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Greenfield Investments Versus Acquisitions: Capital Market Drivers of

R&D Organization in Technology-Intensive Industries

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Abstract

Multinational companies (MNCs) organize innovation in new markets either through greenfield R&D efforts of wholly owned subsidiaries, or through external acquisition of know-how. Firms are constantly challenged to choose between these two modes of capabilities development to maximize returns to innovation spend. This study introduces capital market variables - prior market performance, expectations of growth versus profitability, and risk - as important drivers of the choice between greenfields and acquisitions. We use data on 154 R&D centers established by US MNCs in technology intensive industries in India and 96 acquisitions made by MNCs in these industries between 1990 and 2009 to test our hypotheses. We find that MNCs, which are marked by higher market performance, higher market expectations of growth versus profitability, and lower volatility in returns, innovate through acquisitions. Our findings underscore the importance of taking into account market variables when explaining the organization of innovation in new markets.

Greenfield Investments Versus Acquisitions: Capital Market Drivers of R&D

Organization in Technology-Intensive Industries

Technology-intensive industries involve high information clockspeed and fierce competition. In response to the rising costs, speed and complexity of technological developments, multinational companies (MNCs) in these industries are increasingly leveraging emerging markets to develop innovative capabilities. Booz & Company, in their 2008 survey of 1000 public corporations worldwide that invest most in R&D¹, found 83 percent of new R&D sites of MNCs were in India and China. 91 percent of new R&D staff in these firms was also located in these countries. Foreign direct investment in R&D in new markets leverages both low cost resources to create scale economies in coordination of innovations that advance the MNC's global competitive position as well as competences not available in-house to develop innovations that adapt to local needs. The coordination or adaptation of innovations in new markets is effected by MNCs through equity-based entry modes or non-equity modes such as licensing or strategic alliances. The choice between these different modes of capabilities development has been examined from various theoretical lenses including transaction cost theory, firm growth, and the ownership-location-internationalization framework (see Harzing 2002 for a review of this literature).

Equity investments in innovation are effected in new markets in one of two ways – greenfield research and development (R&D) efforts of wholly owned subsidiaries or through external acquisition of products and know-how. This study explores how MNCs in technologyintensive industries choose between greenfields and acquisitions for organization of their innovative capabilities. Several studies (e.g. Caves and Mehra 1986, Kogut and Singh 1988; Hennart and Park 1993; Cho and Padmanabhan 1995; Brouthers and Brouthers 2000), in investigating the drivers of the choice between greenfields and acquisitions as the mode of organization of capabilities and resources in new markets, have largely adopted a transaction cost approach. The extent of diversification, R&D intensity, foreign experience, cultural distance, size

¹ http://www.booz.com/media/file/sb61_10408-R.pdf

of investment relative to the firm, and time of entry are some factors that have been found to influence relative transaction costs and in turn, the mode of capability development.

This study introduces a new perspective to the study of organization of firm capabilities, including R&D – the role of capital markets. The organization of R&D capabilities in new markets, either through subsidiaries or acquisitions, involves significant expend of capital and uncertainty in future cash flows. As a consequence, access to capital, costs of available capital, expectations of capital markets, and risk profiles and risk seeking behaviors of firms become important determinants of the mode of organization of such capabilities. Yet, these market variables are relatively unexamined in prior research. This study addresses this gap in the literature to posit prior market performance, firm risk, and market expectations of growth versus profitability are important determinants of the mode of organization of new R&D capabilities.

We empirically investigate these hypotheses in the context of R&D acquisitions and subsidiaries established in technology-intensive industries in India during 1990-2009. The importance of innovation in technology intensive industries renders them an ideal context to study the mode of organization of innovation. Further, over the past decade, India has attracted significant investments in R&D. Similarly, over the past decade, there has been a spate of mergers and external acquisition of technological know-how in India with high-tech industries at the forefront of such activity. Our analyses confirm that MNCs, marked by higher (lower) financial performance, higher (lower) market expectations of growth versus profitability and lower (higher) volatility in returns innovate through acquisitions (captive centers).

The study represents a perspective that is different from prior research at the intersection of strategy and finance. Rather than examine the impact of strategic decisions on market value, we analyze whether prior market value and expectations influence strategic choices of firms. Prior research (e.g. Mizik 2010; Chakravarthy and Grewal 2011) views internal R&D as a discretionary expense that is often myopically cut by managers in response to poor market performance to reduce further earnings shortfalls. However, as firms, especially in technologyintensive industries, complement the development of internal innovative capabilities with external acquisition of technology and know-how, an understanding of how market variables, including performance, expectations and risk, influence external R&D investments, becomes important. Especially since the two dominant forms of external acquisition of R&D – greenfield subsidiaries and acquisitions – differ in the efficiency of their valuation by financial markets, capitalization of benefits, and riskiness. In examining the influence of market variables on the organization of R&D capabilities, this study recognizes that market performance represents variegated intelligence on costs of capital and risk-seeking propensity of the firm. The findings shed light on the tradeoffs between these perspectives and the dominant influence in the context of R&D organization. Finally, we separate market expectations of growth and risk from market performance and assess their independent effects on mode of capability development to develop a more holistic model of organization of innovative capabilities in new markets.

The rest of this paper is organized as follows. The next section uses financial theories, including the efficient markets hypothesis and prospect theory, to examine the informational content of market performance, expectations and risk, and the relationship between these variables and the choice between acquisition or greenfield organization of R&D. Specific hypotheses pertaining to the impact of these variables on choice of entry mode are formulated. Section III empirically tests the hypotheses in the context of 96 acquisitions and 154 R&D captive centers established by US MNCs in technology-intensive industries in India. Data, measures and methods are described in this section. Section IV presents results of our analyses. Section V concludes with a discussion of the implications of results to theory and practice, limitations, and directions for future research.

