tests comparing the baseline and augmented models indicate that inclusion of our two theoretical variables adds significantly to the explanatory power of the models (i.e., p = 0.0029 for Models I and II; p = 0.0095 for Models IV and V). Finally, Models III and VI add the interaction between technological capability and international alliance activity. In both cases, no significant improvement occurs in model fit.

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Models I and IV present our findings regarding the relationship between the control variables and foreign sales activity. These results are largely consistent with the implications from the
correlation analysis: established firms with greater domestic scale tend to derive more revenue from foreign markets than their younger (p<0.05) and smaller (p<0.001) counterparts. Firms that obtain the greatest foreign revenue also tend to invest in overseas marketing operations (p<0.01). While the correlation matrix indicates no relationship between foreign sales intensity and our control variables, the multivariate analysis shows that, controlling for all other variables, firms with foreign marketing operations have higher foreign sales intensity (p<0.05), and firms with a large domestic sales base tend to have lower foreign sales intensities (p<0.01).

Hypothesis 1 predicted that the firm’s technological capability will have a positive impact on its foreign sales base. The results presented in Models II and V show that firms’ with more advanced technological capabilities tend to derive both a larger absolute dollar amount of revenue and a greater percentage of their revenue from overseas business (both p<0.05). These findings provide strong support for H1.

Hypothesis 2 posited that firms that are more active in forming international alliances are also better positioned to develop their foreign sales base. Our findings indicate that the formation of international alliances is associated with greater foreign sales (p<0.05) and foreign sales intensity (p = 0.106). These findings provide support for H2.

Hypothesis 3 suggested that firms will benefit more from international alliances when they have an advanced technological capability to leverage through inter-firm collaboration than when such a capability is lacking. Models III and VI test for this positive interaction effect. Significance levels are not indicated for the direct effects of variables that appear in interaction terms in Models III and VI. This is done to avoid unwarranted interpretation of the coefficients of these variables. In these instances, we report F-statistics that provide an indication of the overall significance of the variable through both its direct and interaction effects (Kmenta, 1986). The results provide no evidence that firms are better able to penetrate foreign markets through alliances when their technological capabilities are well developed. As such, we find no evidence in support of H3.

In order to check whether the linear relationships reported in Table 2 fully capture the association between our theoretical variables and foreign sales, we tested a number of alternative specifications. For instance, to determine if the marginal effects of international alliance activity or
technological capabilities are constant or diminishing, we incorporated quadratic terms in the models for the two theoretical variables. The results for these models provided no indication of non-linear effects, however.

To test hypotheses 4 and 5 suggesting differential effects of technological capabilities and alliances across entrepreneurial and established firms, we estimated additional models incorporating two multiplicative terms constructed from our theoretical variables and firm size. These models are presented as Models II and IV in Table 3. For comparison purpose, the direct-effects models appearing in Table 2 are also reported in Table 3. As before, significance levels are not indicated for the direct effects of variables that appear in interaction terms. A series of F-tests indicated that our measures of firm size, technological capability, and international alliances had a significant overall effect on foreign sales and foreign sales intensity in the presence of the two interactions.6

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Model IV shows that the positive impact of a firm’s technological capability on foreign sales intensity decreases with firm size (p = 0.009). This result underscores the importance of having an advanced technological capability for small rivals attempting to increase their foreign sales presence. The interaction effect is similar when analyzing absolute foreign sales (i.e., Model II), but does not reach significance at the 0.10 level. Model IV also suggests that, if anything, the positive effect of international alliance activity on the firm’s foreign sales base is stronger for large firms than small firms (p = 0.116). The coefficient estimate is also positive for this interaction term in Model II, but it does not reach significance. Together these findings provide some evidence indicating that the effects of the theoretical variables differ across entrepreneurial and established semiconductor firms as hypothesized in H4 and H5.

