KATHOLIEKE UNIVERSITEIT
LEUVEN

Faculty of Business and Economics

Multinationality and downside risk:

The contingent roles of option portfolio characteristics and organizational factors

René Belderbos, Tony W. Tong and Shubin Wu

DEPARTMENT OF MANAGERIAL ECONOMICS, STRATEGY AND INNOVATION (MSI)

OR 1214

Multinationality and Downside Risk: The Contingent Roles of Option Portfolio Characteristics and Organizational Factors[*]

René Belderbos
Department of Managerial Economics, Strategy and Innovation
University of Leuven
Naamsestraat 69, B-3000 Leuven, Belgium
Rene.Belderbos@econ.kuleuven.be
&
UNU-MERIT
&
School of Busines and Economics
Maastricht University
The Netherlands

Tony W. Tong
Leeds School of Business
University of Colorado
Boulder, CO 80309-0419, United States
tony.tong@colorado.edu

Shubin Wu
Department of Managerial Economics, Strategy, and Innovation
Katholieke Universiteit Leuven
Naamsestraat 69, B-3000 Leuven, Belgium
Shubin.Wu@econ.kuleuven.be
&
School of Humanities and Law
Northeastern University of China

[*] We are grateful to Jay Anand, Dirk Czarnitzki, Seung-Hyun Lee, Michael Leiblein, and participants at the 2009 SMS Conference (Washington, DC, October 2009), the 2009 ZEW Ph.D. Workshop (Manheim, Germany, December 2009), and the 2010 AIB Conference (Rio, Brazil, June 2010) for comments on earlier versions of this paper.

Multinationality and Downside Risk:
The Contingent Roles of Option Portfolio Characteristics and Organizational Factors

ABSTRACT

Multinational operations confer firms a portfolio of switching options that offer the potential for operating flexibility in the context of input cost variability, allowing firms to reduce downside risk. In this paper, we argue that two conditions may shape the relationship between multinationality and downside risk suggested by real options theory. First, when subadditivity is present in a multinational firm's option portfolio (e.g., when the firm operates affiliates predominantly in host countries with high labor cost correlations), multinationality is less likely to reduce downside risk since less valuable opportunities exist for shifting operations. Second, when a firm's organization facilitates the coordination of cross-border activities, multinationality is more likely to reduce downside risk because the firm is better able to exploit the shifting opportunities. Analysis of a comprehensive panel dataset of Japanese manufacturing firms and their foreign manufacturing affiliates confirms that the negative impact of multinationality on downside risk is significantly stronger for firms operating in host countries with relatively low labor cost correlations. Increased control and coordination of foreign affiliates associated with greater equity stakes in the affiliates and more intensive expatriate assignment strengthen the relationship between multinationality and downside risk, in particular for those firms operating in host countries with relatively low labor cost correlations.

Keywords: Multinational firm, downside risk, switching option, affiliate portfolio, organization

Running Head: Multinationality and Downside Risk

INTRODUCTION

One important characteristic of multinational firms is that they invest in multiple countries and operate international affiliates across heterogeneous external environments (Kogut, 1989). According to real options theory, the network of international operations (Kogut, 1989: 383) provides the multinational firm with a portfolio of switching options, which confer the firm the right, but not the obligation, to shift operating activities among its cross-country affiliates in response to changes in environmental conditions (e.g., Kogut & Kulatilaka, 1994; Li & Rugman, 2007; Chi & Seth, 2009). Theoretical research suggests that, to the extent that such options offer valuable switching opportunities that the firm is able to exploit, they should enhance the firm's operational flexibility and reduce its downside risk, i.e., performance that falls below certain target (see Huchzermeier & Cohen, 1996). A number of empirical studies have examined the value of switching options and operational flexibility of multinational firms. For example, research has reported that multinational firms do shift sourcing, production, and other activities in response to input cost movements, though such shifts might be relatively modest (e.g., Rangan, 1998). International investments also reduce multinational firms' economic exposures to foreign exchange rate fluctuations, yet greater multinationality does not necessarily lead to lower levels of downside risk (e.g., Kim, Hwang, & Burgers, 1993; Miller & Reuer, 1998; Reuer & Leiblein, 2000; Tong & Reuer, 2007).

In keeping with prior arguments that an options approach to strategy has a distinguishing focus on firms' options investments for "limiting downside risk" (Bowman & Hurry, 1993: 765; McGrath, Ferrier, & Mendelow, 2004), our study investigates the downside risk implications of multinational investment. Specifically, our arguments emphasize the need to examine more closely real options theory's boundary conditions in multinational firms, and to incorporate more

explicitly organizational contingencies that may facilitate or obstruct firms' implementation of real options. We aim to make two contributions. First, our study examines how characteristics of the firm's foreign affiliate portfolio, in terms of host countries' environment, may shape the relationship between multinationality and downside risk. Research has suggested that multiple options within a portfolio can interact negatively if the characteristics of the options are correlated; in such cases, the options in the portfolio are considered subadditive (Trigeorgis, 1996; McGrath, 1997), and the value of the option portfolio is smaller than the sum of the values of the individual options. We argue that in the context of multinational switching options, subadditivity can arise from correlations in the host countries' economic conditions such as labor cost developments. Such correlations decrease the benefit of flexibility available from shifting operations across countries and thus weaken the negative impact of multinationality on downside risk. Our study's focus on the implications of subadditivity for firms' performance outcomes complements prior real options research showing that subadditivity in option portfolios affects firms' corporate strategy decisions such as market entry and exit (e.g., McGrath & Nerkar, 2004; Vassolo, Anand, & Folta, 2004; Belderbos & Zou, 2009).

Second, we examine how particular organizational characteristics of the multinational firm's portfolio of foreign affiliates can shape the relationship between multinationality and downside risk. We argue that greater equity share as well as expatriate assignment in the firm's affiliates give the firm increased control and system-wide coordination of multinational operations and therefore strengthen the negative impact of multinationality on downside risk. We further suggest that these moderating effects will be stronger for firms that have potentially the greatest switching opportunities in their affiliate portfolios, i.e., firms operating in host countries with small labor cost correlations (low subadditivity). Our theoretical arguments are

consistent with Kogut's seminal idea that whereas switching options provide the potential for operating flexibility (e.g., Kogut, 1983) the firm must possess the "organizational wherewithal" to coordinate cross-border activities between affiliates in order to benefit from flexibility (Kogut, 1985: 27). Although the importance of organizational factors is well recognized in the literature (e.g., Bowman & Moskowitz, 2001; Kogut & Kulatilaka, 2004; Coff & Laverty, 2007), few empirical studies have examined such factors, and to our knowledge no study in the real options literature has tested the joint and interactive effects of organizational characteristics and external conditions in an *integrated* manner.

We empirically test our arguments using a comprehensive panel dataset of 1,010 Japanese manufacturing firms and their foreign manufacturing affiliates from 1985 to 2006. Japanese firms are important investors in the international arena, and research suggests that these firms tend to take an integrated approach to managing their overseas manufacturing plant networks (e.g., Belderbos & Zou, 2009), making them interesting and relevant for our study on multinational operating flexibility. Our empirical findings confirm our hypotheses and support the central thesis that subadditivity in an option portfolio and organizational factors jointly and interactively affect multinational firms' ability to benefit from operating flexibility conferred by the global dispersion of activities.

THEORETICAL BACKGROUND

Initial applications of real options theory in the strategy field appeared in the context of multinational firms and the coordination of their operating activities dispersed across country borders. Kogut (1983) first argued that multinational operations provide firms with "a string of options" that offer the potential for flexibility by allowing the switching of activities within the "multinational network" (Kogut, 1989: 383). Compared to other theories of multinational firms,

real options theory emphasizes downside risk reduction and dynamic production efficiency gains, as well as the unique opportunities to shift activities in response to changes in environmental conditions (e.g., Kogut, 1985, 1989). Research has sought to extend Kogut's pioneering ideas in several ways. For example, a large amount of work has applied real options theory to examine multinational firms' strategies under uncertainty, such as their market entry and exit decisions, sequential investments, entry mode choices, and ownership strategies (e.g., Chi & McGuire, 1996; Rangan, 1998; Kouvelis, Axarloglou, & Sinha, 2001; Belderbos & Zou, 2009; Chi & Seth, 2009; Chung, Lee, Beamish, & Isobe, 2010; Cuypers & Martin, 2010; Li & Li, 2010; Brouthers, Brouthers, and Werner, 2008). For instance, Brouthers *et al*. (2008) use real options theory and transaction cost theory to study the determinants and performance implications of firms' foreign entry mode choices (i.e., exporting, equity joint venture, and wholly-owned affiliate); they find that real options variables are significant predictors of firms' entry mode choices, and that firms selecting entry modes predicted by a combined real options / transaction cost theory model report a higher level of satisfaction with subsidiary performance than firms that do not.

Theoretical and empirical research has also examined the implications of switching options for multinational firms' performance outcomes and risk levels. For example, Kogut and Kulatilaka (1994) develop an analytic model to study the option to switch production between two host countries. They find that the value of the switching option increases with uncertainty concerning the exchange rate between the currencies of the two countries, and that the flexibility to switch production to a location offering lower input costs can reduce firms' downside risk that profits are negatively affected by adverse exchange rate fluctuations. Kogut and Kulatilaka (1994) clarify that the option value of multinationality is different from that of the benefits of

geographic diversification (Rugman, 1976). For instance, as these authors argue, "(T)he benefits of diversification are created by the reduction in variance of the overall portfolio of subsidiary results. An option, on the other hand, is valuable because it gives managerial discretion to respond profitably to the realization of uncertain events (p. 125)."[1] Kogut and Kulatilaka's (1994) findings are in line with those reported in Huchzermeier and Cohen (1996), whose simulation analyses reveal that operating flexibility in firms' multinational operations can specifically reduce their downside risk, defined as the "expected deviation of the firm's value over the planning horizon from a profit level (p. 108)." Empirical research that followed the real option approach has sought to understand further the conditions under which multinational operations can enhance firms' market value (e.g., Allen & Pantzalis, 1996; Tang & Tikoo, 1999; Tong, Reuer, & Peng, 2008; Lee & Makhija, 2009) or reduce firms' downside risk (e.g., Reuer & Leiblein, 2000; Tong & Reuer, 2007; Driouchi & Bennett, 2011).

This study seeks to advance existing knowledge of the flexibility benefits afforded by multinational operations, particularly downside risk reduction by multinationality given option theory's distinctive focus on limiting downside risk (e.g., Bowman & Hurry, 1993: 765). Specifically, our arguments emphasize the need to examine more closely real options theory's boundary conditions in multinational firms, and to incorporate more explicitly organizational contingencies that may facilitate or obstruct firms' implementation of real options. First, prior analytical modeling research finds that while switching options offer operating flexibility in general, correlations in input cost developments (e.g., exchange rate, labor cost, raw material cost) between host countries can decrease the value of the options, reducing the benefits of flexibility (e.g., de Meza & van der Ploeg, 1987; Dasu & Li, 1996; Kogut & Kulatilaka, 1994).

[1] In a supplementary analysis below, we report an empirical test distinguishing the real options perspective of downside risk from the geographic diversification perspective of the variance of firm performance.

This finding is consistent with a core argument in option theory that the values of individual options in an option portfolio may be subadditive when characteristics or outcomes of these options are highly correlated, and we further develop this argument in the research context of multinational firms and operating flexibility below. Second, prior research also emphasizes the importance of understanding firms' ability to coordinate multinational activities in order to identify and exercise the embedded switching options for achieving flexibility (e.g., Kogut, 1985; Kogut & Kulatilaka, 1994; Rangan, 1998). In developing our hypotheses below, therefore, we pay explicit attention to the role organizational factors may play in shaping the flexibility benefits of multinational operations and moderating the relationship between multinationality and downside risk. Third, we develop hypotheses suggesting that option portfolio subadditivity and organizational factors will have an interactive effect such that the moderating effects of organizational factors will be stronger for multinational firms operating manufacturing affiliates in host countries with smaller labor cost correlations.