II. Theory and Hypotheses Development

Organization of R&D through Greenfields and Acquisitions

Over the past decade, several firms in technology-intensive industries have sought to internationalize their R&D activities. Booz & Company, in their 2008 survey of 1000 public

corporations worldwide that invest most in R&D, found that firms spent an average of 55 percent of their innovation dollars outside their home country. Further, a bulk of the FDI in R&D has been directed at emerging markets. The principal motive behind this R&D activity of MNCs in emerging markets has been to reduce costs of innovation by leveraging relatively lower cost resources in these countries. In certain sectors such as the pharmaceutical industry, growth in revenue (annual compound growth rate of about 11% in the US over the last 25 years) is lower than the growth in R&D expenses (annual compound growth rate of about 15% in the US over the last 25 years) (Chesbrough 2007), yielding declining returns to innovation spend. Access to lower cost resources in emerging markets allows MNCS to reduce their costs of innovation. Further, the skill base in emerging markets, including scientific and engineering talent, has improved significantly. Thus, access to a wider scale and range of competencies is an important motive for the internationalization of R&D. Finally, emerging markets such as India and China are growth markets that are important sources of revenue for the MNC. R&D facilities in these countries allow for development of products that cater to idiosyncratic tastes of the local market.

An MNC can develop R&D capabilities in new markets, either through hierarchical governance forms or market structures such as strategic alliances and joint ventures. Greenfield investments in R&D and external acquisition of technological know-how are both hierarchical structures under common ownership of the MNC. However, the management capabilities required of each structure and ensuing transaction costs are different. If an MNC chooses to organize its R&D through a wholly owned subsidiary in the emerging market, it has to incur the costs of *replicating* its structures and processes, *building* business networks required for profitable functioning of the company, and potentially *coordinating* with other business units and geographies for effective product and/ or market expansion. On the other hand, if the MNC acquires an existing company and its technological know-how, it has to incur costs in *adapting and integrating* the acquired company's structures, processes and business networks to its own for effective product and/ or market expansion. Consistent with these differences in capability

requirements, prior research has identified several variables that influence the relative transaction costs between greenfield subsidiaries and acquisitions and in turn, the MNC's choice of entry mode. Specifically, prior research argues that the choice of acquisition is positively associated with the extent of diversification of the MNCs (Chatterjee, 1990; Zejan, 1990), experience of the MNC in the foreign market, competitive disadvantage relative to the local firms (Hennart and Park, 1993), competitiveness and growth of the local industry, the size of the local affiliate relative to that of the parent MNC (Chatterjee, 1990; Hennart and Park, 1993).

Prior research also points out that subsidiaries and acquisitions differ in terms of their resource requirements and risk profile. R&D subsidiaries involve phased outflow of capital and may be viewed as an "incremental approach to diversification" (Teece 1982). As a consequence, they often draw on slack resources over longer periods of time (Chatterjee 1990; Teece 1982). In contrast, acquisitions that require payment to another firm, the target, often use a sudden infusion of slack resources or external funding. Therefore, access to complementary capital may dictate acquisition of innovative capabilities. The cost of deploying equity capital is also relatively lower in the case of acquisitions since an active takeover market minimizes capital market imperfections and provides more discipline in valuation of the investment (Williamson 1975, Chatterjee 1990). Finally, acquisitions are riskier than greenfield subsidiaries. Makovitch et al. (2005) point out that investments in R&D subsidiaries are "substantial and not easily reversible, but they do produce tangible benefits, such as eventual products or learning". As such, the downside is relatively lower than in acquisitions, which are also not easily reversible, but "can be very costly, and typically involve a higher probability of a substantial loss of investment" (Makovitch et al. 2005).

To the extent that financial market performance, expectations and risk influence access to and costs of capital, they will influence managers' budgetary decisions and in turn, result in different modes of capability development. In the next section, we develop specific hypotheses pertaining to the impact of prior market performance, expectations and risk on the mode of organization of R&D capabilities of the MNC.

Financial Market Performance and Organization of R&D

Superior market performance allows access to equity capital at relatively lower costs. However, the cost of such equity capital is also influenced by the efficiency of financial markets in pricing the firm. The efficient markets hypothesis posits that at any given time, the stock price of a firm reflects all publicly available information, and, in turn, the collective belief of investors regarding future prospects of the firm. In such case, the cost of equity capital correctly reflects the risks inherent to strategic initiatives that the firm seeks to finance. However, for many types of strategic events, the market may not have the required information to efficiently price the event. The firm too may not be incentivized to disclose pertinent information for competitive reasons or even if it does, the market may differ from the firm in its interpretation and pricing of the firm's stock that in turn, increases the costs of equity capital (Mani et al. 2010). For these reasons, given access to equity capital at relatively lower costs, firms will deploy such capital in investments characterized by limited information asymmetry between investors and managers, and in turn, fewer capital market imperfections.

Prior research (Teece 1987; Chatterjee 1990) finds greater information asymmetry between markets and mangers and in turn, greater mispricing in the case of greenfield investments. At the time of establishment of the subsidiary, the market is likely unaware of what products the subsidiary will focus on developing and in turn, of the financial payoffs from these R&D activities. The MNC too may be reluctant to reduce this asymmetry through disclosure of detailed information about its investment. First, information disclosure may engender a degree of competitive parity that is not justified by improvement in investor forecasts. Further, R&D intrinsically involves significant uncertainty in outcomes; any *ex post* downward revision to benefits communicated *ex ante* in a detailed announcement will result in an adverse reaction from financial markets. The uncertainty underlying market imperfections in valuation of payoffs from R&D is particularly pronounced in technology-intensive industries, where gestation periods for new products are long and rates of new product diffusion are low. For these reasons, MNCs in technology intensive industries are unlikely to engage in elaborate disclosure of information on greenfield R&D investments.

In the absence of information, pessimistic investors may depress the MNC's stock price during the announcement of its greenfield investment. If the stock is indeed mispriced during the announcement period, it may be restored to its correct level resulting in long-term abnormal returns. However, if the firm raises equity capital at the depressed price, the principal beneficiaries will be the new shareholders who bought the company's shares at the depressed price. Thus, capital market imperfections in valuation of greenfield investments render it costly to finance the latter with equity capital. Our theorization is consistent with findings of prior research (e.g. Eberhart et al. 2002) on myopic market valuation of unanticipated changes in R&D expenses of the firm. Indeed, due to high costs of capital resulting from capital market mispricing and to benefit their existing shareholders, MNCs often tailor subsidiaries as an incremental approach to diversification (Teece 1986) that largely employs debt or retained earnings (Yip 1982; Hennart and Park 1993).