**DISCUSSION**

This study had two broad objectives. The first was to provide an empirical test of received wisdom regarding the influence of firm capabilities and international alliances on foreign sales activity. The second main objective of the study was to respond to recent calls for research that
examines differences in the resource profiles and strategies employed by small and large firms and the implications of these differences (e.g., Chen and Hambrick, 1995: 477; Dean, Brown, and Bamford, 1998: 726). In pursuing this second objective, our broader aim was to begin to identify some relevant contingencies that might strengthen or dampen the positive effects of alliances (or technological capabilities) discussed in prior research.

This paper addresses the first of these objectives by putting to an empirical test the basic claim of a number of streams of research in the strategy and international business fields that alliances facilitate expansion in general and the development of foreign sales in particular. We conduct this test in an international context while also controlling for relevant organizational characteristics, other modes of international investment, and the firm’s manufacturing technology, all of which can be associated with collaborative activity as well as successful international expansion by the firm.

The empirical evidence presented in this paper confirms that both internal technological skills and externally-forged relationships enhance firms’ ability to develop foreign sales. In Doz and Hamel’s (1998) terminology, significant overlaps exist between firms’ races for the future and for the world. As such, firms focusing on either developing capabilities or entering into alliances to the neglect of the other activity may be missing out on opportunities to more fully develop their foreign sales base. Further, our results suggest that these opportunities are of great practical importance. The results presented in Model II of Table 2 indicate that the formation of an international alliance is associated with a 3.1% increase in foreign sales and that a one generation improvement in technology is associated with a 15.1% increase in foreign sales.

This paper addresses our second objective by examining how small and large firms differ in their abilities to exploit internal capabilities and international alliances when building a foreign sales base. Our results indicate that the heterogeneity of technological capabilities is greater for smaller firms, and the impact of technological capabilities on foreign sales is also more pronounced for smaller firms lacking slack resources and well-developed skills across the value chain. By contrast, if anything the positive effects of international alliances are stronger for larger firms that tend to have greater legitimacy, slack resources, and downstream skills. Our research therefore suggests the need
for a more contingent perspective on the roles played by internal capabilities and inter-firm collaboration in firms’ international corporate strategies.

Our results have several implications for future research in the international strategy area. First, the joint significance of technological capabilities and international alliances, as well as the strong positive correlation between them, suggests that research on international corporate expansion that focuses on the partial effects of either variable needs to control for the other to avoid attaching undue importance to either of the variables and making attribution errors. The strong bivariate relationships between technological capabilities and foreign sales and between international alliances and foreign sales weaken in significance once we account for the other covariate. This suggests the importance of using a multivariate framework that encompasses both firm capabilities and the firm’s corporate development activities.

Second, our findings indicate that while firms can benefit from both alliances and technological capabilities when expanding abroad, and firms active in forming alliances also tend to have more advanced technologies, the presence of more developed technological capabilities does not necessarily improve the foreign market penetration achieved by the firms’ international alliances at the margin (in contrast to H3). This insignificant interaction might be explained by limits inherent in using alliances to leverage certain technological capabilities across firm and country borders. Such a position is supported by logic developed in the transaction cost economics literature, which suggests that the ability to appropriate rents from a given capability through market mechanisms varies with both the tacitness of the capability and the appropriability regime (e.g., Teece, 1986). Since the technological capability measure in this paper was based on process expertise and since process expertise is quite tacit (e.g., Levin, Klevorick, Nelson, & Winter, 1987: 794), it is likely that firms may be better able to use alliances to leverage other capabilities based on less tacit skills (i.e., product expertise).

Third, the results show that the effects of the two theoretical variables differ across entrepreneurial firms and larger, more established rivals in the industry. For future empirical studies, these results indicate the importance of competitor status in specifying multivariate models since the effects of the theoretical variables differ across these classes of competitors. This also implies that
parameter estimates from models incorporating only the direct effects of technological capabilities and international alliances will be subject to the mix of entrepreneurial and established firms in the particular sample employed. On the most general level, the study demonstrates the value of taking a more contingent view of technological capabilities and alliances, a theme that could be extended in future research.