HYPOTHESES DEVELOPMENT

Subadditivity in Option Portfolios

Researchers have suggested that firms undertaking multiple investment projects can be viewed as possessing a portfolio of real options (e.g., Bowman & Hurry, 1993; Luehrman, 1998; Zingales, 2000). However, the values of the individual options in a portfolio may be subadditive because of option interactions, i.e., the value of a portfolio of options may be less than the summation of the values of these options if they were independent. Milgrom and Roberts (1990) develop the notion of subadditivity in terms of correlated cost functions and optimal designs of organization practices. Extending their notations to options, subadditivity between two real options, A and B, in an option portfolio can be defined as: $V(A, B) < V(A) + V(B)$, where $V(A, B)$ denotes the

value of the option portfolio, and V(A) and V(B) denote the value of the two individual options, respectively. Real options research recognizes that individual options within a portfolio may be subadditive in their values due to redundancies or overlaps among multiple investments (e.g., Trigeorgis, 1996; McGrath, 1997), reducing the option value of the portfolio as a whole. Consistent with this logic, McGrath and Nerkar (2004) find that firms are less likely to take out additional options (i.e., patents) in technological areas where they previously have acquired options. In terms of divestment decisions, Vassolo *et al*. (2004) first show that subadditivity in the form of an alliance's technological proximity to that of other alliances in the firm's portfolio increases the likelihood of the alliance being divested. More recently, Belderbos and Zou (2009) find that, controlling for other factors, a foreign affiliate is more likely to be divested when it is more subadditive in the multinational firm's portfolio of affiliates, such as when the economic conditions of the affiliate's host country are highly correlated with those of the other countries in which the firm operates; this is because in this case, the option value of the affiliate is partially redundant to the option value of the multinational firm's overall affiliate portfolio.

The idea that options may be subadditive applies to multinational firms operating a portfolio of manufacturing affiliates in multiple countries that confers switching options for manufacturing activities. Such subadditivity is a function of potential correlations in economic conditions in the external environments of the countries in which the firm operates. For instance, Kogut and Kulatilaka (1994) show through an analytical model that as the input costs in two host countries become more correlated, the value of switching operations between the affiliates in these countries will decrease. Extending their analysis to operations across multiple countries, the options in a multinational firm's affiliate portfolio will be more subadditive, the greater the correlations in the input cost conditions in these countries; by contrast, the firm's affiliate

portfolio is likely to experience less subadditivity, the smaller such correlations. This idea is in line with earlier analytical research suggesting that correlations in production cost fluctuations among multiple host countries can decrease the value of shifting activities across these countries and affect firms' risk and profit levels (e.g., de Meza & van der Ploeg, 1987).

The notion of subadditivity in the multinational firm's option portfolio is conceptually different from the idea of decreasing marginal benefit with increasing multinationality (e.g., Contractor, Kundu, & Hsu, 2003; Lu & Beamish, 2004; Qian, Khoury, Peng, & Qian, 2010). Subadditivity focuses on the *correlations* between options (their characteristics) in a firm's option portfolio, rather than the number of options in the firm's portfolio. In our study's context, subadditivity focuses on the characteristics of the host countries in which the firm operates, rather than the sheer number of countries in which the firm has operations. As one example to illustrate this, a firm operating in two host countries can experience high subadditivity if the characteristics (such as labor cost movements) of these two countries are highly correlated, whereas according to prior findings, declining marginal returns to multinationality usually do not occur for multinationality involving just two countries.[2]

We suggest that subadditivity may shape the impact of multinationality on firms' downside risk. Specifically, to the extent that subadditivity among individual options in the multinational firm's affiliate portfolio exists, it will reduce the benefit of operating flexibility because less valuable opportunities exist for the firm to shift production and other activities. The higher the degree of subadditivity, the smaller the contribution of investing in multiple countries to the flexibility potential of shifting the firm's activities across countries (e.g., Kogut & Kulatilaka, 1994), and the less such investment will reduce downside risk. One important source

[2] In an extension below we examine the implications of including the squared and cubic terms of multinationality. Results show that it is subadditivity rather than the number of countries *per se* that leads to the reduced downside risk of multinationality.

of subadditivity in multinational operations that has received the most research attention is correlations in labor costs among the countries in which the firm operates affiliates (e.g., de Meza & van der Ploeg, 1987; Kogut & Kulatilaka, 1994; Dasu & Li, 1997). For manufacturing firms, labor cost development is a particularly critical consideration in international manufacturing and a major driver of foreign direct investment (e.g., Kouvelis *et al*., 2001). This focus is consistent with prior research on multinational plant configurations and operating flexibility, where minimizing production cost is one of the primary objectives (e.g., de Meza & van der Ploeg, 1987). Prior theoretical research and analytical models have suggested a negative impact of multinationality on downside risk (e.g., Kogut & Kulatilaka, 1994; Huchzermeier & Cohen, 1996). Given the role of subadditivity in shaping the value of option portfolios as discussed, we propose that the negative impact of multinationality will be weaker for firms that experience high correlations in labor costs among the host countries in which they operate than firms that experience low correlations:

> ***Hypothesis 1****: The negative impact of multinationality on downside risk is stronger for firms operating in host countries with relatively low correlations in labor costs.*

The Organization of Affiliate Portfolios

Heterogeneous economic conditions such as labor cost movements in the multinational firm's international operations provide more valuable shifting opportunities and greater *potential* for the firm to benefit from operating flexibility. However, whether such flexibility is realized and downside risk reduction materializes might also depend on the firm's ability to control and coordinate the shifting of cross-border activities among the dispersed affiliates. Research has long emphasized the need to attend to organizational issues and coordination problems that can surround the management of a portfolio of switching options in multinational firms (e.g., Kogut, 1985, 1989). This point has been made clear in Kogut's (1989) pioneering work: "having the

potential to exercise flexibility is a far cry from having the management system to do it (p. 388)." Recent research echoes this view, arguing that organizational forms and management systems can play a critical role in facilitating or inhibiting the implementation of real options and thus affecting flexibility in multinational firms (Kogut & Kulatilaka, 1994; Rangan, 1998; Kouvelis *et al*., 2001; Tong & Reuer, 2007).

Consistent with calls for research to give more attention to the organizational aspects of real options, we examine several ways multinational firms can organize their foreign affiliates to achieve flexibility and reduce risk. One important factor that may affect firms' control and coordination of shifting production and other activities is the equity ownership of their foreign affiliates, because such ownership affects the distribution of incentives and control rights throughout the firms' international operations. The idea that equity ownership may shape incentive alignment in foreign affiliates and affect firms' pursuit of system-wide operating flexibility can be traced to Stopford and Wells' (1972) seminal work on multinational firms. Stopford and Wells analyzed the conflict between serving subsidiary versus system-wide goals in the context of subsidiary equity ownership, and they suggested that when local partners have greater equity stakes and control in a subsidiary, partner conflicts are more likely to increase and firms may lose flexibility as a result (see Kogut, 1989). This argument is consistent with recent research suggesting that partnering firms tend to differ in goals, values, routines, and cultural backgrounds, and that these differences likely lead to greater conflicts over their affiliates' strategic directions and operational practices (e.g., Hennart, Kim, & Zeng, 1998). In the real options literature, such conflicts dampen the system-wide objectives to exercise the option to coordinate multinational activities and "obstruct operating flexibility" (Kogut & Kulatilaka, 1994: 125).

Equity ownership can also determine the firm's ability to exercise control over its foreign affiliates and coordinate cross-border operations (e.g., Gatignon & Anderson, 1988). Control and coordination are important for achieving operating flexibility, since the firm would need to manage its affiliates as an integrated operation network in order to adjust production optimally in response to environmental conditions among the host countries (e.g., Kogut, 1985; Kogut & Kulatilaka, 1994). Indeed, Kogut and Kulatilaka (1994) argue that a lack of effective control and coordination often explains why many multinational firms might not be able to benefit from operating flexibility embedded in their international operations. Everything else constant, the control and coordination required for operating flexibility may be more difficult to obtain, when firms have a smaller equity share in their foreign affiliates (e.g., Stopford & Wells, 1972; Kogut, 1989). In fact, in such cases, greater control rights are put in the hands of partners in the host country, whose objectives are more likely to be country-specific, rather than consistent with the interests of the multinational firms as a whole. Combined with the earlier argument on partners' incentives and conflicts, this line of reasoning focusing on control and coordination suggests that firms having greater equity share in their affiliates will be better able to exploit the opportunities for switching. Using real option terms, the improved incentive alignment and superior control and coordination should facilitate the firm's evaluation and exercise of the switching options, leading to lower downside risk. Thus, we hypothesize that the firm's equity share in its foreign affiliates will strengthen the negative impact of multinationality on downside risk, namely:

> ***Hypothesis 2a:*** *The greater the firm's equity share in its portfolio of foreign affiliates, the stronger the negative impact of multinationality on downside risk.*

The above hypothesis indicates a moderating effect of equity share on the relationship between multinationality and downside risk for multinational firms in general. Considering the role of subadditivity in shaping the value of option portfolios emphasized in Hypothesis 1 earlier,

we suggest that this moderating effect may also vary across specific firms confronting differing input cost conditions in their host countries. Specifically, when labor cost developments in the firms' host countries are less correlated (i.e., less subadditive), more valuable opportunities exist for switching activities (de Meza & van der Ploeg, 1987). Effective implementation of switching opportunities to reduce downside risk requires greater coordination (e.g., Kogut, 1985; Kogut & Kulatilaka, 1994), which will be more readily available with a greater equity share. By contrast, when labor cost movements are more correlated (i.e., more subadditive), less valuable scope exists for switching and the organizational demands for coordinating affiliates are also lower; in this situation, greater equity share will be less useful for facilitating cross-border coordination to implement switching options. Taken together, these lines of argument suggest that when firms operate in host countries with less-correlated labor costs, greater equity share will be particularly important in strengthening the negative effect of multinationality on downside risk, leading to the following hypothesis:

> ***Hypothesis 2b:*** *The moderating effect of equity share on the relationship between multinationality and downside risk will be greater for firms operating in host countries with relatively low correlations in labor costs.*

Another factor that can affect multinational firms' control and coordination of foreign affiliates is their human resource management policies, and specifically we suggest that firms' assignment of expatriates to their affiliates can shape the relationship between multinationality and downside risk. Prior research has shown that multinational firms often assign expatriates overseas to exercise control and to coordinate foreign affiliates' activities with the headquarters and with sister affiliates (e.g., Edström & Galbraith, 1977; Boyacigiller, 1990). The assignment of expatriates to an affiliate helps to ensure that the way the affiliate is managed is in line with the global interest of the parent company to enhance system-wide coordination (e.g., Geringer & Frayne, 1990; Gupta & Govindarajan, 2000; Fang, Jiang, Makino, & Beamish, 2010). For

example, by directly supervising affiliate operations, expatriate managers can help to reduce goal incongruence and information asymmetry between the affiliate and the headquarters (e.g., O'Donnell, 2000). Japanese multinational firms in particular often assign expatriates to assume top management positions in their overseas affiliates to achieve these benefits and better perform the control and coordination functions (Baliga & Jaeger, 1985; Belderbos & Heijltjes, 2005).

We argue that increased control and coordination through expatriate assignment can enhance the firm's ability to implement the switching options embedded in its multinational operations, contributing to flexibility and risk reduction. Our argument is consistent with prior research that emphasizes the importance of management systems and internal structures in applying real options theory to study multinational firms. For example, Kogut (1985) considers a multinational firm's human resource management systems one important type of organizational resource to help the firm coordinate activities among dispersed affiliates in order to benefit from operating flexibility. Kogut and Kulatilaka (1994) also highlight that a multinational firm's management control systems and corporate reporting procedures must be able to support the network structure of multinational operations, and the use of expatriates and human resource management policies can help to achieve this objective (e.g., Hedlund, 1986; Bartlett & Ghoshal, 1989). Rangan (1998) suggests that weak control systems such as administrative heritage in firms' foreign affiliates might increase affiliate managers' local mandates, detract from the interest of the corporation, and reduce flexibility as a whole. More generally, real options scholars have emphasized that it is critical to have the appropriate management systems and control processes in place for firms to follow the optimal policies in implementing real options and benefit from their investments (see Trigeorgis, 1996: 375; Smit & Trigeorgis, 2004: 47). Considering the role of firms' expatriate assignment policy in coordinating their multinational

operations leads to the following hypothesis on the moderating effect of expatriate assignment on the relationship between multinationality and downside risk:

> ***Hypothesis 3a:*** *The greater the firm's assignment of expatriates in its portfolio of foreign affiliates, the stronger the negative impact of multinationality on downside risk.*

We build on this hypothesis and further suggest that the moderating effect of expatriate assignment will likely vary across firms operating in host countries with differing levels of labor cost correlations, considering the role of subadditivity in shaping the value of option portfolios highlighted in Hypothesis 1 earlier. When labor costs in the firms' host countries are less correlated (i.e., less subadditive), more valuable opportunities exist for switching activities, thus requiring more organizational coordination in order to achieve operating flexibility and downside risk reduction (e.g., Kogut & Kulatilaka, 1994); in this situation, greater expatriate assignment will be particularly useful for implementing switching options. Expatriate assignment will be less useful for this purpose, everything else equal, when labor costs in the host countries are more correlated (i.e., more subadditive). This is because there will be less valuable scope for switching activities, and the organizational demands for coordinating cross-border operations are also lower. Therefore, in a similar way as we argued for the moderating effect of equity share earlier, we hypothesize that greater expatriate assignment will be particularly important in strengthening the negative effect of multinationality on downside risk when firms operate in host countries with low, rather than high correlations in labor costs.

