ALLIANCE ACTIVITY AS A DYNAMIC CAPABILITY: SEARCH AND INTERNALIZATION OF EXTERNAL TECHNOLOGY

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ABSTRACT

Previous research has often seen alliances as a mechanism used by disadvantaged firms to seek new capabilities. But are alliances an effective dynamic capability? We find that less competent firms can use alliances to access new technologies, but more competent firms are superior in internalizing new capabilities from their alliances.

INTRODUCTION

Dynamic capabilities are the antecedent organizational and strategic routines by which managers alter their source base to generate new value-creating strategies (Eisenhardt and Martin, 2000). In this perspective, the ability of the firm to create and manage new alliances in order to explore and eventually internalize new technologies in presence of discontinuous technological change is considered a dynamic capability.

We ask two related questions on the effectiveness of alliances as mechanisms of reducing technology gaps. Corresponding to search, we test whether alliances allow less technologically endowed firms to enter a new technology faster. Under internalization, we study whether existing technological competences affect a firms' ability to integrate and retain the new technologies explored through alliances. We develop hypotheses based on the received theory and evidence on alliances as dynamic capabilities. Although previous work has investigated the role of different types of alliances in distinct stages of the product development process (Rothaermel and Deeds, 2004), to our knowledge less attention has been paid to the distinction between the creation of an alliance and the subsequent eventual integration of the underlying technology. Research on the distinction between these two processes can yield important implications for the literatures on dynamic capabilities as well as strategic alliances.

In order to answer these questions and test our hypotheses, we study the case of US and European pharmaceutical firms responding to the biotech revolution from the 1980s through the end of 1990s.

THEORY AND HYPOTHESES

Previous literature identifies the relative roles of different modes of investments. When it comes to development of new technology, firms face significant challenges internally due to inertia and the inertness of their routines. Alliances can then be a mechanism to break out of local

search constraints, and as such, they are more likely to be used when the firm is pursuing competences that are technologically distant. On the other hand, such an argument runs counter to the resource based view which suggests that firms need to own inimitable resources or capabilities in order to possess a competitive advantage. Specifically, it ignores the potentially significant firm-specific and path dependent effects of existing technological competences.

In order to further examine these arguments, we break down the advantages of technologically proximal firms into superior *technology search* and superior *technology internalization* and then examine the implications of alliance strategies for each. Superior search is related to the capability to identify a relevant new technology and select the alliance partner to acquire that technology. Superior internalization requires learning from the alliance partner in order to access the new technology (Lane and Lubatkin, 1998) and integrate it into the existing base of competence within the firm (Helfat and Raubitschek, 2000). This is a necessary pre-condition to develop new successful products and processes from the technology accessed through the alliance. By decomposing the nature of alliance advantages and of the underlying dynamic capabilities, we can examine if alliances are more effective in neutralizing some of these advantages than others. We discuss each one of these in turn.

Alliances and Technology Search

Consider two kinds of firms competing in a environment of disruptive technology: one firm has developed new capabilities internally and is therefore, closer to the new technologies, while the other is relatively distant from the new technologies. Firms technologically closer to new technologies may be able to evaluate and access these technologies earlier. Would the use of alliances reduce the time lag between entries of these different firms (Mitchell and Singh, 1992)?

In order to understand the role of alliances in the search of new technologies, we break down the entry of firms into new technologies into parts: through internal development (or acquisitions) and through alliances. In the first hypothesis we consider firms' entry into new technologies through internal development without including entry through alliance formation, and in the second case, we consider entry into new technologies through alliances:

> *H1a: When entry through internal development or acquisitions is considered, firms that are technologically better endowed are likely to enter these new technologies earlier.*
>
> *H1b: This gap in timing of entry between firms with different levels of technological competences will diminish when entry through alliances is considered.*

Alliances and technology internalization

By technology internalization we mean the ability of firms to integrate the technologies that they have explored through their alliances within their base of existing capabilities (Helfat and Raubitschek, 2000). We propose that there will be significant differences among firms in their ability to internalize the technologies from their alliances. Firms with superior technological competences will be more likely to internalize and retain the technologies from their alliance investments. This argument is based on several inter-related points. First, the existing technological competencies provide better access to potential partners, and thus, enable the choice of better partners in alliances (Gulati, 1995; Stuart and Podolny, 1996). Second, superior technological competences lead to better absorptive capacity (Cohen and Levinthal, 1990). Third,

firms with weaker technological capabilities are likely to possess dense and narrow portfolios of alliance technologies, which can be "sub-additive" (Vassolo, Anand and Folta, 2004). Such portfolios may suffer from significant redundancies and overlaps among technological and market opportunities pursued in alliances (Katila and Ahuja, 2002). This implies that firms are less likely to assimilate a large number of technologies given that even a large number of alliances expose them to only a few technologies. Based on these arguments, we conclude that:

H2a: Existing technological competences positively affects the internalization of the new technologies accessed through alliances

While, as the above hypothesis argues, technological competence may have a positive effect on the internalization of new technologies, this effect may not be homogenous at different levels of competencies. Specifically, beyond a certain level of technological competence this effect may begin to plateau in keeping with the standard diminishing returns arguments. Therefore:

H2b: Existing technological competences have a decreasing marginal effect on the internalization of the new technologies accessed through alliances

Notice that the dependent variable in the hypothesis is not only about the internalization of alliance capabilities through a buy-out of the partner, but can also involve assimilation of alliance capabilities through learning. This is important because under certain conditions, the firm may choose to invest in learning from the partner, followed by a divestiture of the alliance (Hamel, 1991). Since both mechanisms of internalization are included here, it is a better performance measure than any single one.