In contrast to their valuation of greenfield product development in new markets, capital markets may be more efficient in their pricing of product acquisitions. Greater competition for acquisitions and greater discipline in the market for corporate control results in fewer asymmetries between managers and investors (Chatterjee 1990; Williamson 1975). Further, information on the target's existing products and markets is more easily available, rendering it easier to assess complementarities with those of the acquiring MNC as well as payoffs.

The above arguments emphasize the relatively higher costs of deploying equity capital in greenfield R&D investments. Given the relatively lower costs of equity financing for acquisitions, managers may be motivated to exploit superior market performance through

acquisition of firms with exchange of stock (Copeland and Weston 1983; DeAngelo, DeAngelo and Rice 1984). Therefore, we posit:

Proposition 1a: The greater the market performance of the MNC, the more likely it will organize innovative activity in the emerging market through acquisitions.

While strong stock price performance is positively associated with access to capital at lower costs, an alternate perspective is provided by prospect theory (Kahneman and Tversky 1979). The latter suggests managers will exhibit risk aversion in the face of gains and risk-seeking in the face of losses (Bazerman 1998; Kahneman et al. 1991). Superior market performance is indicative of the market's positive expectations of future cash flows from the firm and faith in its current business strategies. Therefore, it is likely that MNCs with better market performance (and hence, in the domain of gains) will exhibit risk aversion in their business strategy, whereas MNCs with lower market performance (and hence, in the domain of losses) will be more risk seeking to change their negative status quo.

Prior research (e.g. Markovitch et al. 2005) defines the riskiness of investments in capability development in terms of their potential downside and reversibility. Capital investments in greenfield subsidiaries are often significant and not easily reversible. However, although these subsidiaries may fail to develop new products that cater to the idiosyncratic tastes of the local market, they could produce tangible benefits such as leveraging low cost resources of emerging markets to reduce costs of innovation, create scale economies in coordination of standardized products across geographies, and learning. As such, the downside of greenfield subsidiaries is limited in contrast to acquisitions that involve high levels of integration risk and limited alternate uses failing integration. Therefore, acquisitions are "are not easily reversible, can be very costly, and typically involve a higher probability of a substantial loss of investment" (Markovitch et al. 2005). To the extent that acquisitions are riskier than greenfield investments in emerging markets in terms of potential downside and reversibility, and poor performers will pursue riskier strategies, we posit:

Proposition 1b: The greater the prior market performance of the MNC, the more likely it will organize innovative activity in the emerging market through wholly owned subsidiaries.

Financial Market Expectations and Organization of R&D

Financial market performance, in addition to providing access to capital and influencing the risk seeking behavior of firms, may also convey investor expectations for future business strategies that influence the choice of entry mode. Business strategies often emphasize one of revenue growth or margin improvements that in turn, trigger different responses from investors. The difference in market response to increase in revenue growth versus profitability defines the relative value of revenue growth for the firm (Mass 2005; Rappaport et al. 2001).

A firm's choice of acquisitions or subsidiaries for development of capabilities has different impacts on revenue and margin improvement. Acquisition of new products of the target also provides access to allied networks, operations and markets of the target. Thus, acquisitions of new products are viewed as "*strategies that enhance the product line in the short run*" (Markovitch et al. 2005), and are consequently, associated with increase in revenue of the parent corporation. However, even if the acquired product line is successful, the company must still incur the costs of integration of the target's structures and processes with the parent. Indeed, growth in revenue from acquisitions is often accompanied by an increase in short-term costs and consequent decline in short-term profitability.

On the other hand, wholly owned R&D subsidiaries may be viewed as a phased approach to new product development (Teece 1987) that can produce basic learning and improve the MNC's overall R&D capabilities instead of being linked to the success or failure of any particular product(s) and increase in short-term revenue. Greenfield subsidiaries are also often part of a global product strategy that emphasizes product coordination across geographies to yield cost efficiencies and scale economies rather than a multidomestic strategy that emphasizes product adaptation to yield revenue increases (Harzing 2002). Given that wholly owned R&D subsidiaries are more likely to yield long-term margin improvements rather than short-term revenue increases, MNCs are more likely to use them to organize their R&D capabilities when market expectations of profitability dominate growth:

Proposition 2: The greater the relative value of growth (versus profitability) of the MNC, the more likely it will organize innovative activity in the emerging market through acquisitions.

Volatility in Stock Market Returns and Organization of R&D

As noted earlier, managers are incentivized to reduce volatility in stock market returns for various reasons. Increases in past volatility often motivate managers to prevent shortfalls in earnings and signal less underlying uncertainty in income to investors (Chakravarty and Grewal 2011). Therefore, budgetary cuts in value generating functions that are marked by uncertainty in future cash flows, and which increase short-term earnings are not uncommon in response to prior volatility in returns (Bushee 1998, Mizik and Jacobson 2007).

We posit that budgetary constraints imposed by stock market volatility will impact the mode of development of innovative capabilities by the MNC because R&D subsidiaries and acquisitions differ in terms of their riskiness, capital outlay and allied cash outflows. As noted earlier, subsidiaries represent a phased approach to diversification that is often funded through slack resources over longer periods of time (Chatterjee 1990; Teece 1982). In contrast, acquisitions require an upfront infusion of cash, debt or equity capital financing equal to the expected future cash flows from the project. Therefore, acquisitions are more costly and involve a higher probability of substantial loss of investment.

Further, subsidiaries largely involve replication of processes and structures of the parent or other R&D centers rather than creation or integration of new structures and processes, as is the case in acquisitions. For these reasons, unforeseen contingencies and risks are lower in the case of subsidiaries, and resultant cash outflows are more predictable. To the extent these subsidiaries are part of global product strategies that leverage the R&D capabilities of emerging markets to reduce costs of innovation and create scale economies in coordination of standardized products across interconnected global markets, such predictability in future cash flows is even higher.

Finally, product acquisitions are characterized by limited alternate product uses failing integration. On the other hand, the phased nature of investments in subsidiaries renders them more reversible at lower costs. The similarity between structures and processes of the subsidiary and other organizational units also renders the assets in these subsidiaries more re-deployable than those of an acquired company. For instance, the subsidiary could leverage low cost resources of emerging markets to create scale economies in coordination of standardized products across geographies and reduce the costs of innovation.