> ***Hypothesis 3b:*** *The moderating effect of expatriate assignment on the relationship between multinationality and downside risk will be greater for firms operating in host countries with relatively low correlations in labor costs.*

METHODS

Data and Sample

To examine our hypotheses, we constructed a comprehensive panel dataset of all publicly-listed

Japanese manufacturing firms and their overseas manufacturing affiliates from 1985 to 2006. Japanese firms are important investors in the international arena, and research has suggested that these firms often take an integrated approach to manage their overseas manufacturing plant networks, making them appropriate for research on multinational flexibility (e.g., Belderbos & Zou, 2009). Our focus on Japanese firms also moves beyond extant real options studies that have often focused on U.S. multinational firms (e.g., Rangan, 1998; Reuer & Leiblein, 2000; Kouvelis *et al*., 2001). We first gathered the financial data for all Japanese manufacturing firms listed on Japanese stock exchanges from the database maintained by the Development Bank of Japan. This database derives its information directly from financial reports submitted by Japanese firms to the Ministry of Finance under Japanese reporting requirements. We then matched these firms to various *Directories of Overseas Affiliates* published by Toyo Keizai, Inc. The directories provide detailed information on all the foreign affiliates of listed firms, including the affiliates' industry, establishment year, parent firms' equity stakes, number of employees, and number of Japanese expatriate employees, among others. We used information collected from electronic and hardcopy versions (for early years) of the *Directories*, as well as information from the separate lists of divested affiliates published in the hardcopy in order to determine when each affiliate was established and until which year the affiliate survived and was owned by the Japanese parent. Consistent with prior research, affiliates in which the Japanese parent has at least a 10 percent equity stake are included; if there are multiple Japanese parents, the affiliate is assigned to each parent.

Given our interest in studying how the characteristics of the host countries in which firms operate may shape downside risk, we focused our analysis on those manufacturing firms that operated at least one foreign manufacturing affiliate during this period. This produced a sample

of 1,010 manufacturing firms that were listed on one of the Japanese stock exchanges and active for at least five years during 1985-2006. The unbalanced sample contains 10,799 firm-year observations for which the dependent variable downside risk can be calculated and for which information on the theoretical and control variables is available. As the number of listed firms has increased over time, the unbalanced sample has a larger number of firms in more recent years. Within our study period 1985-2006, 1990 is the first year for which we have full data for calculating our dependent variable, downside risk, as calculating this variable requires the use of a five-year time window (i.e., 1985-1989) to be explained in detail below. We find that in 1990, there are 325 firms for which we are able to calculate the downside risk variable; in 2006, the last year of our study's time window, this number increases to 837. The total number of foreign manufacturing affiliates operated by these firms also increases to 4,835 in 2006. Table 1 reports the distribution of the firms and their foreign manufacturing affiliates by industry in 1990 compared to 2006. As the table shows, whereas these firms span the whole manufacturing sector, they are most concentrated in the following industries: electrical machinery, general machinery, transportation equipment, and chemicals. Table 2 reports the distribution of foreign affiliates by region and main host countries. While the number of affiliates in North America doubled between 1990 and 2006, the major increase in Japanese firms' foreign manufacturing presence took place in Asia (from 806 to 3,619); in particular, the nearly 40-fold increase in the number of manufacturing affiliates in China stands out. By contrast, Africa, Oceania, and South America only saw moderate growth in Japanese firms' manufacturing affiliates.

Insert Tables 1 and 2 about here

Variables and Measures

Dependent variable. Our dependent variable is the firm's downside risk, which has received significant attention in previous real options research. For example, researchers in economics and management have suggested that real investment projects with option features help to limit the firm's downside risk (Kogut, 1991; Smit & Trigeorgis, 2004). In particular, Bowman and Hurry (1993) focus on the implications of the firm's real option portfolio for its downside risk, suggesting that an organization's option bundle protects it against downside risk (also see McGrath *et al*., 2004). Downside risk measures are therefore particularly suitable for examining real options theory's core prediction on firms' focus on "limiting downside risk" (Bowman & Hurry, 1993: 765), and have been adopted in prior empirical studies. For instance, in specifying downside risk measures, Miller and Reuer (1996: 674) indicate that "firms invest in real options to reduce downside risk."

In keeping with prior research, downside risk is a function of the deviation of the firm's return on assets from the industry mean in the preceding year, which is considered the target level (e.g., Reuer & Leiblein, 2000; Tong & Reuer, 2007). In contrast to conventional variance-based measures of risk that incorporate the entire distribution of firm performance, the downside risk measure focuses on performance outcomes that only fall below some target level (Miller & Leiblein, 1996; Miller & Reuer, 1996). Note that this measure is consistent with Huchzermeier and Cohen's (1996) definition of downside risk as the "expected deviation of the firm's value over the planning horizon from a profit level (p. 108)" in their analytical model of multinational switching options.[3] Specifically, to calculate *Downside Risk*, we specify downside risk as a function of a firm's annual return on assets relative to a target level that changes over time, in the form of a second-order root lower partial moment:

[3] In sensitivity tests reported below, we measure downside risk with alternative target levels (i.e., zero profit and the firm's lagged performance).

$$(1)\ \textit{Downside Risk}_{t=0} = \sqrt{\frac{1}{5}\sum_{t=0}^{t=-4}(\mathrm{IROA}_{t-1} - \mathrm{ROA}_{t})^{2} \Big|\ \mathrm{IROA}_{t-1} > \mathrm{ROA}_{t}},$$

where ROA_t is the firm's annual return on assets; and IROA_{t-1}, the target performance level, is the average return on assets for the firm's two-digit industry in the preceding year.[4] The difference between the industry's average ROA and the firm's ROA, conditional on this difference being positive (i.e., the firm's ROA falling below the target level), is squared and summed over a five-year period from the focal year (t=0) to four years back (t=-4). Hence, downside risk is positive in the case of below-target performance and zero in the case where the firm performs better than the target.

Explanatory variables. To be consistent with the way the time-varying dependent variable downside risk is calculated, construction of all time-varying explanatory and control variables below is based on a five-year moving average. Our longitudinal, panel dataset provides an advantage over prior related studies that relied on cross-sectional data (e.g., Reuer & Leiblein, 2000), and the use of a panel dataset enables calculation of variables using the moving average approach. Our first explanatory variable is *Multinationality*, which is measured as the number of countries in which the Japanese firm operates manufacturing affiliates, averaged for the same five years as the dependent variable. The use of multinationality as a measure of the switching options embedded in multinational investment reflects the idea in Kogut's pioneering theoretical work (Kogut, 1985; Kogut & Kulatilaka, 1994), and related work in economics and operations management (e.g., de Meza & van der Ploeg, 1987; Huchzermeier & Cohen, 1996; Dasu & Li, 1997). For instance, Kogut (1985: 33) argued that operating subsidiaries "located in separate

[4] The focus on the two-digit industry level follows precedents (e.g., Reuer & Leiblein, 2000: 206). This level of industry classification allows us to maintain reasonable within-industry sample sizes for calculating the industry's average ROA, and narrowing the industry definition would result in loss of meaningful data. To capture the target performance level in the population, IROA_{t-1} is calculated based on the full population in the Development Bank of Japan database instead of the screened regression sample described in Table 1 reported above.

countries" can provide the multinational firm with the valuable "option to shift production" because of fluctuations in variable labor cost, exchange rate, as well as other economic parameters. We note that our measurement of multinationality follows the precedent in the literature (e.g., Reuer & Leiblein, 2000; Tong & Reuer, 2007; Chung *et al*., 2010), so using this measure facilitates comparison with prior real options studies.

The variable measuring cost subadditivity in the portfolio of host countries in which the firm operates is calculated based on correlations in labor costs (adjusted for exchange rates) among *all* of the host countries in which the firm has established manufacturing activities. A high correlation indicates high cost subadditivity, suggesting that labor cost levels, due to labor market conditions, exchange rate movements, price changes, etc., develop in a similar manner across the host countries; as a result, there are limited opportunities for the firm to exploit country differences in labor costs within the multinational network of operations. By contrast, a low or, in particular, a negative correlation indicates that production switching opportunities are more abundant and more valuable. We note that our focus on labor cost correlations is in line with prior analytical modelling research that examines how the correlations between input cost developments across countries may shape manufacturing firms' operational flexibility (e.g., de Meza & van de Ploeg, 1987; Kogut & Kulatilaka, 1994). This focus also follows from our empirical focus on manufacturing firms and their overseas manufacturing affiliates. Specifically, our calculation of the variable *Cost Subadditivity* is based on the following formula:

$$(2)\ Cost\ Subadditivity_{t=0} = \left[\sum_{j=1}^{N}\sum_{k=2}^{N}\frac{\sum_{t=0}^{-4}(C_{jt}-\overline{C_j})(C_{kt}-\overline{C_k})}{\delta_j\delta_k}\right]\Big/\frac{N(N-1)}{2},\ \text{where j, k} = 1\cdots N;\ j < k;$$

where C_{jt} and C_{kt} represent dollar-denominated labor costs in host countries j and k for year t, respectively; $\overline{C_j}$ and $\overline{C_k}$ denote average labor costs over the five years including the focal year (t=0) in countries j and k; and δ_j and δ_k are the standard deviations of labor costs within these

past five years in countries j and k. N is the total number of countries in which the focal firm operates manufacturing affiliates. Intuitively, we first calculate the labor cost correlation for *any pair* of host countries in the firm's portfolio, sum up all these correlations, and then divide the summed value by the total number of possible host country pairs to obtain an average correlation measure. We use the average to address the situation where larger multinational operations display higher cost subadditivity levels simply because the firms operate in a larger number of countries. In a supplementary analysis reported below, we also test the robustness of our results to the dispersion of labor cost correlations among the firms' host countries. Data for labor costs for the host countries (denominated in local currencies) are obtained from the International Labour Organization's LABORSTA Labour Statistics Database. The data are then converted into dollar terms using the exchange rate information obtained from the United Nation's National Accounts Main Aggregates Database – Exchange Rates and Population.

We note that our operationalization of cost subadditivity is consistent with Kogut and Kulatilaka's (1994) conceptualization in their analytical model (i.e., correlation in input cost across two host countries). Our operationalization of subadditivity however goes beyond their definition by considering real labor costs and by expanding the measure to include multiple countries—all the host countries where the multinational firm operates manufacturing affiliates. Furthermore, our operationalization follows recent empirical studies on real option subadditivity in other contexts (e.g., Vassolo *et al*., 2004; Belderbos & Zou, 2009). This measure captures the role that uncertainty plays in extant switching options models by incorporating the standard deviation of labor cost changes into the calculation and by controlling exchange rate volatility. By its construction, our measure of labor cost correlations is a continuous variable that captures the full range of values (from -1 to 1) that correlations can theoretically take. In our study's

context, we would expect lower correlations to strengthen the negative effect of multinationality on downside risk more than higher correlations.

Our third hypothesis-testing variable is *Equity Share*, which is calculated as the Japanese firm's average equity stake in its portfolio of foreign manufacturing affiliates, averaged for the five years including the focal year. This operationalization is consistent with research suggesting that a firm's equity share in its affiliates captures the control it has over the affiliates (e.g., Stopford & Wells, 1972; Kogut, 1989; Tong & Reuer, 2007). Prior real options studies (e.g., Brouthers *et al*., 2008) have used the firm's equity stake in its affiliates to classify an individual affiliate as a joint venture or a wholly-owned to test how the firm's entry mode choices are shaped by uncertainty and other factors. Our measurement of equity share is different, given our focus on the firm's entire portfolio of affiliates rather than any individual affiliate, as well as our interest in using this variable as a proxy for a multinational firm's coordination of cross-border activities among its portfolio of affiliates (see Kogut, 1989).