RESEARCH METHODS

Biotechnology research involves many technological domains, which we have referred to as 'technologies' throughout the paper. There are about 150 such biotech domains. Examples of technological domains used in this study are AIDS Therapeutics, DNA Probes, and Vaccines.

Data

We test the above hypotheses using data on biotech investments made by pharmaceutical firms. The main source of information about technological distances and overlapping, equity agreements, acquisitions, and divestitures is BioScan. Biotechnology research involves many kinds of technological domains, which we have referred to as 'technologies' throughout the paper. There are about 150 such biotech domains. Examples of technological domains used in this study are AIDS Therapeutics, DNA Probes, and Vaccines.

Data collected include all the equity agreements and outright acquisitions made by the largest worldwide 30 pharmaceutical companies – hereafter, 'firms' - with biotech labs between 1989-1999. These thirty firms come from several different countries, including USA, England, France, Germany, and Switzerland. The final sample includes 448 R&D based equity transactions: 364 minority equity investments in biotechnology labs, 22 outright acquisitions of biotechnology labs, and 61 divestitures.

Dependent Variables

Our study deals with two different dependent variables corresponding to the different hypotheses. In the hypotheses H1a and H1b, the analysis involves timing of entry. In this case, the dependent variable is defined as the timing of the exercise event – i.e., the timing of the first investment in each technology by each firm. As concerns H2, internalization of alliance technologies involves internalization of a technology within an alliance in which the firm is not already investing. This can be achieved by either acquiring the alliance partner or investing in this technology internally (learning) while keeping the alliance. The dependent variable is defined as the timing of the exercise event, and it is coded "1" if the focal firm internalizes a technology and "0" otherwise.

Independent Variable

In order to test our hypotheses, we include a measure of technological competence of firms. Following a consolidated approach (e.g., Narin, Noma and Perry, 1987), we use patent data to build this measure. We gathered patent information from the NBER database. For each year and firm in the sample, we calculated the cumulative stock of patents.

Control Variables

This study uses a measure of organization size for control for the financial resource position: *total pharmaceutical annual sales*, in US$ millions. The *number of firm technologies* is a proxy of the technological domains that the pharmaceutical incumbent is investigating (Rothaermel, 2001). This study proposes the *number of firm alliances* established in the history of the pharmaceutical company as a control variable for firm's absorptive capacity (Sarkar, Echambadi, and Harrison, 2001). The attractiveness of investment in biotech is controlled for by *industry returns*, which is based on the biotechnology industry index adjusted by the risk-free interest rate. We use an indicator variable approximate the degree of appropriability of the partnership: *license*. Interest rates influence the opportunity cost of an investment. *Interest* is measured using the one-year Treasury Bill rate.

Statistical Analyses

In our empirical analysis we use hazard rate models. The Gompertz distribution was selected among several possible parameterizations based on the Akaike Information Criterion.

RESULTS

In general, our results provide support for our hypotheses. Hypotheses 1a is supported: firms with greater number of patents are likely to enter new technologies earlier, since the coefficient of the number of patents is positive and statistically significant at the 1% level. Our results also support hypothesis 1b: the coefficient corresponding to the measure of technological competence is negative and statistically significant at the 0.1% level. This result suggests that firms with greater technological capabilities tend to enter new technologies earlier through internal development (or acquisitions) and firms that are less technologically competent tend to catch up using alliances.

In hypotheses 2a and 2b we had suggested that firms technologically better endowed would be more likely to internalize technologies accessed through alliances, even though the marginal effect would be decreasing with the level of technological competence. When we test the linear effect of the number of patents, we do not obtain a statistically significant coefficient,

although the Likelihood Ratio test indicates that the addition of this variable provides significant explanatory power ($p < 0.001$). When the non-linearity predicted by H2b is accounted for, we obtain results fully supporting H2a and H2b. The first order coefficient of the number of patents, in fact, has a positive and statistically significant coefficient (0.1%), suggesting that a higher number of patents favor technology internalization. This implies that the number of patents has a marginal decreasing effect on internalization.

CONCLUSIONS AND DISCUSSION

Previous research has documented that technological or capability development is often path dependent, and alliances can serve as a dynamic capability for firms that are less technologically competent. In this sense Alliances are particularly important when firms are faced with a technological discontinuity and search for new technologies. Our results confirm that alliances are used to access new technological competencies, but also reveal the difficulty in internalizing new technology for such firms.

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