For the above reasons, MNCs, characterized by significant volatility in stock market returns, are more likely to organize innovative activities through greenfield subsidiaries to signal lower risks and greater predictability in future cash flows. Therefore, we posit:

Proposition 3: The greater the volatility in stock market returns of the MNC, the more likely it will organize innovative activity in the emerging market through greenfield subsidiaries.

EMPIRICAL ANALYSES

Data

We use data on 154 R&D subsidiaries or captive centers established by US MNCs in technologyintensive industries in India between 1990 and 2009, and 94 acquisitions of Indian companies by US MNCs in these industries during this time period. Our focus on US MNCs in India allows us to bring out more clearly the impact of firm attributes such as market performance, expectations and firm risk on their mode of development of R&D capabilities. In particular, in eliminating multiple host countries, we can separate firm effects that we are interested in from that of host country regulations and investment climates. Our focus on stock market performance, expectations, and volatility also renders it problematic to study the entry strategies of firms based in different countries. International differences in accounting rules, reporting requirements, and market risks such as volatility of the local currency render it difficult to effectively compare differences in market performance, expectations and risk across firms based in many different countries. A focus on the mode of development of innovative capabilities of US MNCs in India through rich firm-level data while controlling for industry effects, allows us to better analyze the impact of the financial variables of interest to us on the mode of organization of innovation.

The data on R&D centers in India are obtained from a census conducted periodically by Zinnov Consulting. Zinnov's census comprises an installed base of nearly 700 captive R&D centers of MNCs in India including 452 centers of US MNCs (Zinnov Consulting, 2011). Only wholly owned R&D subsidiaries are considered in Zinnov's census. We collected information from news sources as Factiva to identify subsidiaries that were in fact, cost centers or back-office centers, but were misclassified as R&D subsidiaries. We also used these news sources to verify the US parent's stake in the Indian center, time of inception of the center, and the strategic objectives of the center. The data on acquisitions are obtained from Thomson Financial's Securities Data Corporation (SDC) and Zephyr databases. WE identified 94 transactions where the acquirer was a US based firm and the target, an Indian company. In this case too, we collected information from Factiva to verify various details of the acquisitions – value, reasons for entering the acquisition, mode of payment for the acquisition, and the time of the acquisition.

Three additional filters were applied to the above data to arrive at the final sample. First, we eliminated those subsidiaries and acquisitions where the parent or acquirer was a private US firm. Second, we selected only those transactions that occurred in technology intensive industries. Technology intensive environments are characterized by high rates of product and technological development, information change, and turbulence (Mendelson and Pillai 1998; McAfee and Brynjolfsson 2008). For instance, McAfee and Brynjolfsson (2008) find that turbulence, as reflected in the average jump in sales rankings of firms in an industry, and performance spread between the top performers and laggards in an industry were markedly higher for technology-intensive industries. In turn, companies in these industries are more likely

to leverage new markets, new products and new linkages with other firms in order to cope with these challenges (Duysters and Hagedoor 2002, Osborn and Hagedoorn 1997). This high pace of technological development, multitude of new market expansions and product alliances make technology intensive industries particularly attractive for studying organization of innovation. The US Department of Labor (Hecker, 1999; Kask and Sieber, 2002) considered industries as technology intensive if employment in R&D and technology-oriented occupations was at least twice the average for all industries. These technology-orientated workers per thousand workers. Stern (2005) points to four frequently referenced studies that have followed this approach in the literature - Hecker (1999), the Organization for Economic Co-operation and Development (OECD, 1993), The Bureau of the Census, and the Milken Institute's study of "High Tech America" (DeVol and Wong, 1999). Industries that have been identified by at least one of these studies were included in the current study, producing a list of 31 three-digit SIC codes that defined technology-intensive industries.

Finally, we use the Center for Research on Security Prices (CRSP) files to compute stock market performance, expectations, and risk, and the Compustat Basic and Research files to assess characteristics of the parent firm/ acquirer. Those transactions for which these data were not available were eliminated. Our final sample comprised 154 wholly owned R&D subsidiaries and 96 acquisitions by US MNCs in the Indian market.

Measures

Dependent Variable

The mode of development of innovative capabilities by the US MNCs in India is captured by a dummy variable. The latter is assigned a value of one if the US MNC established a wholly owned subsidiary and zero of it made an acquisition.

Independent Variables

Prior Market Performance

Following prior research (Eberhart et al. 2003; Sood and Tellis 2009; Chakravarty and Grewal 2011), we use abnormal returns, to assess firm value, as the measure of market performance of firm f in period t. We estimate two types of abnormal returns for the twelve-month period preceding the month of establishment of the subsidiary or acquisition – event-time buy-and-hold abnormal returns (BHAR) and calendar-time abnormal returns.

BHAR have become the standard method of measuring long-term abnormal returns (Barber and Lyon 1997; Lyon, Barber and Tsai 1999) to an event. The BHAR for stock i over holding period T is estimated as:

$$BHAR_{i,T} = BHR_{i,T} - BHR_{m,T}$$
⁽¹⁾

where $BHR_{i,T}$ is the buy-and-hold return of the sample firm and $BHR_{m,T}$ is the buy-and-hold return of the matching control firm over the same period. Here, the buy-and-hold return for holding period *T* beginning time *a* through time *b* is:

$$BHR_{i,T} = \left[\prod_{t=a}^{b} (1+r_{it}) - 1\right],$$
(2)

where r_{ii} is the return for firm *i* in month *t*. In this study, we estimate BHAR for the twelve months preceding the event. Following Barber and Lyon (1997), we consider an industry, size-and book-to-market matched sample as a benchmark portfolio.