The final hypothesis-testing variable is *Expatriate Ratio*, which is similarly calculated as the unweighted average of the ratio of expatriate employees over total employees over all foreign manufacturing affiliates that the firm operates. We use a ratio rather than a count measure to account for affiliate size and the associated coordination challenges. This measure reflects the extent to which expatriates have managerial influences in the affiliates and the degree to which the affiliates can be managed in close coordination and communication with corporate headquarters (e.g., Edström & Galbraith, 1977; Gupta & Govindarajan, 2000; Fang, Jiang, Makino, & Beamish, 2010). A limitation of this measure is that we are not able to fully identify the roles of all expatriates in the affiliates. Like other time-variant variables, this variable is also averaged for the same five years.

Control variables. Our analysis includes a number of control variables. First, prior research suggests that exporting may provide benefits of operational flexibility (e.g., Rangan, 1998; Lee & Makhija, 2009). We therefore include into the model a control variable, *Export Intensity*, which is the value of exports divided by the firm's total sales. Second, we include a measure of *Firm Size*, for which we take the value of consolidated assets in trillion Yen. Third, following prior work (e.g., Reuer & Leiblein, 2000), we include *Organizational Slack*, measured as the sum of the ratios of receivables, inventory, and selling, general, and administrative expenses over total sales. Fourth, we include another control variable, *Tobin's q*. Tobin's q has been used as a proxy for a firm's general intangible assets (Morck & Yeung, 1992: 46), and we incorporate this variable to control for the potential impact of such assets on downside risk.[5] We calculate Tobin's q as the number of shares issued times the average of the highest and lowest stock price during the year, plus the book value of preferred stock and liabilities, divided by total assets (e.g., Chung & Pruitt, 1994). Since the market valuation element of Tobin's q might be correlated with the firm's profitability and downside risk, we lag the five-year moving average of q by one year (i.e., for the five years from year t-1 to year t-5). Fifth, we control for the firm's *Product Diversity* (e.g., Tallman & Li, 1996), defined as the number of two-digit industries in which the firm operates in Japan and abroad. Sixth, we control for the firm's *International Experience*, which may affect its international investment performance (e.g., Kogut, 1983; Li, 1995; Brouthers *et al*., 2008). This variable is measured as the average number of years in operation for all of the firm's foreign affiliates; we use the average instead of the sum to address the situation in which larger firms have larger values of international experience simply because they have a larger number of foreign affiliates. Seventh, we include a control for the host

[5] We use Tobin's q because we find the quality of information on advertising and R&D expenditures to be poor in Japanese financial reports, in particular in earlier years in the sample. We report the robustness test results excluding Tobin's q at the end of the Results section.

countries' *GDP Growth*, measured as the average GDP growth rate for all the host countries in which the Japanese parent firm operates over the past five years. The data source is the Key Global Indicators published by the United Nations. All of the control variables are time-varying and therefore are calculated based on a five-year moving average. Finally, we include *Firm Fixed Effects* and *Year Fixed Effects* when we run fixed effects panel estimations, to be explained in detail below; when we run alternative random effects Tobit panel estimations, we include *Industry Fixed Effects*, as well as *Year Fixed Effects*.

Econometric Models

Prior studies have often used cross-sectional data to examine the relationship between multinationality and downside risk. In this paper, we use a panel dataset and apply panel data techniques to examine how the configuration of firms' affiliate portfolios and the organization (coordination and control) of foreign affiliates may shape the impact of multinationality on downside risk. Panel data estimators with firm specific fixed effects allow researchers to better control for unobserved firm heterogeneity that might be relevant to performance outcomes (Hsiao, 2003). Since our dependent variable, *Downside Risk*, is censored at zero, a Tobit panel estimation model with fixed effects would be suitable for our purpose. However, Tobit panel estimators are only available for random effects models (Wooldridge, 2002: 541), and Greene (2004) has shown that fixed effects Tobit panel estimators are likely to produce underestimated standard errors. Random effects models, however, rely on the assumption that the unobserved firm effect is randomly distributed and uncorrelated with the other right-hand-side variables. If this assumption does not hold, the preferred model would need to include fixed effects. Indeed, Hausman tests rejected the linear random effects model in favor of the fixed effects model ($p<0.001$), suggesting substantial firm heterogeneity and potential inconsistency of estimates if

random effects models were to be used. Our preferred specification to address unobserved heterogeneity therefore is the fixed effects panel estimator. This estimation method also allows us to perform Chow tests across subsamples to test our hypotheses (see below). For comparison and to examine the sensitivity of our results to model specification, we also report the results of random effects Tobit panel estimations in the section below.

To test Hypothesis 1's prediction that the negative effect of multinationality on downside risk will vary across firms depending on the labor cost correlations between the host countries represented in the firms' manufacturing affiliate portfolios (i.e., the degree of subadditivity), we perform subsample analysis based on the median of labor cost subadditivity in the sample firms' option portfolios. Subsample analysis is the more general test specification when comparing coefficients between groups (Greene, 2008): subsample analysis does not require that unexplained variance be identical between the two groups of firms, and it allows the impact of other firm characteristics to differ systematically between the groups, leading to consistent within-group estimates. Using subsample analysis, H1 suggests that the negative impact of *Multinationality* on *Downside Risk* will be stronger (i.e., its coefficient will be more strongly negative) in the low cost subadditivity subsample (firms with lower-than-median labor cost subadditivity in their portfolios) than in the high cost subadditivity subsample (firms with higher-than-median labor cost subadditivity in their portfolios).

To test H2a and H3a, we interact *Multinationality* with *Equity Share* and with *Expatriate Ratio*, respectively, and run regressions on the full sample. Findings of a negative coefficient for the interaction terms would support the two hypotheses, indicating that the negative impact of *Multinationality* on *Downside Risk* is strengthened by *Equity Share* and *Expatriate Ratio*. To test H2b and H3b, we rely again on subsample analysis: the hypotheses predict that the above two

negative interaction effects will be stronger in the low cost subadditivity subsample than in the high cost subadditivity subsample. For ease of comparison, we report regression results obtained for the full sample and the two subsamples throughout for all specifications.

RESULTS

Table 3 provides descriptive statistics for the variables for the full sample (Panel A), the subsample of firms with high cost subadditivity (Panel B), and the subsample of firms with low cost subadditivity (Panel C). To facilitate presentation of the regression results in the tables and figures below, the downside risk measure is multiplied by 100. As Panel A of the table shows, an average firm in the sample operated affiliates in about 3.5 foreign countries, had about 0.32 trillion yen of assets, and derived about nine percent of its sales from export. On average, a firm's equity stake across its portfolio of foreign affiliates was about fifty eight percent and about seven percent of affiliate employees were Japanese expatriates.

Insert Table 3 about here

Table 4 reports correlations between the variables for the full sample (Panel A), the subsample of firms with high cost subadditivity (Panel B), and the subsample of firms with low cost subadditivity (Panel C). As shown in the tables, the largest correlation is between *Firm Size* and *Multinationality*, while the other correlations are relatively low. To reduce potential multicollinearity in regression analyses, we mean-centered all of the explanatory variables that constitute the interaction terms and then constructed the interaction terms by multiplying the relevant mean-centered variables. We checked the variance inflation factor values and condition indices for the variables, and they were all well below the rule-of-thumb threshold values of 10 and 30, respectively (Neter *et al*., 1996). These statistics indicate that multicollinearity is not a

concern for us, consistent with Hsiao's (2003: 311) suggestion that one of the major benefits of using panel data is reduced multicollinearity.

Insert Table 4 about here

Table 5 reports results for the determinants of downside risk based on fixed effects panel estimations. The table consists of five blocks; within each block are three columns reporting the results for the full sample, the high cost subadditivity subsample, and the low cost subadditivity subsample, respectively. The level of statistical significance and p-values in all models are based on two-tailed tests.

Insert Table 5 about here

Columns 1-3 report the results of the baseline model that only includes the control variables. We find that *Export Intensity* is negative and highly significant, indicating that greater export is related to lower downside risk. *Firm Size* is also significantly negative, suggesting that larger firms have lower downside risk levels. *Organizational Slack* is significant in all models and has a positive sign; when we measure organizational slack using other measures suggested by prior research (e.g., Singh, 1986), we again find similar positive and significant results. Our result is consistent with the recent finding reported by Mizutani and Nakamura (2009) that Japanese firms' performance is negatively related to organizational slack. As suggested in prior research (e.g., Nohria & Gulati, 1996), organizational slack might appear more as an indicator of inefficiency in the context of Japanese firms, rather than as a buffer to help firms respond flexibly to environmental changes. *Tobin's q* is negatively significant in the first two columns, suggesting that firms with more intangibles have lower downside risk particularly when labor

cost correlations across the host countries are high. *Product Diversity* has a negative and highly significant coefficient, indicating that firms operating in more industries have lower downside risk. *International Experience* is negatively significant in the first two columns; thus, firms with greater overseas operating experience have lower downside risk, and this is true for the high subadditivity subsample in particular. *GDP Growth* is negatively significant in the middle column, suggesting that operating in high-growth host countries reduces downside risk. Finally, both *Firm Fixed Effects* and *Year Fixed Effects* are jointly significantly, indicating that firm heterogeneity and macroeconomic conditions have an impact on firms' downside risk. Results for these control variables are qualitatively similar in other models where the hypotheses testing variables are introduced.

Columns 4-6 augment the baseline model by adding the key explanatory variable *Multinationality*. Log likelihood ratio tests show that models in Columns 4 and 6 witness a significant improvement in model fit, compared to their respective basic models (i.e., Columns 1 and 3). We use the results reported in the three columns to test Hypothesis 1, since the other columns include different interactions with multinationality, and the interpretation of the main effect of multinationality is changed accordingly. As suggested earlier, H1 predicts that multinationality will have a more negative impact on downside risk for firms operating a low subadditivity option portfolio than for firms operating a high subadditivity option portfolio. In Column 4 focusing on the full sample, the variable *Multinationality* has a negative and significant coefficient (i.e., $p<0.01$), suggesting that multinationality is negatively related to downside risk as predicted by real options theory. Results in Columns 5-6 further indicate that the negative and significant impact of *Multinationality* on downside risk is only observed in the low subadditivity subsample (i.e., $p<0.01$ in Column 6), and not in the high subadditivity

subsample (i.e., Column 5). A test comparing the coefficients for *Multinationality* across the two columns suggests that the difference in the coefficients is statistically significant (i.e., $F=15.60$, $p<0.01$). These results provide strong support for H1.

Columns 7-9 report the results of models testing H2a,b by adding the interaction term between *Equity Share* and *Multinationality*. H2a posits that the interaction between *Equity Share* and *Multinationality* will be negatively significant in the full sample, and H2b further predicts that this negative interaction effect will be stronger in the low subadditivity subsample than in the high subadditivity subsample. As shown in the table, the interaction term is significant in the full sample (i.e., $p<0.05$ in Column 7), providing support for H2a. In subsample analysis, the interaction term is significant in the low subadditivity subsample (i.e., $p<0.01$ in Column 9), but not significant in the high subadditivity subsample (i.e., Column 8). When we conduct tests comparing the coefficients for the interaction between *Equity Share* and *Multinationality* across Columns 8 and 9, we find that the difference in the coefficients is statistically significant (i.e., $F=5.92$, $p<0.05$). This result supports H2b, suggesting that greater equity stake in the firm's foreign affiliates strengthens the negative impact of multinationality on downside risk to a larger degree for firms operating a low subadditivity option portfolio than for firms operating a high subadditivity option portfolio.

Columns 10-12 report the results of models testing H3a,b by adding the interaction term between *Expatriate Ratio* and *Multinationality*. H3a posits that the interaction between *Expatriate Ratio* and *Multinationality* will be negatively significant in the full sample, and H3b further predicts that this negative interaction effect will be stronger in the low subadditivity subsample than in the high subadditivity subsample. We find that the interaction term is indeed significant in the full sample (i.e., $p<0.01$ in Column 10), in support of H3a. The interaction

term is also significant in both Columns 11 and 12 (i.e., both $p<0.01$), and its coefficient in Column 12 is more strongly negative than that in Column 11. A test comparing the coefficients for the interaction term across the two columns confirms that the difference is statistically significant (i.e., $F=4.37$, $p<0.05$). This result lends support for H3b, indicating that greater expatriate assignment in the firm's foreign affiliates strengthens the negative impact of multinationality on downside risk more for firms with a low subadditivity option portfolio than for firms with a high subadditivity option portfolio.