The present study’s scope and limitations also point to a number of other areas where additional research may prove valuable. First, work is needed in other industries to test the generalizability of the present findings on the roles of firm capabilities and strategic alliances. Second, while the present study suggests that alliances facilitate growth through foreign sales development, future studies with access to primary, longitudinal data may test these predictions using a dynamic framework and explore other contingencies besides technological capabilities and competitor status that potentially have a bearing on the benefits the firm derives from entering into cross-border collaborations. Finally, the development of a foreign sales base is only one of many organizational outcomes of strategic alliances. As alliances increase in number and diversity, and alliance motivations identified by scholars similarly grow in number, alliance research would benefit from additional empirical analysis of the specific implications of different alliance forms for partnering firms. Understanding these issues will be important to the testing of conceptual frameworks on interfirm collaboration and advancing theory in the area. Research in these directions can also provide an empirical testing ground for emerging thinking on the theory of the firm and the specific implications of firms’ changing boundaries.
ENDNOTES

1 Prior research that has considered the performance effects of alliances generally falls into one of several categories. A number of studies have examined the corporate effects of collaboration by investigating parent firms’ share price reactions to alliance formation announcements (e.g., Das, Sen, & Sengupta, 1998; Koh & Venkatraman, 1991). This work differs from other alliance studies measuring the current performance of the venture itself (e.g., Chowdhury, 1992; Woodcock, Beamish, & Makino, 1994). Still another approach has been to study the effects of alliances on parent firm survival (Singh & Mitchell, 1996). This is in contrast to the more typical application of longitudinal models to study JV longevity and the determinants of venture survival (e.g., Li, 1995; Millington & Bayliss, 1997; Park & Ungson, 1997). Other research has considered managers’ perceived satisfaction with alliances (e.g., Geringer & Hebert, 1991; Parkhe, 1993). Recent research has begun to narrow performance assessments by focusing on the relationship between alliances and parent firms’ innovativeness, as proxied by partners’ patenting activities (Hagedoorn & Schakenraad, 1994; Mowery, Oxley, & Silverman, 1996; Almeida, Grant, & Song, 1998).

2 Zaheer (1995: 343) traces the liability of foreignness to the following four sources: (1) spatial costs due to factors such as transportation and coordination costs, (2) firm-specific costs due to unfamiliarity with the local environment, (3) host country specific costs due to economic nationalism or a foreign firms’ lack of legitimacy, and (4) home country specific costs due to export restrictions.

3 Visual inspection and skewness statistics indicated that our measure of foreign sales exhibited significant positive skew. Regression analyses involving skewed variables are susceptible to generalizability concerns as well as Type I and Type II errors. One correction for such problems involves a logarithmic transformation. Consequently, we redefined our measure as the natural logarithm of foreign sales.

4 A logarithmic transformation was also used to correct for skewness exhibited by the untransformed measure of domestic sales (see endnote 2).

5 The appropriate test for the significance of the overall effect of a variable through both its direct effect and the interaction term is an F test (Kmenta, 1986). Since the interaction term is not significant in either Model III or Model VI, we draw all conclusions from the models which only incorporate direct effects.

6 The overall effect of firm size on foreign sales and foreign sales intensity was significant at the $p = 0.015$ and $p < 0.001$ levels. Similarly, the overall effect of technological capability was significant at the $p = 0.059$ and $p = 0.003$ levels. The overall effect of international alliances was significant at the $p = 0.037$ and $p = 0.035$ levels.
REFERENCES

Almeida, P., Grant, R., & Song, J. 1998. *Firms, alliances, and markets in cross border knowledge flow*. Georgetown University working paper.