Certain studies (Fama 1998; Mitchell and Stafford 2000) argue that BHAR measures magnify underperformance through compounding single-period returns. Further, the use of BHARs does not adequately account for potential cross-sectional dependence in returns, thereby, resulting in biased estimates. To address these issues with event-time BHARs, we also estimate abnormal returns using the Fama and French (1993) three-factor model:

$$R_{pt} - R_{ft} = \alpha + \beta_m (R_{mt} - R_{ft}) + \beta_s SMB_t + \beta_h HML_t + \varepsilon_t$$

where R_t is the excess return to a stock in calendar month t, R_{ft} is the risk-free interest rate, R_{mt} is the CRSP value-weighted market index return, SMB_t measures growth risk, and HML_t measures value risk. The expected value of the intercept (α) in the above equation measures the monthly abnormal return in excess of that achieved by passive investments in the factors; it is zero under the null hypothesis of market efficiency. The implied one-year abnormal return is $[(1 + \alpha)^{12} - 1]$, the estimated average buy-and-hold return resulting from earning the intercept return every month for 12 months. All standard errors in the model are corrected for heteroskedasticity.

In addition to examining the effect of prior market performance on entry mode, we also analyze the impact of its interaction with prior operating and technological performance of the MNC. Operating performance is measured as the net income per employee as of the year preceding that of the acquisition or greenfield investment. We measure technological performance as the average number of patents (normalized by total assets) awarded annually to the parent MNC for the three-year period preceding that of the acquisition or greenfield.

Market Expectations

We draw on Mass (2005) to estimate the relative value of growth (RVG) to the parent firm/ acquirer. RVG is estimated as the ratio of the value of growth to the value of margin improvement. The value of growth is estimated in two steps. In the first step, we build a basic perpetuity growth model to estimate the embedded growth rate in the value of the firm:

$$EV = \frac{CF}{WACC - g} , \qquad (1)$$

where EV is the enterprise value of the MNC, CF is the sustainable cash flow, WACC is the weighted average cost of capital and g is the embedded growth rate. Here, EV is estimated as the sum of the market value of equity and book value of net debt (Mass 2005; Healy et al. 1990). Market value of equity is the product of the annual closing price of the stock and the number of shares outstanding. CF is estimated as sales, less cost of goods sold, and selling and

administrative expenses, plus depreciation and goodwill expenses (Healy et al. 1990). In the case of firms with both debt and equity financing, the after-tax weighted average cost of capital (WACC) (Modigliani and Miller 1958) can be computed as:

$$WACC = \left(\frac{E}{D+E}\right)r_e + \left(\frac{D}{D+E}\right)r_d(1-T), \qquad (2)$$

where:

E = market value of the firm's equity;

D = market value of the firm's debt;

 $r_e =$ the firm's cost of equity capital;

 \mathbf{r}_{d} = the firm's cost of debt capital; and

T = the firm's rate or corporate taxation.

We use the above estimates of WACC and EV to solve for g in (1). This allows for an estimation of the value of growth - the gain in enterprise value, EV, which would result from increasing the growth rate by an additional percentage point.

In order to estimate the value of margin improvement, we estimate equation (1), with the above computed values of WACC and embedded growth rate, g. The cash flow, CF, is estimated as the increase in net income resulting from a 1% improvement in operating margins adjusted for the corporate tax rate. The ratio of the value of growth to the value of margin improvement reflects the relative value of growth to the MNC.

Volatility in Stock Market Returns

Volatility in stock market returns represents firm risk. We estimate and use two measures of firm risk in the analyses. First, we calculate the standard deviation of the daily residuals of the Fama and French (1993) four-factor model as a measure of the idiosyncratic risk of the firm (Chakravarty and Grewal 2011; Tuli and Bharadwaj 2009). We use a measure of overall firm risk, calculated as the standard deviation of one-year daily stock returns preceding the investment

(Carter et al. 1998, Dewan et al. 2007). For reasons of brevity, a summary of the above variables and their measures is provided in an online appendix to this document.

Controls

The analyses also control for several variables that have been used in prior research (e.g. Harzing 2002, Hennart and Park 1993, Chatterjee 1990) on the choice between greenfields and acquisitions. These include the MNC's prior experience of the Indian market, degree of product diversification, leverage, R&D intensity and the year of establishment of the subsidiary.

Methodology

The econometric specification of the model takes the form $P(Y_{ii} = 1) = \phi(\beta X_{ii})$, where Y_{ii} represents the mode of capability development selected by firm *i* in date *t*. Y_{ii} is assigned a value of one if the US MNC established a wholly owned subsidiary and zero of it made an acquisition. X_{ii} is a vector of attributes - market performance, expectations, risk and other control variables - that impact the choice of acquisitions versus greenfield investments, and β is a vector of estimated coefficients for these characteristics. A clustered robust logistic specification (Petersen 2009; Cameron et al. 2011) was employed to account for potential correlations across clients within a certain time period and within clients across time. The clustered logistic specification accounts for residual effects correlated across observations (Petersen 2009) by generalizing the independent heteroskedastic errors of White (1980) to provide unbiased estimates. In addition to the pooled estimates, we also report results of a random effects specification.

We use lagged instead of contemporaneous regressors in our model for three reasons. First, the hypotheses in this study pertain to how *ex ante* market performance, expectations and risk affect access to capital and the risk seeking behavior of firms and in turn, the choice of R&D captive centers or acquisitions. Further, Blonigen and Taylor (2000) argue that a model of acquisition activity may be better specified with contemporaneous regressors *"if firms can find* *targets and finalize deals quickly*". However, establishing a subsidiary or acquiring another firm in a new market involves significant time, including that of evaluating country risks, market potential, searching and finding an appropriate target firm, and successfully finalizing a deal. Finally, contemporaneous regressors introduce endogeneity concerns and simultaneity bias that result from the possibility that the mode of capability development in the Indian market can influence future financial performance and the performance impacts of consolidation of financial statements in the case of acquisitions.

RESULTS

Panel A of Table 1 lists the distribution of our sample firms across primary SIC codes. Given our focus on technology-intensive industries, primary SIC codes 0(Agriculture, Forestry, and Fishing), 1(Mining and Construction), 5(Wholesale and Retail Trade), 6(Finance, Insurance, and Real Estate) and 9(Public Administration) are not represented in this study. The distribution indicates some clustering; to address bias arising from industry clusters, we report industry adjusted BHAR. Also included is the sample distribution across the choice of greenfield investments and acquisitions. The former constitute nearly 62% of the sample.

Panel B of Table 1 lists some of the characteristics of the sample firms and contracts. As of the beginning of the contract implementation year, the mean (median) market value of equity of our sample firms is \$18.3 (\$2.9) bn. The mean (median) market to book ratio is 2.5 (3.2). We control for these size and value effects in our analyses.