Finally, Columns 13-15 report the results of models including all of the variables simultaneously. As shown in these columns, the results for the hypotheses and control variables are consistent with those reported in the previous columns.

Figures 1 and 2a & 2b draw the simulated effect of multinationality on downside risk for various levels of the two moderating variables *Equity Stake* and *Expatriate Ratio*, while keeping all other significant variables at their sample mean. Figure 1 plots the significant interaction between *Equity Share* and *Multinationality* for the low subadditivity subsample based on the results in Column 15, by showing the effect of *Multinationality* on *Downside Risk* at three representative values of *Equity Share*: the minimum level of 10%, 50% (i.e., 50/50 joint ventures), and 95% (i.e., wholly-owned affiliates); we do not plot for the high subadditivity subsample given that the interaction term is not significant. While Figure 1 shows the negative relationship between multinationality (number of countries) and downside risk, it also illustrates that the greater the firm's average equity share in its affiliates, the steeper the slope is. This points to the strengthening effect of *Equity Share* on the negative relationship between *Multinationality* and *Downside Risk*. Figures 2a and 2b plot the significant interaction between *Expatriate Ratio* and *Multinationality* for the high and low subadditivity subsamples based on

the results in Columns 14 and 15, respectively. The figures show the effect of *Multinationality* on *Downside Risk* at three percentiles (25%, 50%, and 75%) of *Expatriate Ratio* in the sample. In both figures, the greater the expatriate ratio, the steeper the slope is, illustrating that a higher *Expatriate Ratio* strengthens the negative relationship between *Multinationality* and *Downside Risk* for both subsamples. A comparison of the curves in the two figures further suggests that the curves are steeper at given levels of expatriate ratio in Figure 2b, in line with our prediction that the moderating effect of expatriate ratio is stronger for the low subadditivity subsample.

Insert Figures 1, 2a, and 2b about here

Supplementary Analyses

We performed a series of sensitivity analyses to check the robustness of our results. Our findings are detailed below.

Alternative econometric model. As suggested in the Methods section above, we also conducted random effects Tobit panel estimations. As shown in Table 6, the results are largely consistent with those reported in Table 5. First, the coefficient for *Multinationality* is negatively significant in the low subadditivity subsample (i.e., Column 6) but not significant in the high subadditivity subsample (i.e., Column 5). Second, the interaction between *Equity Share* and *Multinationality* is negatively significant in the full sample as well as the low subadditivity subsample (i.e., Columns 7 and 9) but not significant in the high subadditivity subsample (i.e., Column 8). Finally, the interaction between *Expatriate Ratio* and *Multinationality* is significant in all of the three samples (i.e., Columns 10-12), with the coefficient more negative in the low subadditivity subsample. Results for the control variables are also qualitatively similar. Taken together, these results suggest that our key findings are consistent whether we use a fixed effects

or random effects estimation model.

Insert Table 6 about here

Endogeneity. Although firms may undertake multinational investment and assign equity shares and expatriates with the objective to reduce downside risk, there are reasons to believe that in general firms' investment objective is not minimizing downside risk *per se*. The various streams of research on multinational firms have identified many other reasons why firms seek to undertake multinational investment, assume smaller or larger equity shares, and make greater or less use of expatriates (see Caves, 1996, for a review). Moreover, even if we are limited to the real options literature on multinational investment, there is work suggesting that whereas having greater equity share facilitates the coordination of switching options and operating flexibility, it can reduce firms' growth option values (e.g., Chi & McGuire, 1996; Tong *et al*., 2008). Although firms might be choosing investment strategies to reduce downside risk, the difficulty to predict changes in country environments such as labor cost movements may still lead firms to end up having a suboptimal portfolio in terms of executing switching options and reducing downside risk. The descriptive statistics in Table 3's Panels B and C do not suggest that firms generally choose investment strategies strongly reflecting the objective of minimizing downside risk. If that would be the case, we would expect firms in Panel C (low-cost subadditivity subsample) to assume greater equity shares and make greater use of expatriates to coordinate switching options, compared to firms in Panel B (high-cost subadditivity subsample). However, the pattern we observe is the opposite: the mean of the two variables *Equity Share* and *Expatriate Ratio* is larger in Panel B (high-cost subadditivity subsample) than in Panel C (high-cost subadditivity subsample), and the differences are significant (for *Equity Share*, t=25.7; for

Expatriate Ratio, t=5.9; both p<0.01). Hence, these descriptive statistics provide no *general* evidence suggesting that firms align their strategies with environmental characteristics to achieve downside risk minimization in our study. Our results do show that firms whose equity shares and expatriate ratios turn out to be aligned with correlations in real labor cost movements are likely to experience reduced downside risk. While the above considerations weaken *a priori* expectations of endogeneity, we also conducted a formal test to examine whether there are feedback effects of downside risk on subsequent multinational investment strategies. As suggested by Wooldridge's test of strict exogeneity (2002: 285), we added the one-year lead (t+1) values of equity stake and expatriate ratio to the original model. If the coefficients of the lead variables are jointly significant, the null hypothesis of strict exogeneity is rejected. We found that for the full sample as well as the two subsamples, the null hypothesis could not be rejected: F=0.42 for the full sample; F=1.05 for the high-subadditivity subsample; and F=1.57 for the low-subadditivity subsample. None of the F values was statistically significant.

Alternative dependent variables. Whereas real options theory suggests that portfolio subadditivity moderates the negative relationship between multinationality and downside risk, geographic diversification theory suggests that multinational operation reduces the total variance of the firm's performance (Rugman, 1976; Kogut & Kulatilaka, 1994). It is important to rule out geographic diversification as an alternative explanation for our empirical findings. We therefore conducted analyses using the variance of the firm's ROA as a dependent variable instead of downside risk. In these analyses, multinationality was negative and significant in the full sample, but insignificant in either subsample; these results suggest that labor cost subadditivity does not play a moderating effect. In addition, the interaction between equity share and multinationality was not significant in any model; and although the interaction between

expatriate ratio and multinationality was significant in the full sample as well as in the two subsamples of high- and low-cost subadditivity, the coefficients were not significantly different. These findings suggest that multinationality reduces the variability of firms' profits, as diversification theory would suggest; however, the findings are not consistent with a view that cost subadditivity reflecting the active use of switching options matters for variability reduction. Hence, the results of our main empirical analyses are not consistent with the geographic diversification explanation. These findings are in line with Kogut and Kulatilaka's (1994) argument that the option value of multinationality is different from that of the benefits of geographic diversification, highlighting some of the unique advantages that real options theory ascribes to multinational operations (e.g., Kogut, 1985, 1989; Reuer & Leiblein, 2000).

In a second test, we calculated the dependent variable downside risk by using zero profit as the firm's target performance level (e.g., Fishburn, 1977; Miller & Reuer, 1996). While the downside risk formulation in our main analyses is consistent with prior real options studies and facilitates comparison of results (e.g., Reuer & Leiblein, 2000; Tong & Reuer, 2007), in this alternative formulation, the firm is truly incurring a loss rather than just performing below industry average. We found that the results based on this alternative measure of downside risk were very similar to those in the main analyses and that all the hypotheses received convincing support. In another test where we specified a firm's own lagged performance as the target level, we again obtained qualitatively similar results. We conclude that our results are robust to the specification of different target levels.

Alternative model specification. Our hypotheses follow the precedent in prior analytical and empirical real options research (e.g., Kogut & Kulatilaka, 1994; Rangan, 1998; Belderbos & Zou, 2009) to focus on the role of labor cost correlations among the host countries

in which firms operate manufacturing affiliates; however, downside risk reduction due to switching options may also be affected by correlations in host countries' economic development and demand conditions (e.g., Buckley & Casson, 1998). *A priori* we may expect weaker results for demand factors; prior research has argued that input costs such as labor are priced locally while markets are likely to be international, such that operating flexibility is more likely to hinge on input factors (de Meza & van der Ploeg, 1987; Kogut & Kulatilaka, 1994). To test the role of demand factors, we calculated a measure of GDP Subadditivity using the host countries' GDP data collected from the Key Global Indicators published by the United Nations, and then ran regressions to examine whether this measure of subadditivity also affects firms' downside risk. We found that the results based on this measure were qualitatively similar to those based on labor cost subadditivity, though the effects were quantitatively weaker in the full model where all interactions enter simultaneously potentially causing larger standard errors.

Second, we checked the sensitivity of the results to potential dispersion of labor cost correlations among the host countries, since the measure of subadditivity represents an *average* across all host countries. Specifically, we split the high- and low-cost subadditivity subsamples further by the median of the *variance* of labor cost correlations in each of the two subsamples, and arrived at four subsamples: high cost subadditivity with low dispersion (Subsample 1), high cost subadditivity with high dispersion (Subsample 2), low cost subadditivity with low dispersion (Subsample 3), and low cost subadditivity with high dispersion (Subsample 4); we then ran regressions on all of the four subsamples. We found that *Multinationality* had a negative and highly significant coefficient in both low-cost subadditivity subsamples (Subsamples 3 and 4), but that the coefficients in the two subsamples were nearly equal in magnitude. These results suggest that multinationality reduces downside risk as long as the option portfolio experiences

low cost subadditivity, and that dispersion of labor cost correlations does not materially change the negative effect of multinationality on downside risk. Among the two high-cost subadditivity subsamples, *Multinationality* was not significant in Subsample 1, but it did have a negative and significant coefficient in Subsample 2. This suggests that firms operating affiliate portfolios characterized by on-average relatively high cost subadditivity can still derive the benefit of downside risk reduction from switching flexibility, if dispersion of labor cost correlations is high such that part of the portfolio experiences lower correlations in labor costs.

Third, we examined whether our results were robust in models controlling for the decreasing marginal benefit of multinationality. To do so, we created a squared term of *Multinationality* and added it to the baseline model specification; we then ran regressions on the full sample, as well as on the high- and low-subadditivity subsamples. We found a U-shaped relationship between multinationality and downside risk in the full sample, where we do not account for subadditivity. The U-shaped relationship, however, no longer held when we controlled for subadditivity in subsample analyses: a Chow test comparing the coefficients for the variable *Multinationality* across the high- and low-subadditivity subsamples confirmed that these coefficients were statistically different ($p<0.01$), whereas *Multinationality Squared* was not significant in either subsample, and the coefficients were not statistically different across the two subsamples. In another analysis, we further examined a possible S-shaped relationship between multinationality and downside risk; however, we found that the cubic term of *Multinationality* was never significant in any of the three samples, while the coefficients for *Multinationality* and *Multinationality Squared* had similar interpretations as above. The set of results confirm that it is the subadditivity of the multinational portfolio, rather than the alternative idea of decreasing marginal benefit of multinationality *per se*, that influences downside risk.

Fourth, we tested for a potential moderating effect of *International Experience* on the *Multinationality—Downside Risk* relationship. It may be that firms with more operating years in their affiliates have accumulated greater experience with strategic flexibility (Brouthers *et al*., 2008) or global integration (Belderbos & Zou, 2009), enabling more effective implementation and execution of switching options. We found that the moderating effect was negative but not significant in the low subadditivity subsample as well as in the full sample, and the effect was positive and significant in the high subadditivity subsample. A possible explanation for the latter finding may be that firms that have been operating subadditive affiliate portfolios for a long time are more likely to be 'locked' into routines and organizational settings that do not allow for flexibility and switching, leading to suboptimal downside risk reduction. However, we should be careful in interpreting this finding, since the experience measure we constructed is not a direct measure of global coordination experience. Further research should examine the influence of relevant coordination experience in a finer-grained manner.

Fifth, we also examined whether the results were robust to the exclusion of *Tobin's q*. When we reran the analyses by dropping this variable from the control structure, we found that all hypotheses were confirmed except H2a: *Equity Share * Multinationality* had a negative, but insignificant coefficient in the full sample. On the other hand, this interaction term became again significantly negative in the low subadditivity subsample, and a Chow test indicated that this coefficient is more strongly negative compared with that in the high subadditivity subsample (i.e., $F=7.19$, $p<0.01$), in support of H2b.

Finally, substituting for our current sample a balanced panel dataset of firms with observations throughout the period produced similar results. Details about this and other tests are available from the authors.