**TABLE 1**

Descriptive Statistics and Correlation Matrix

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Log of Foreign Sales</td>
<td>4.060</td>
<td>1.887</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Foreign Sales Intensity</td>
<td>0.458</td>
<td>0.234</td>
<td>0.522***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Firm Tenure</td>
<td>19.776</td>
<td>13.603</td>
<td>0.480***</td>
<td>0.062</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Log of Domestic Sales</td>
<td>4.247</td>
<td>1.695</td>
<td>0.749***</td>
<td>-0.134</td>
<td>0.473***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. International Marketing</td>
<td>1.365</td>
<td>1.252</td>
<td>0.594***</td>
<td>0.076</td>
<td>0.159</td>
<td>0.628***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. International Production</td>
<td>0.306</td>
<td>1.205</td>
<td>0.500***</td>
<td>0.076</td>
<td>0.543***</td>
<td>0.501***</td>
<td>0.201†</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>7. International Acquisitions</td>
<td>0.024</td>
<td>0.152</td>
<td>-0.018</td>
<td>-0.108</td>
<td>0.261†</td>
<td>0.045</td>
<td>-0.045</td>
<td>-0.040</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Technological Capability</td>
<td>2.682</td>
<td>1.774</td>
<td>0.541***</td>
<td>0.204†</td>
<td>0.261†</td>
<td>0.480***</td>
<td>0.342***</td>
<td>0.308***</td>
<td>-0.016</td>
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</tr>
<tr>
<td>9. International Alliances</td>
<td>6.929</td>
<td>9.932</td>
<td>0.441***</td>
<td>0.152</td>
<td>0.105</td>
<td>0.376***</td>
<td>0.162</td>
<td>0.376***</td>
<td>-0.046</td>
<td>0.406***</td>
</tr>
</tbody>
</table>

\[ \text{a} \quad N = 85. \quad \hat{p} < 0.10, \quad * p < 0.05, \quad ** p < 0.01, \quad *** p < 0.001. \]
# TABLE 2

**Estimates of Multiple Regression Analyses\(^b\)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model I</th>
<th>Model II</th>
<th>Model III</th>
<th>F-Statistic</th>
<th>Model IV</th>
<th>Model V</th>
<th>Model VI</th>
<th>F-Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Foreign Sales (log of SM)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>0.913(^*)</td>
<td>0.756(^†)</td>
<td>0.878(^†)</td>
<td>0.598(^***)</td>
<td>0.568(^***)</td>
<td>0.593(^***)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.405)</td>
<td>(0.385)</td>
<td>(0.453)</td>
<td>(0.078)</td>
<td>(0.075)</td>
<td>(0.088)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Firm Tenure</td>
<td>0.025(^*)</td>
<td>0.030(^*)</td>
<td>0.030(^*)</td>
<td>0.003(^†)</td>
<td>0.004(^†)</td>
<td>0.004(^†)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.012)</td>
<td>(0.012)</td>
<td>(0.012)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log of Domestic Sales</td>
<td>0.489(^***)</td>
<td>0.351(^**)</td>
<td>0.336(^**)</td>
<td>-0.069(^**)</td>
<td>-0.093(^***)</td>
<td>-0.096(^***)</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>(0.117)</td>
<td>(0.117)</td>
<td>(0.121)</td>
<td>(0.023)</td>
<td>(0.023)</td>
<td>(0.024)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>International Marketing</td>
<td>0.394(^**)</td>
<td>0.403(^**)</td>
<td>0.396(^**)</td>
<td>0.060(^*)</td>
<td>0.060(^*)</td>
<td>0.059(^*)</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>(0.135)</td>
<td>(0.128)</td>
<td>(0.130)</td>
<td>(0.026)</td>
<td>(0.025)</td>
<td>(0.025)</td>
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</tr>
<tr>
<td>International Production</td>
<td>0.200</td>
<td>0.090</td>
<td>0.069</td>
<td>0.029(^*)</td>
<td>0.012</td>
<td>0.008</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>(0.138)</td>
<td>(0.135)</td>
<td>(0.142)</td>
<td>(0.026)</td>
<td>(0.026)</td>
<td>(0.028)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>International Acquisitions</td>
<td>-0.833</td>
<td>-0.785</td>
<td>-0.832</td>
<td>-0.178(^**)</td>
<td>-0.167</td>
<td>-0.177</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>(0.896)</td>
<td>(0.842)</td>
<td>(0.851)</td>
<td>(0.172)</td>
<td>(0.164)</td>
<td>(0.166)</td>
<td></td>
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</tr>
<tr>
<td>Technological Capability</td>
<td>0.164(^*)</td>
<td>0.151</td>
<td>0.033(^*)</td>
<td></td>
<td>0.031</td>
<td></td>
<td>2.355(^†)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.081)</td>
<td>(0.085)</td>
<td>(0.016)</td>
<td></td>
<td>(0.017)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>International Alliances</td>
<td>0.032(^*)</td>
<td>0.006</td>
<td>0.005</td>
<td>0.005(^*)</td>
<td>-0.001</td>
<td>0.001</td>
<td>1.4753</td>
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</tr>
<tr>
<td></td>
<td>(0.014)</td>
<td>(0.053)</td>
<td>(0.003)</td>
<td>(0.010)</td>
<td>(0.003)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technological Capability*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>International Alliances</td>
<td>0.007</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model F</td>
<td>27.491(^***)</td>
<td>24.090(^***)</td>
<td>20.911(^***)</td>
<td>2.307(^†)</td>
<td>3.227(^**)</td>
<td>2.834(^**)</td>
<td></td>
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</tr>
<tr>
<td>R-Squared</td>
<td>0.635</td>
<td>0.686</td>
<td>0.688</td>
<td>0.127</td>
<td>0.227</td>
<td>0.230</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