Table 2 presents cross tabulations of the raw data showing the association between the likelihood of choice of investments in product acquisitions and market attributes – prior market performance, expectations and volatility. Panel A reports the likelihood of acquisition of knowhow by the MNC in India for the lowest and highest triad of firms ordered by market performance, expectations and risk. The "difference" column reports the difference in the probability of making an acquisition between the two sub-samples. The results provide

preliminary evidence in support of our theoretical arguments. On average, the choice of an acquisition relative to a greenfield investment is 20% more likely with greater market performance, 12% more likely for greater market expectations, and 27% less likely for greater volatility in stock market returns. The positive association between market attributes and the likelihood of greenfield investments in wholly owned subsidiaries is also reflected in differences in the average number of greenfield investments between different quartiles of performance, expectations and risk. The average number of acquisitions made in the lowest quartile of market performance is 14, lowest quartile of expectations of growth versus profitability is 22, and highest quartile of idiosyncratic risk is 13. The equivalent estimates are 33 for the quartile with high market performance, 29 for high market expectations and 35 for low idiosyncratic risk.

Panel A of Table 6 reports the event-time abnormal returns for the one year preceding the year of establishment of the subsidiary or acquisition. The pre-event BHAR are an insignificant - 7.0 percent for the portfolio of MNCs investing in greenfield subsidiaries while the corresponding estimate for the portfolio of firms investing in product acquisitions is 23.2 percent (p<0.05). Panel B reports the calendar-time abnormal returns after attribution to the Fama and French (1993) factors. MNCs that organized their R&D capabilities through greenfield subsidiaries earned an insignificant one-year return of 7.4 percent [(1+0.002)¹² – 1]. The equivalent estimate for MNCs that invested in acquisitions in the Indian market is 35.1 percent (p<0.05). The results for pre-event BHAR and calendar time abnormal returns provide evidence for a positive association between prior market performance and the likelihood of acquisitions.

The results of the logistic specification are presented in Table 4. Model I presents the baseline specification with controls alone. Models II – V test the impact of market performance, expectations and risk on the likelihood of developing innovative capabilities through greenfield investments. Models II and III controls for firm and time effects by clustering standard errors by firm and year of implementation of the outsourcing contract. A Hausman test finds random effects estimators are consistent and efficient. These results are reported in Models IV and V.

Models II and IV specify event-time abnormal returns while Models III and V specify calendartime abnormal returns. The fully specified equations in Models II- V have high explanatory power, reflected in the significant chi-square values, log-likelihood ratios, and pseudo R-squares. All control variables in Model I, the baseline model, are significant. Therefore, our results confirm the explanatory power of these variables as well as the comparability of our sample relative to prior research on organization of capabilities in new markets. Results for the fully specified model (Models II - V) support our hypotheses - firms' access to external capital, investor expectations of growth, and the risk profile of firms all influence the mode of capability development by the firm in new markets.

The results in Table 4 support Hypothesis 1a – the greater the market performance of the firm, the greater is the likelihood of choice of acquisitions. Equity gains, estimated over a long horizon (twelve months or more), are associated with real economic gains and are less likely to be an outcome of capital market inefficiencies or chance (Eberhart et al. 2004). The profitability of a firm is an important signal of economic gains to the firm. Thus, we include net income per employee for the year preceding the year of acquisition or greenfield investment, and assess the impact of its interaction with BHAR for the same twelve-month period on the mode of capability development. Model I in Table 5 reports these results. For firms in technologyintensive industries, technological performance too is an important economic gain. Indeed, technological performance is often at odds with short-term profitability since firms often modify R&D budgets to improve immediate profitability and stock market performance. However, these myopic modifications may reduce technological performance and in turn, reduce long-term stock returns and increase the firm's vulnerability to competitors (Melaetal 1998; Lehmann 2004; Lodish and Mela 2007). Therefore, in addition to profitability, we also estimate the average number of patents filed annually by the firm during the five years prior to the year of acquisition or greenfield investment, and assess the impact of its interaction with the twelve-month BHAR on the likelihood of choice of greenfield investments. Model II in Table 5 reports these results.

These results are largely robust to the use of both event-time and calendar-time abnormal returns. However, for brevity, we report results of interactions between market, financial and technological performance only for event-time abnormal returns.

We find that the greater the profitability of the firm, the greater is the impact of abnormal stock market returns on the likelihood of acquisitions. Greater profitability reduces any noise associated with market value, and provides clearer signals to the market of the firm's strategic abilities. Resultant investor confidence, in turn, reduces the costs of equity capital that increases the likelihood of acquisitions. On the other hand, superior technological performance suggests that the firm has a robust product pipeline that it can leverage in entering new markets. In such case, notwithstanding information asymmetries and allied costs of capital, firms may decide to invest in greenfield subsidiaries that leverage existing product performance to increase long-term market value. Indeed, we find that the greater the technological performance of the firm, the greater is the impact of stock market returns on the likelihood of greenfield investments. The moderating impact of technological performance is likely to be more significant in the case of MNCs with global product strategies (Harzing 2002). However, we do not have data on the product strategy of the MNC – future research could contrast how technological performance moderates the impact of market performance on the choice of acquisitions versus greenfields differently for firms with global product strategies versus local strategies.

The results in Table 4 also provide strong support for Hypothesis 2 – market expectations of growth versus profitability share a positive association with the likelihood of choice of acquisitions. It is likely that the industry context in which firms are situated influences their response to market expectations of growth. For instance, as competitive intensity in the market declines and industry concentration increases, the resultant increase in market share of firms yields greater cash reserves (e.g., Vossen 1999) and profits (e.g., Syzmanski et al. 1993). Therefore, as industry concentration increases, increased slack resources will enable firms to be less dependent on external capital such as equity capital (e.g., Titman and Wessels 1988). In turn,

these firms may be less responsive to market pressures and expectations. We estimated the Herfindahl-Hirschman index (HHI) as a measure of concentration in the MNC's industry. We control for the industry HFI and assess the impact of its interaction with market expectations of growth on the likelihood of choice of subsidiaries versus acquisitions. The results are robust to this specification, providing support for Hypothesis 2; however, market concentration and its interaction with growth expectations do not impact the MNC's mode of organization of economic activity Given the competitive intensity of technology-intensive industries, it is not surprising that the mean HHI for the sample is 0.09, suggesting little concentration. We removed data where HHI was greater than 0.5; our results hold for this sample too.