DISCUSSION

Our study makes several contributions to research on real options and multinational firms. First, recent real options research (e.g., Li *et al*., 2007) emphasizes the importance of investigating the portfolio aspect of real options due to correlations within a firm's option portfolio (subadditivity) reducing the value of the portfolio as a whole. We apply this novel perspective to the context of multinational firms' international operations that confer a portfolio of switching options, and our empirical study also extends prior analytical modeling research in this area (e.g., de Meza & van der Ploeg, 1987; Kogut & Kulatilaka, 1994). Our study's focus on the impact of subadditivity in option portfolios on firms' downside risk complements prior work on the impact of subadditivity on firms' investment and divestment decisions (e.g., McGrath & Nerkar, 2004; Vassolo, Anand, & Folta, 2004; Belderbos & Zou, 2009) by showing that subadditivity can shape firm outcomes as well as strategic choices. Our finding of a negative moderating impact of subadditivity on the relationship between multinationality and downside risk highlights the value of considering the role of option portfolio characteristics in real options research. We believe that our portfolio focus and contingent approach can provide a useful step toward better understanding real options theory's boundary in its applications to multinational firms.

Second, our study responds to recent calls for real options research to give greater attention to some of the organizational aspects of real options analysis when applying the theory to strategic management (e.g., Bowman & Moskowitz, 2001; Kogut & Kulatilaka, 2004; Coff & Laverty, 2007). We show that multinational firms' equity stakes and expatriate assignment policy in their foreign affiliates strengthen the negative impact of multinationality on downside risk, and that these organizational policies are more salient for firms operating in host countries with relatively low labor cost correlations. According to our knowledge, we provide one of the

first studies to *integrate* firms' organizational characteristics with their environmental conditions in the empirical literature on real options. A key implication of our finding on the moderating effect of firms' ownership level is that smaller equity shares that increase the value of growth options, as emphasized in prior research (e.g., Chi & McGuire, 1996; Li & Li, 2010), need to be balanced against their reduced value in implementing switching options and lowering downside risk. This also points to the importance of using variables that can directly address switching and growth options in order to further advance real options research (Tong *et al*., 2008).

Finally, our study has useful implications for several streams of international strategy research. As one example, our study is related to a large body of work on the relationship between multinationality and performance (e.g., Mitchell, Shaver, & Yeung, 1992; Hitt, Hoskisson, & Kim, 1997; Contractor *et al*., 2003; Lu & Beamish, 2004; Qian *et al*., 2010). Despite its significance and contributions, Hennart (2007) suggests that this body of work has often neglected the role of host country environments and similarly has paid insufficient attention to the importance of organizational factors (also see Li, 2007). While our study uses downside risk as the dependent variable in line with our focus on real options theory, our study addresses some of the limitations identified by Hennart (2007), by analyzing the role of host countries' labor cost correlations, the roles of equity share and expatriate assignment, as well as the interactive effects between the two sets of factors. Consistent with the calls by Hennart (2007) and Li (2007), our sensitivity tests incorporating the nonlinear effect of multinationality on downside risk suggest that research on the declining marginal impact of increased multinational scope on firm performance will benefit from explicitly considering the configuration of host country characteristics.

As another example of our study's implication for international strategy research, our use of the multinational firm's equity share in its portfolio of affiliates as a measure of the firm's coordination of activities at the affiliate portfolio level (e.g., Kogut, 1989; Tong & Reuer, 2007) complements prior entry mode choice research that examines equity share at the transaction or entry level as a proxy of the firm's control over an individual affiliate (e.g., Brouthers *et al*., 2008). Furthermore, our study's finding on the impact of expatriate assignment on downside risk also has implications for the literature on human resource management in multinational firms. Specifically, that literature has examined many of the advantages that expatriates can offer at the individual affiliate level and has suggested that these advantages should be traded off against the high expatriation cost for the firm. Our study suggests that it may be important to assign expatriates to affiliates in order to implement system-wide flexibility and to achieve the multinational firm's global objective of positive performance outcomes and risk reduction. At a more general level, our findings on the important roles that host country conditions and organization characteristics play have useful implications for multinational firms' configuration of international value chains, subsidiary location choices, and global investment strategies (e.g., Kouvelis *et al*., 2001; Belderbos & Sleuwaegen, 2005).

We would like to note several areas for future research, which can help to address some of the limitations of this paper. Our study joins recent international strategy research to apply real options theory to multinational firms based in other countries than the U.S. (e.g., Brouthers *et al*., 2008; Lee & Makhija, 2009), yet the findings we report might be country-specific. For instance, Japanese firms have made substantial investments in the emerging economies in Asia that tend to be more heterogeneous in their economic and institutional environments, while U.S. firms' overseas investments have historically concentrated in developed countries such as Europe

that are relatively more homogeneous. In addition, Japanese multinationals tend to make greater assignment of expatriates and rely more on expatriates to manage and coordinate their foreign affiliates' activities. However, we do believe that the theory we draw from and the arguments we develop can be applicable to multinational firms based in other countries. Future work might find it valuable to compare the roles of option portfolios and organizational policies in affecting firms' downside risk and other performance outcomes across different countries.

Our study focuses on correlations in labor costs (adjusted for exchange rates) as a major source of subadditivity in multinational firms' option portfolios. This focus is consistent with the original conceptualization of subadditivity in correlated *cost* functions (Milgrom & Roberts, 1990), and labor cost developments are particularly relevant given the manufacturing emphasis of our sample firms and their affiliates (e.g., de Meza & van de Ploeg, 1987; Kogut & Kulatilaka, 1994). Our additional analysis also shows that the main results continue to hold when we examine correlations in host countries' aggregate economic development. Future research can investigate other sources of input cost subadditivity (e.g., raw materials), as well as subadditivity in specific product markets and other environmental factors. Researchers can also examine how subadditivity affects multinational firms' strategic choices and performance outcomes in other cross-border investment contexts studied in prior real options research (e.g., foreign market entry and exit, international alliances and acquisitions).

In our study, we rely on measures such as equity share and expatriate assignment as proxies for firms' abilities to control and coordinate activities among dispersed affiliates. Researchers might consider how specific organizational processes, such as particular control systems, delegation and autonomy, compensation policies, and incentive schemes (e.g., Kogut, 1989; Kogut & Kulatilaka, 1994; Smit & Trigeorgis, 2004), might also shape the firms' abilities

to exploit the switching opportunities to coordinate multinational activities and achieve flexibility. Issues such as these might be more productively investigated through surveys or field interviews, which can examine in finer-grained terms some of the specific mechanisms through which firms can implement the embedded switching options as well as the opportunities and challenges they might encounter during the implementation process. In addition, future research might be able to examine how multinational firms actually shift and coordinate operating activities, and such research can complement our study's focus on the performance outcomes of shifting and coordinating activities. As multinational firms' activities are increasingly located and coordinated across countries of heterogeneous environmental conditions nowadays, we believe that research on the portfolio as well as organizational aspects of real options will prove particularly useful in enhancing the value of real options theory for understanding multinational investments and the associated performance outcomes.

REFERENCES

Allen L, Pantzalis C. 1996. Valuation of the operating flexibility of multinational corporations. *Journal of International Business Studies* **27**(4): 633-653.

Baliga BR, Jaeger AM. 1985. Control systems and strategic adaptation: Lessons from the Japanese experience. *Strategic Management Journal* **6**: 115-134.

Bartlett CA, Ghoshal S. 1989. *Managing across Borders: The Transnational Solution*. Harvard Business School Press: Boston, MA.

Belderbos RA, Heijltjes MG. 2005. The determinants of expatriate staffing by Japanese multinationals in Asia: Control, learning and vertical business groups. *Journal of International Business Studies* **36**: 341-354.

Belderbos RA, Sleuwaegen L. 2005. Competitive drivers and international plant configuration strategies: A product level test. *Strategic Management Journal* **26**(6): 577-593.

Belderbos RA, Zou J. 2009. Real options and foreign affiliate divestments: A portfolio perspective. *Journal of International Business Studies* **40**: 600-620.

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

Bowman EH, Moskowitz GT. 2001. Real options analysis and strategic decision making. *Organization Science* **12**: 772-777.

Boyacigiller N. 1990. The role of expatriates in the management of interdependence, complexity and risk in multinational corporations. *Journal of International Business Studies* **21**(3): 357-381.

Brouthers KD, Brouthers LE, Werner S. 2008. Real options, international entry mode choice and performance. *Journal of Management Studies* **45**(5): 936-960.

Buckley PJ, Casson MC. 1998. Models of the multinational enterprise. *Journal of International Business Studies* **29**(1): 21-44.

Caves RE. 1996. *Multinational Enterprise and Economic Analysis* (4th ed). Cambridge University Press: New York.

Chi T, McGuire DJ. 1996. Collaborative ventures and value of learning: Integrating the transaction cost and strategic option perspectives on foreign market entry. *Journal of International Business Studies* **27**: 285-308.

Chi T, Seth A. 2009. A dynamic model of the choice of mode for exploiting complementary capabilities. *Journal of International Business Studies* **40**: 365-387.

Chung CC, Lee S-H, Beamish PW, Isobe T. 2010. Subsidiary expansion/contraction during times of economic crisis. *Journal of International Business Studies* **41**: 500-516.

Chung KH, Pruitt SW. 1994. A simple approximation of Tobin's q. *Financial Management* **23**(3): 70-74.

Coff RW, Laverty KJ. 2007. Real options meet organizational theory: Coping with path dependencies, agency costs, and organizational form. *Advances in Strategic Management* **24**: 333-361.

Contractor F, Kundu SK, Hsu CC. 2003. A three-stage theory of international expansion: The link between multinationality and performance in the service sector. *Journal of International Business Studies* **34**(1): 5-18.

Cuypers I, Martin X. 2010. What makes and what does not make a real option? A study of international joint ventures. *Journal of International Business Studies* **41**(1): 47-69.

Dasu S, Li L. 1997. Optimal operating policies in the presence of exchange rate variability. *Management Science* **43**(5): 705-722.
de Meza D, van der Ploeg F. 1987. Production flexibility as a motive for multinationality. *Journal of Industrial Economics* **35**(3): 343-351.
Driouchi T, Bennett D. 2011. Real options in multinational decision-making: Managerial awareness and risk implications. *Journal of World Business* **46**(2): 205-219.
Edström A, Galbraith JR. 1977. Transfer of managers as a coordination and control strategy in multinational organizations. *Administrative Science Quarterly* **22**(2): 248-263.
Fang Y, Jiang GF, Makino S, Beamish PW. 2010. Multinational firm knowledge, use of expatriates, and foreign subsidiary performance. *Journal of Management Studies* **47**(1), 27-54.
Fishburn PC. 1977. Mean-risk analysis with risk associated with below-target returns. *American Economic Review* **67**(2): 116-126.
Gatignon H, Anderson E. 1988. The multinational corporation's degree of control over foreign subsidiaries: An empirical test of a transaction cost explanation. *Journal of Law, Economics, and Organization* **4**: 305-336.
Geringer JM, Frayne CA. 1990. Human resource management and international joint venture control: A parent company perspective. *Management International Review* **30** (Special issue), 103-120.
Greene WH. 2004. Fixed effects and bias due to the incidental parameters problem in the Tobit model. *Econometric Reviews* **23**(2):125-147.
Greene WH. 2008. *Econometric Analysis* (6rd ed.). Pearson/Prentice Hall: Upper Saddle River, NJ.
Gupta AK, Govindarajan V. 2000. Knowledge flows within multinational corporations. *Strategic Management Journal* **21**: 473-496.
Hedlund G. 1986. The hypermodern MNC: A heterarchy? *Hum Resource Management* **25**(1): 9-35.
Hennart J-F. 2007. The Theoretical Rationale for a Multinationality-Performance Relationship. *Management International Review* **47**(3): 423-452.
Hennart J-F, Kim DJ, Zeng M. 1998. The impact of joint venture status on the longevity of Japanese stakes in U.S. manufacturing affiliates. *Organization Science* **9**(3): 382-395.
Hitt MA, Hoskisson RE, Kim H. 1997. International diversification: Effects on innovation and firm performance in product-diversified firms. *Academy of Management Journal* **40**: 767-798.
Hsiao C. 2003. *Analysis of Panel Data* (2nd ed). Cambridge University Press: Cambridge, United Kingdom.
Huchzermeier A, Cohen MA. 1996. Valuing operational flexibility under exchange rate risk. *Operations Research* **44**(1): 100-113.
Kogut B. 1983. Foreign direct investment as a sequential process. In *The Multinational Corporation in the 1980s*, Kindleberger CP, Audretsch DB (eds). MIT Press: Boston, MA: 62-75.
Kogut B. 1985. Designing global strategies: Profiting from operational flexibility. *Sloan Management Review* **27**(1): 27-38.
Kogut B. 1989. A note on global strategies. *Strategic Management Journal* **10**(4): 383-389.
Kogut B. 1991. Joint ventures and the option to expand and acquire. *Management Science* **37**(1): 19-33.