\(^b\) N = 85. Standard errors appear in parentheses. \(^†\) p < 0.10, \(^*\) p < 0.05, \(^**\) p < 0.01, \(^***\) p < 0.001.
### TABLE 3

**Estimates of Multiple Regression Analyses**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Foreign Sales</th>
<th>Foreign Sales Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model I</td>
<td>Model II</td>
</tr>
<tr>
<td>Intercept</td>
<td>0.756† (0.385)</td>
<td>0.302 (0.782)</td>
</tr>
<tr>
<td>Firm Tenure</td>
<td>0.030* (0.012)</td>
<td>0.033** (0.012)</td>
</tr>
<tr>
<td>Log of Domestic Sales</td>
<td>0.351** (0.117)</td>
<td>0.459 (0.200)</td>
</tr>
<tr>
<td>International Marketing</td>
<td>0.403** (0.128)</td>
<td>0.434** (0.130)</td>
</tr>
<tr>
<td>International Production</td>
<td>0.090 (0.135)</td>
<td>0.081 (0.148)</td>
</tr>
<tr>
<td>International Acquisitions</td>
<td>-0.785 (0.842)</td>
<td>-0.747 (0.842)</td>
</tr>
<tr>
<td>Technological Capability</td>
<td>0.164† (0.081)</td>
<td>0.424 (0.226)</td>
</tr>
<tr>
<td>International Alliances</td>
<td>0.032* (0.014)</td>
<td>-0.017 (0.048)</td>
</tr>
<tr>
<td>Log of Domestic Sales *</td>
<td>-0.063 (0.053)</td>
<td>-0.026** (0.010)</td>
</tr>
<tr>
<td>Technological Capability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log of Domestic Sales *</td>
<td>0.010 (0.009)</td>
<td>0.003 (0.002)</td>
</tr>
<tr>
<td>International Alliances</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model F</td>
<td>24.090***</td>
<td>18.997***</td>
</tr>
<tr>
<td>R-Squared</td>
<td>0.686</td>
<td>0.695</td>
</tr>
</tbody>
</table>

\(^c N = 85\). Standard errors appear in parentheses.  \(† p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001\).