The results for the fully specified model in Table 4 also support Hypothesis 3 – the greater the volatility in market returns of the MNC, the more likely it will organize innovative activity in the emerging market through greenfield subsidiaries. A key assumption behind this hypothesis is that acquisitions involve greater risk or uncertainty in future cash flows than greenfields. Indeed, we find that the post-event risk, as measured by the standard deviation of the daily residuals from the Fama and French three-factor model for the three-year period following the establishment of the subsidiary or acquisition, is significantly higher for the acquisitions (p<0.05). Similarly, the variance in free cash flow following the event is also significantly higher for acquisitions. The variance in free cash flows for the three-year period following the establishment of a subsidiary is USD 2.64 million while that following an acquisition is USD 3.74 million. Equivalent estimates for the five-year period following the establishment of the subsidiary or acquisition and USD 7.46 million respectively.

The data were subject to various robustness checks. First, we removed outliers with large market and financial value. Further, we eliminated firms that engaged in both acquisitions and greenfields. Finally, we included measures of both idiosyncratic and overall risk as predictors of the mode of organization of innovative activity. The results are robust to all these specifications.

DISCUSSION AND CONCLUSION

In technology-intensive industries, characterized by high levels of volatility and information churn, R&D is critical to firm competitiveness. In response to the rising costs, speed and complexity of technological innovations, multinational companies (MNCs) in these industries are increasingly leveraging emerging markets to develop new innovative capabilities. These new capabilities may be organized through greenfield investments in wholly owned subsidiaries or acquisition of extant products and know-how. This study finds that a set of market variables that have not been considered in prior research on organization of capabilities – stock market returns, market expectations of growth versus profitability, and stock market volatility – have a significant impact on the mode of capability development, with lower market performance, lower market expectations of growth, and higher volatility in returns being significantly correlated with greenfield investments in wholly owned R&D subsidiaries. Therefore, this study extends the literature on entry mode and organization of firm capabilities. In doing so, this research also extends the literature that has underscored the importance of research at the interface of strategy and finance (e.g. Bettis 1983).

The decision to acquire new products and know-how or establish a wholly owned R&D subsidiary may also be viewed as the choice between value creation and appropriation respectively². Our results are consistent with prior research that asserts, "value creation capability is more important in environments in which technology is changing (i.e. in high-technology industries)" (Mizik and Jacobson 2003). The results emphasize on average, firms in technology-intensive industries use capital infusions to create value through acquisition of new products. However, such impact is moderated by performance changes that underlie the change in market value of the firm. We find for a given level of technological product performance, marginal improvements in

² Value creation and value appropriation interact with each other to create competitive advantage for the firm. The former involves the creation of customer value through the innovation, production and delivery of products to the market while the latter focuses on appropriating value in the marketplace through extraction of profits from extant products. To the extent that R&D subsidiaries are associated with global product strategies or coordination of extant products across geographies, they may be viewed as part of value appropriation strategies. On the other hand, acquisition of new products for extant markets as part of multidomestic product strategies may be viewed as part of value creation strategies of the firm.

profitability are likely to be invested in creating value. This is likely because changing customer preferences and high rates of product development result in dissipation of profits from existing products; therefore, firms invest profits from existing products in developing new products at a faster rate than that at which their existing advantages are likely eroded by competition. On the other hand, for a given level of profitability, marginal improvements in technological performance are associated with greater likelihood of value appropriation through greenfield investments. This result suggests that firms with robust rates of product development focus on capitalizing these innovations or appropriating value from them in new markets. The above results for moderating impact of financial profitability and technological performance help to resolve competing hypotheses in the literature regarding the impact of market performance on the choice to create or appropriate value (Mizik and Jacobson 2003).

This study asserts that one of the reasons firms do not invest equity capital in wholly owned R&D subsidiaries is because greater information asymmetry between managers and markets about the potential value of the subsidiary increases the costs of such capital. To determine whether the market is slow to incorporate information on greenfield R&D investments, we estimate the long-term abnormal returns following the establishment of the R&D subsidiary. Corroborating our view on information asymmetry between managers and markets on potential gains from greenfield investments, we find the three-year buy-and-hold abnormal returns following the establishment of the subsidiary are 8.1% (p<0.01). In other words, the market is slow to incorporate information on potential gains from greenfield R&D.

Our measure of relative value of growth versus profitability provides a simple way to estimate market expectations. The significant impact of these expectations on R&D organization suggests that markets are also an important source of intelligence for firms. However, we do not comment on the efficiency of the decision to respond to market expectations. For e.g., a firm, in acquiring new products at speed, may be myopic or ignoring private information on its abilities to integrate new products that in turn, influence its ability to leverage the acquired firm's product portfolio. The mean operational performance of the sample firms engaging in acquisitions decreases over the three-year period following the implementation of the acquisition. The median sales efficiency for this period is USD 257,000 compared to USD 227,000 in the year of the acquisition; the median income efficiency for this period is USD 12,000 compared to USD 14,000 in the year of the acquisition; the median RoA for this period is 4.2 percent compared to 5.2 percent in the year of the acquisition. Therefore, on average, there is an insignificant change in the operational performance of the acquiring firm after the implementation of the acquisition.

The above preliminary results for post-event performance emphasize a limitation of our study, which is common to other studies on organization of capabilities or mode of entry in new markets – we do not assess the normative efficiency of our model. Further, the above preliminary results for post-event performance are not sufficient evidence of such efficiency. A comparative analysis of long-term market and operational performance of firms engaging in these two modes of capability development, including the drivers of such performance, constitutes an interesting avenue for future research. Such studies, in addition to establishing the normative efficiency of R&D subsidiaries versus acquisitions, will provide insights into the operational challenges of managing these two modes of R&D organization.

Future research could also analyze firm attributes such as ownership structure, board composition, or market share that are more likely to impact response to market expectations and performance. Further, although this study examines the association between market performance and entry mode in high-tech industries, it may be instructive to test the generalizability of our findings to other industries that are also expanding innovation activities in emerging markets.