Kogut B, Kulatilaka N. 1994. Operating flexibility, global manufacturing, and the option value of a multinational network. *Management Science* **40**(1): 123-139.
Kogut B, Kulatilaka N. 2004. Real options pricing and organizations: The contingent risks of extended theoretical domains. *Academy of Management Review* **29**: 102-110.
Kouvelis P, Axarloglou K, Sinha V. 2001. Exchange rates and the choice of ownership structure of production facilities. *Management Science* **47**(8): 1063-1080.
Lee S-H, Makhija M. 2009. Flexibility in internationalization: Is it valuable during an economic crisis? *Strategic Management Journal* **30**: 537-555.
Li J, Li Y. 2010. Flexibility versus commitment: MNEs' ownership strategy in China. *Journal of International Business Studies* **41**: 1550-1571.
Li J, Rugman AM. 2007. Real options and the theory of foreign direct investment. *International Business Review* **16**(6): 687-712.
Li JT. 1995. Foreign entry and survival: Effects of strategic choices on performance in international markets. *Strategic Management Journal* **16**(5): 333-351.
Li L. 2007. Multinationality and performance: A synthetic review and research agenda. *International Journal of Management Reviews* **9**(2): 117-139.
Li Y, James B, Madhavan R, Mahoney J. 2007. Real options: Taking stock and looking ahead. *Advances in Strategic Management* **24**: 31-66.
Lu JW, Beamish PW. 2004. International diversification and firm performance: The S-curve hypothesis. *Academy of Management Journal* **47**(4): 598-609.
Luehrman TA. 1998. Strategy as a portfolio of real options. *Harvard Business Review* **76**(5): 89-99.
McGrath RG. 1997. A real options logic for initiating technology positioning investments. *Academy of Management Review* **22**(4): 974-996.
McGrath RG, Ferrier WJ, Mendelow A. 2004. Real options as engines of choice and heterogeneity. *Academy of Management Review* **29**: 86-101.
McGrath RG, Nerkar A. 2004. Real options reasoning and a new look at the R&D investment strategies of pharmaceutical firms. *Strategic Management Journal* **25**: 1-21.
Milgrom P, Roberts J. 1990. The economics of modern manufacturing: Technology, strategy, and organization. *American Economic Review* **80**(3): 511-528.
Miller KD, Leiblein MJ. 1996. Corporate risk-returns relations: returns variability versus downside risk. *Academy of Management Journal* **39**(1): 91-122.
Miller KD, Reuer JJ. 1996. Measuring organizational downside risk. *Strategic Management Journal* **17**(9): 671-691.
Miller KD, Reuer JJ. 1998. Asymmetric corporate exposures to foreign exchange rate changes. *Strategic Management Journal* **19**(12): 1183-1191.
Mitchell W, Shaver JM, Yeung B. 1992. Getting there in a global industry: Impacts on performance of changing international presence. *Strategic Management Journal* **13**(6): 419-432.
Mizutani F, Nakamura E. 2009. Managerial incentive, organizational slack, and performance: Empirical analysis of Japanese firms' behavior. Discussion Paper Series 2009-46, Graduate School of Business Administration, Kobe University.
Morck R, Yeung B. 1992. Internationalization: An event study test. *Journal of International Economics* **33**: 41-56.
Neter J, Kutner MH, Nachtsheim CJ, Wasserman W. 1996. *Applied Linear Statistical Models* (4^{th} ed.). Irwin: Homewood, IL.

Nohria N, Gulati R. 1996. Is slack good or bad for innovation? *Academy of Management Journal* **39**: 1245-1264.
O'Donnell SW. 2000. Managing foreign subsidiaries: Agents of headquarters, or an interdependent network? *Strategic Management Journal* **21**(5): 525-548.
Qian G, Khoury TA, Peng MW, Qian Z. 2010. The performance implications of intra- and inter-regional geographic diversification. *Strategic Management Journal* **31**: 1018-1030.
Rangan S. 1998. Do multinationals operate flexibly? Theory and evidence. *Journal of International Business Studies* **29**(2): 217-237.
Reuer JJ, Leiblein MJ. 2000. Downside risk implications of multinationality and international joint ventures. *Academy of Management Journal* **43**(2): 203-214.
Rugman AM. 1976. Risk reduction by international diversification. *Journal of International Business Studies* **7**(2): 75-80.
Singh JV. 1986. Performance, slack, and risk taking in organizational decision making. *Academy of Management Journal* **29**: 562-585.
Smit HTJ, Trigeorgis L. 2004. *Strategic Investment: Real Options and Games*. Princeton University Press: Princeton, NJ.
Stopford JM, Wells LT. 1972. *Managing the Multinational Enterprise*. Basic Books: New York.
Tallman S, Li JT. 1996. Effects of international diversity and product diversity on the performance of multinational firms. *Academy of Management Journal* **39**(1): 179-196.
Tang CY, Tikoo S. 1999. Operational flexibility and market valuation of earnings. *Strategic Management Journal* **20**: 749-761.
Tong TW, Reuer JJ. 2007. Real options in multinational corporations: Organizational challenges and risk implications. *Journal of International Business Studies* **38**(2): 215-230.
Tong TW, Reuer JJ, Peng MW. 2008. International joint ventures and the value of growth options. *Academy of Management Journal* **51**(5): 1014-1029.
Trigeorgis L. 1996. *Real Options: Managerial Flexibility and Strategy in Resource Allocation*. MIT Press: Cambridge, MA.
Vassolo RS, Anand J, Folta TB. 2004. Non-additivity in portfolios of exploration activities: A real options-based analysis of equity alliances in biotechnology. *Strategic Management Journal* **25**(11): 1045-1061.
Wooldridge JM. 2002. *Econometric Analysis of Cross Section and Panel Data*. MIT Press: Cambridge, MA.
Zingales L. 2000. In search of new foundations. *Journal of Finance* **55**(4): 1623-1653.

Table 1. Numbers of Firms and Foreign Affiliates by Industry

	Industry	Number of Firms		Number of Affiliates	
		1990	2006	1990	2006
1	Foods and tobacco	33	68	110	273
2	Textiles	15	38	53	269
3	Wood and wood products	0	4	0	6
4	Pulp, paper, and paper products	7	14	16	56
5	Printing	0	8	0	48
6	Chemicals	42	117	188	651
7	Petroleum refining	0	1	0	1
8	Rubber products	7	16	36	111
9	Ceramics, stone, and clay products	16	33	65	226
10	Iron and steel	16	25	56	118
11	Non-ferrous metals	16	25	99	239
12	Fabricated metals	8	37	19	70
13	General machinery	45	120	147	588
14	Electrical machinery	69	145	326	910
15	Transport equipment	26	99	190	935
16	Precision instruments	14	30	36	108
17	Miscellaneous	11	57	18	226
	Total	325	837	1,359	4,835

Table 2. Number of Foreign Affiliates by Region

Region / Country	1990	2006
Asia	806	3619
China	34	1438
Taiwan	156	297
Thailand	161	527
Europe	151	448
North America	294	607
United States	247	527
South America	64	90
Africa	11	13
Oceania	33	58
Total	1,359	4,835

Table 3. Descriptive Statistics

Panel A: Full Sample (N=10,799)

	Variables	Mean	Std. Dev.	Min.	Max.
1	Downside Risk	1.722	2.892	0.000	63.353
2	Export Intensity	0.088	0.142	0.000	0.987
3	Firm Size	0.321	0.939	0.002	23.148
4	Organizational Slack	0.365	0.142	0.023	2.061
5	Tobin's q	1.326	0.468	0.421	5.138
6	Product Diversity	1.438	1.074	0.000	8.000
7	International Experience	9.536	6.530	0.000	80.333
8	GDP Growth	0.070	0.045	-0.044	0.225
9	Multinationality	3.466	3.427	0.000	30.800
10	Equity Share	0.578	0.279	0.000	1.000
11	Expatriate Ratio	0.071	0.120	0.000	1.000
12	Cost Subadditivity	0.259	0.346	-0.916	0.997

Panel B: High Cost Subadditivity Subsample (N=5,399)

	Variables	Mean	Std. Dev.	Min.	Max.
1	Downside Risk	1.397	2.110	0.000	36.417
2	Export Intensity	0.114	0.160	0.000	0.983
3	Firm Size	0.458	1.080	0.004	23.148
4	Organizational Slack	0.359	0.134	0.031	1.016
5	Tobin's q	1.355	0.431	0.421	5.061
6	Product Diversity	1.821	1.106	0.200	8.000
7	International Experience	10.220	5.019	0.000	68.667
8	GDP Growth	0.086	0.036	-0.019	0.216
9	Multinationality	4.926	3.382	0.400	30.800
10	Equity Share	0.645	0.188	0.079	1.000
11	Expatriate Ratio	0.078	0.104	0.000	1.000
12	Cost Subadditivity	0.543	0.241	0.162	0.997

Panel C: Low Cost Subadditivity Subsample (N=5,400)

	Variables	Mean	Std. Dev.	Min.	Max.
1	Downside Risk	2.046	3.473	0.000	63.353
2	Export Intensity	0.063	0.116	0.000	0.987
3	Firm Size	0.184	0.747	0.002	19.332
4	Organizational Slack	0.371	0.149	0.023	2.061
5	Tobin's q	1.298	0.500	0.422	5.138
6	Product Diversity	1.055	0.888	0.000	8.000
7	International Experience	8.853	7.691	0.000	80.333
8	GDP Growth	0.053	0.046	-0.044	0.225
9	Multinationality	2.007	2.791	0.000	30.800
10	Equity Share	0.511	0.333	0.000	1.000
11	Expatriate Ratio	0.064	0.133	0.000	1.000
12	Cost Subadditivity	-0.025	0.138	-0.916	0.162

Table 4. Correlations

Panel A: Full Sample (N=10,799)

	Variables	1	2	3	4	5	6	7	8	9	10	11
1	Downside Risk	1.000										
2	Export Intensity	0.012	1.000									
3	Firm Size	**-0.045**	**0.141**	1.000								
4	Organizational Slack	**0.194**	**0.202**	**0.079**	1.000							
5	Tobin's q	**-0.027**	**0.201**	-0.005	**0.128**	1.000						
6	Product Diversity	**-0.083**	**0.072**	**0.339**	**-0.043**	**-0.074**	1.000					
7	International Experience	0.012	-0.007	**0.106**	**0.079**	**-0.077**	**0.170**	1.000				
8	GDP Growth	**-0.080**	**0.238**	**0.029**	0.011	**0.225**	**0.173**	**0.020**	1.000			
9	Multinationality	**-0.097**	**0.147**	**0.580**	**-0.016**	**-0.032**	**0.642**	**0.220**	**0.113**	1.000		
10	Equity Share	**0.028**	**0.145**	**0.021**	**0.126**	0.013	**0.244**	**0.253**	**0.297**	**0.195**	1.000	
11	Expatriate Ratio	-0.014	**-0.078**	**-0.038**	**0.062**	-0.005	**0.042**	**-0.024**	**0.017**	-0.015	**0.283**	1.000
12	Cost Subadditivity	**-0.099**	**0.174**	**0.082**	**-0.039**	**0.107**	**0.254**	**0.067**	**0.426**	**0.277**	**0.187**	**0.047**

Panel B: High Cost Subadditivity Subsample (N=5,399)