Notwithstanding these limitations, the study is one of the first to extensively examine the role of financial markets in organization of innovation. The finding that strategic decisions of firms in technology-intensive industries respond to market performance and expectations does not imply that managers respond directly to market changes. Rather, the result points to pressures from the board and institutional investors to efficiently deploy capital, develop a viable

strategic emphasis for business strategy, and initiate corrective actions in key areas. Firms should be wary if this is not the case and the stock market is driving the firm's R&D organization decisions since such decisions will have an adverse impact on long-term fundamentals and lead to negative investor reactions in the long-term. Indeed, if future research finds that the response of the firm to market performance and expectations is not efficient, firms may be required to disclose detailed information on their R&D activities. Such call for improved disclosure is consistent with prior research (Chakravarty and Grewal 2011), and reduces the information acquisition and learning costs for investors, and in turn, the costs of capital for the firm. The study points to these important avenues for future research.

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Appendix: Figures and Tables

Table 1: Sample Characteristics of Greenfields and Acquisitions, 1990 – 2009 Panel A: Distribution of sample firms across primary SIC codes

	1						
		Green	nfields	Acqui	sitions	All I	Deals
SIC	Sector	Num	% of all	Num	% of all	Num	% of all
			deals		deals		deals
2	Manufacturing	12	8%	20	21%	32	13%
3	Manufacturing	81	53%	43	45%	124	50%
4	Transportation, Communications, Electric, Gas, & Sanitary Services	2	1%	0	0%	2	1%
7	Lodging and Entertainment	58	38%	29	30%	87	35%
8	Services	1	1%	3	3%	4	2%
	All Sectors	154	100%	96	100%	250	100%

Panel B: Sample P	Parent Charact	teristics
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	Ν	Mean	Median
Market Value of Equity (\$B) – Acquisitions	96	24.2	4.3
Market Value of Equity (\$B) – Greenfields	154	12.5	2.4
Market to Book Ratio – Acquisitions	96	2.2	2.5
Market to Book Ratio – Greenfields	154	2.8	3.6
Pre-event BHAR (%)	250	4.6	-5.2*

Pre-event income efficiency	250	-7.9	13.5
Pre-event stock market volatility	250	10.2	8.7

|--|

Likelihood of Acquisitions (%)	Lowest half	Highest half	Test of difference
			(p-value)
Event-time BHAR	28.0^{***}	48.0***	20.0***
Calendar-time Returns	32.0***	45.0***	13.0**
Market Expectations	35.0***	46.7***	11.7
Firm Risk	52.0***	24.8***	27.2***
* **			

*p<0.10, **p<0.05, ***p<0.01

Table 3: Model of Abnormal Returns

Panel A: One-Year Ind/Size/BTM adjusted Buy-and-Hold Abnormal Returns (%)							
	BHAF	R - Greenfields (N=154)		BHAR - Acquisitions (N=96)			Diff
		(a)			(b)		(a - b)
Mean		-7.0			23.2**		30.2***
Panel B: Calendar-Time Portfolios: $R_{pt} - R_{ft} = \alpha + \beta_m (R_{mt} - R_{ft}) + \beta_s SMB_t + \beta_k HML_t + \varepsilon_t$							
		α	$\beta_{\rm m}$		β_{s}	$eta_{ m h}$	R^2
All Deals		0.0050^{*}	1.3724***		0.3256^{**}	-0.1822	0.55
		[1.35]	[13.37]		[2.21]	[-1.28]	
Implied 1-yr AR (%)					19.6^{*}		
Captives		0.0020	1.2270)***	-0.0689	0.2643*	0.46
		[0.37]	[9.76	5]	[-0.40]	[1.47)	
Implied 1-yr AR (%)					7.4		
Acquisitio	ons	0.0084^{**}	1.5264	4***	0.4377***	-0.5632***	* 0.57
		[1.88]	[11.01	1]	[2.55]	[-2.70]	
Implied 1-yr AR (%)					35.1**		

*p<0.10, **p<0.05, ***p<0.01

Table 4: Logistic Regressions

	Model I	Model II	Model III	Model IV	Model V
		(Two-way	(Two-way	(Random	(Random
		clustering)	clustering)	Effects)	Effects)
Market Performance					
AR_EVENT		-0.427***		-0.763***	
AR_CALENDAR			-0.472**		-0.711**
Market Expectations					
RVG		-0.633***	-0.721***	-1.002**	-1.058**
Market Volatility					
FIRM_RISK		0.580^{**}	0.671**	0.933**	1.012***
Controls					
EXP	-0.426***	-0.403***	-0.413***	-0.593*	-0.589*
DIV	-0.227	-0.288*	-0.256*	-0.459	-0.345
R&D_INT	0.807^{**}	0.726^{*}	0.651	0.818^{**}	0.756**
LEVERAGE	-0.242**	-0.126	-0.296***	-0.181	-0.421
TIME	0.732***	0.691***	0.662***	1.172***	1.061***
CONSTANT	0.633***	0.701***	0.703***	1.300***	1.222***
Ν	250	250	250	250	250

Log-likelihood	-135.96	-123.35	-123.26	-121.21	-120.95
Pseudo- R ²	0.18	0.26	0.26	0.26	0.26

*p<0.10, **p<0.05, ***p<0.01

Table 5: Interactions between Market, Technological and Financial Performance Model I Model II

	Model I	Model II
Market Performance		
AR_EVENT	-0.553***	-0.442***
Market Expectations		
RVG	-0.568**	-0.648***
Market Volatility		
FIRM_RISK	0.492	0.612**
Controls		
EXP	-0.417***	-0.412***
DIV	-0.283*	-0.277*
R&D_INT	0.710	0.759
LEVERAGE	-0.241	-0.088
TIME	0.705***	0.702^{***}
Financial and Technology	ogical Performa	ince
FIN_PERF	-0.154	
AR_EVENT x	-0.401***	
FIN_PERF		
TECH_PERF		-0.122
AR_EVENT x		0.226*
TECH_PERF		
CONSTANT		0.711***
Ν	250	250
Log-likelihood	-122.0	-122.3
Pseudo- R ²	0.27	0.27
* ** ***		

*p<0.10, **p<0.05, ***p<0.01