	Variables	1	2	3	4	5	6	7	8	9	10	11
1	Downside Risk	1.000										
2	Export Intensity	**0.036**	1.000									
3	Firm Size	**-0.041**	**0.146**	1.000								
4	Organizational Slack	**0.095**	**0.254**	**0.132**	1.000							
5	Tobin's q	**-0.102**	**0.169**	**-0.032**	**0.117**	1.000						
6	Product Diversity	**-0.078**	0.014	**0.299**	**-0.045**	**-0.093**	1.000					
7	International Experience	-0.013	**-0.028**	**0.113**	**0.077**	**-0.086**	**0.041**	1.000				
8	GDP Growth	**-0.100**	**0.254**	-0.020	**0.032**	**0.346**	**-0.085**	**-0.206**	1.000			
9	Multinationality	**-0.098**	**0.111**	**0.572**	0.022	**-0.070**	**0.508**	**0.194**	**-0.111**	1.000		
10	Equity Share	**0.067**	**0.166**	**-0.080**	**0.142**	**0.096**	**-0.126**	**0.044**	-0.012	**-0.099**	1.000	
11	Expatriate Ratio	**-0.032**	**-0.122**	**-0.082**	**0.069**	0.019	**-0.083**	**-0.127**	**-0.071**	**-0.141**	**0.138**	1.000
12	Cost Subadditivity	-0.016	**0.046**	**-0.128**	0.010	**0.134**	**-0.120**	**-0.059**	**0.407**	**-0.267**	**0.029**	0.020

Panel C: Low Cost Subadditivity Subsample (N=5,400)

	Variables	1	2	3	4	5	6	7	8	9	10	11
1	Downside Risk	1.000										
2	Export Intensity	**0.034**	1.000									
3	Firm Size	**-0.024**	**0.065**	1.000								
4	Organizational Slack	**0.248**	**0.173**	**0.033**	1.000							
5	Tobin's q	0.022	**0.234**	0.006	**0.143**	1.000						
6	Product Diversity	**-0.028**	0.002	**0.334**	-0.013	**-0.116**	1.000					
7	International Experience	**0.039**	**-0.027**	**0.086**	**0.089**	**-0.084**	**0.239**	1.000				
8	GDP Growth	-0.015	**0.133**	**-0.038**	**0.027**	**0.132**	**0.177**	**0.075**	1.000			
9	Multinationality	**-0.028**	**0.029**	**0.596**	-0.019	**-0.061**	**0.688**	**0.213**	-0.001	1.000		
10	Equity Share	**0.054**	**0.081**	**0.036**	**0.144**	**-0.049**	**0.408**	**0.307**	**0.342**	**0.258**	1.000	
11	Expatriate Ratio	0.003	**-0.062**	-0.012	**0.062**	**-0.027**	**0.130**	0.020	**0.037**	**0.048**	**0.345**	1.000
12	Cost Subadditivity	-0.011	**0.063**	**0.084**	**-0.035**	**0.064**	0.019	-0.014	**0.029**	**0.115**	**-0.076**	**-0.027**

Note: Correlations in bold are significant at $p<0.10$ (two-tailed test).

Table 5. Fixed Effects Panel Estimation of Downside Risk

Variables	1	2	3	4	5	6
	Full Sample	High Cost Subadditivity	Low Cost Subadditivity	Full Sample	High Cost Subadditivity	Low Cost Subadditivity
Export Intensity	-2.46***	-2.43***	-1.30***	-2.41***	-2.41***	-1.20**
	(0.25)	(0.29)	(0.49)	(0.25)	(0.29)	(0.48)
Firm Size	-0.21***	-0.13**	-0.67**	-0.14*	-0.12*	-0.42
	(0.07)	(0.06)	(0.32)	(0.07)	(0.07)	(0.32)
Organizational Slack	14.29***	7.62***	18.90***	14.25***	7.62***	19.10***
	(0.42)	(0.61)	(0.61)	(0.43)	(0.61)	(0.61)
Tobin's q	-0.14*	-0.36***	0.04	-0.11	-0.36***	0.09
	(0.07)	(0.08)	(0.13)	(0.07)	(0.08)	(0.13)
Product Diversity	-0.16***	-0.16***	-0.25**	-0.08	-0.15***	0.19
	(0.05)	(0.06)	(0.11)	(0.06)	(0.06)	(0.15)
International Experience	-0.03***	-0.04***	-0.01	-0.04***	-0.05***	-0.02
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
GDP Growth	-0.78	-3.30***	-0.56	-0.86	-3.23***	0.04
	(0.64)	(1.11)	(0.97)	(0.69)	(1.11)	(1.04)
Multinationality				-0.11***	-0.02	-0.25***
				(0.03)	(0.03)	(0.07)
Equity Share				-0.01	-0.17	-0.61**
				(0.18)	(0.34)	(0.28)
Equity Share * Multinationality						
Expatriate Ratio				0.17	0.35	-0.71
				(0.44)	(0.72)	(0.60)
Expatriate Ratio * Multinationality						
Constant	-2.77***	-0.23	-4.86***	-3.02***	0.22	-6.12***
	(0.23)	(0.33)	(0.36)	(0.25)	(0.33)	(0.45)
Firm Fixed Effects [a]	Included	Included	Included	Included	Included	Included
Year Fixed Effects [a]	Included	Included	Included	Included	Included	Included
N	10799	5399	5400	10799	5399	5400
Log Likelihood	-20447.82	-8747.47	-10480.29	-20438.49	-8746.94	-10467.13
Log Likelihood Ratio Test (χ^2)						
Expanded model vs. basic model [b]				18.66***	1.07	26.33***
Chow Test of Coefficient Equality (F-test)						
Multinationality					15.60***	
Equity Share * Multinationality						
Expatriate Ratio * Multinationality						

[a] Both firm and year fixed effects are jointly significant at p<0.01 (two-tailed test).
[b] For Columns 4(5,6), the basic model is Columns 1(2,3). For Columns 7(8,9), 10(11,12), and 13(14,15), the basic model is Column 4(5,6).
* p<0.10, ** p<0.05, *** p<0.01 (two-tailed test).

Table 5 (continued). Fixed Effects Panel Estimation of Downside Risk

Variables	7	8	9	10	11	12	13	14	15
	Full Sample	High Cost Subadditivity	Low Cost Subadditivity	Full Sample	High Cost Subadditivity	Low Cost Subadditivity	Full Sample	High Cost Subadditivity	Low Cost Subadditivity
Export Intensity	-2.42***	-2.43***	-1.23**	-2.39***	-2.41***	-1.14**	-2.41***	-2.41***	-1.17**
	(0.25)	(0.29)	(0.48)	(0.25)	(0.29)	(0.48)	(0.25)	(0.29)	(0.48)
Firm Size	-0.13*	-0.12*	-0.31	-0.15**	-0.13**	-0.50	-0.15**	-0.13**	-0.41
	(0.07)	(0.07)	(0.33)	(0.07)	(0.07)	(0.33)	(0.08)	(0.07)	(0.33)
Organizational Slack	14.21***	7.60***	19.05***	14.24***	7.53***	19.15***	14.21***	7.52***	19.11***
	(0.43)	(0.62)	(0.61)	(0.43)	(0.61)	(0.61)	(0.43)	(0.62)	(0.61)
Tobin's q	-0.10	-0.36***	0.11	-0.11	-0.37***	0.10	-0.10	-0.37***	0.11
	(0.07)	(0.08)	(0.13)	(0.07)	(0.08)	(0.13)	(0.07)	(0.08)	(0.13)
Product Diversity	-0.11*	-0.17***	0.05	-0.09	-0.16***	0.13	-0.11*	-0.17***	0.04
	(0.06)	(0.06)	(0.16)	(0.06)	(0.06)	(0.15)	(0.06)	(0.06)	(0.16)
International Experience	-0.04***	-0.05***	-0.02*	-0.04***	-0.05***	-0.02	-0.04***	-0.05***	-0.02*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
GDP Growth	-1.25*	-3.41***	-0.56	-1.00	-3.21***	-0.21	-1.27*	-3.33***	-0.58
	(0.71)	(1.12)	(1.06)	(0.69)	(1.11)	(1.04)	(0.71)	(1.12)	(1.06)
Multinationality	-0.10***	-0.01	-0.24***	-0.11***	-0.02	-0.22***	-0.10***	-0.01	-0.22***
	(0.03)	(0.03)	(0.07)	(0.03)	(0.03)	(0.07)	(0.03)	(0.03)	(0.07)
Equity Share	-0.50*	-0.29	-2.20***	-0.09	-0.23	-0.74***	-0.44	-0.30	-1.82***
	(0.28)	(0.35)	(0.65)	(0.18)	(0.34)	(0.28)	(0.28)	(0.35)	(0.67)
Equity Share * Multinationality	-0.20**	-0.12	-0.58***				-0.14	-0.08	-0.41*
	(0.09)	(0.10)	(0.22)				(0.09)	(0.10)	(0.23)
Expatriate Ratio	0.18	0.33	-0.61	-0.83	0.35	-4.07***	-0.71	0.34	-3.37***
	(0.44)	(0.72)	(0.60)	(0.53)	(0.72)	(1.22)	(0.53)	(0.72)	(1.29)
Expatriate Ratio * Multinationality				-0.64***	-0.64***	-1.61***	-0.58***	-0.62***	-1.31**
				(0.19)	(0.21)	(0.51)	(0.19)	(0.21)	(0.54)
Constant	-2.90***	0.26	-5.84***	-2.99***	0.26	-6.02***	-2.91***	0.29	-5.84***
	(0.26)	(0.33)	(0.47)	(0.25)	(0.33)	(0.45)	(0.26)	(0.33)	(0.47)
Firm Fixed Effects [a]	Included	Included	Included	Included	Included	Included	Included	Included	Included
Year Fixed Effects [a]	Included	Included	Included	Included	Included	Included	Included	Included	Included
N	10799	5399	5400	10799	5399	5400	10799	5399	5400
Log Likelihood	-20435.57	-8746.06	-10462.81	-20432.16	-8741.33	-10461.13	-20430.71	-8740.96	-10459.27
Log Likelihood Ratio Test (χ^2)									
Expanded model vs. basic model [b]	5.84**	1.75	8.63***	12.67***	11.21***	11.99***	15.56***	11.96***	15.72***
Chow Test of Coefficient Equality (F-test)									
Multinationality		15.29***			12.65***			13.00***	
Equity Share * Multinationality		5.62**						2.64*	
Expatriate Ratio * Multinationality					6.48**			3.16*	

[a] Both firm and year fixed effects are jointly significant at p<0.01 (two-tailed test).
[b] For Columns 4(5,6), the basic model is Columns 1(2,3). For Columns 7(8,9), 10(11,12), and 13(14,15), the basic model is Column 4(5,6).
* p<0.10, ** p<0.05, *** p<0.01 (two-tailed test).

Table 6. Random Effects Tobit Panel Estimation of Downside Risk

Variables	1	2	3	4	5	6
	Full Sample	High Cost Subadditivity	Low Cost Subadditivity	Full Sample	High Cost Subadditivity	Low Cost Subadditivity
Export Intensity	-3.31***	-2.89***	-2.04***	-3.21***	-2.82***	-1.90***
	(0.31)	(0.35)	(0.57)	(0.31)	(0.35)	(0.57)
Firm Size	-0.37***	-0.17**	-0.66***	-0.23**	-0.13	-0.45*
	(0.11)	(0.09)	(0.21)	(0.11)	(0.09)	(0.23)
Organizational Slack	13.84***	6.44***	17.14***	13.80***	6.49***	17.32***
	(0.46)	(0.60)	(0.65)	(0.47)	(0.60)	(0.66)
Tobin's q	-0.53***	-0.84***	-0.38**	-0.51***	-0.83***	-0.33**
	(0.09)	(0.11)	(0.15)	(0.09)	(0.11)	(0.15)
Product Diversity	-0.15**	-0.12**	-0.20*	-0.04	-0.09	0.13
	(0.06)	(0.06)	(0.11)	(0.07)	(0.06)	(0.14)
International Experience	-0.03***	-0.03***	-0.02	-0.03***	-0.04***	-0.02
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
GDP Growth	-0.53	-5.45***	0.99	-0.54	-5.49***	1.87
	(0.76)	(1.32)	(1.11)	(0.82)	(1.32)	(1.19)
Multinationality				-0.11***	-0.04	-0.15***
				(0.03)	(0.03)	(0.06)
Equity Share				-0.05	-0.24	-0.70**
				(0.21)	(0.34)	(0.30)
Equity Share * Multinationality						
Expatriate Ratio				0.03	-0.76	-0.40
				(0.49)	(0.67)	(0.67)
Expatriate Ratio * Multinationality						
Constant	-3.21***	0.41	-4.74***	-3.60***	0.33	-5.70***
	(0.52)	(0.53)	(0.69)	(0.53)	(0.54)	(0.74)
Industry Fixed Effects [a]	Included	Included	Included	Included	Included	Included
Year Fixed Effects [a]	Included	Included	Included	Included	Included	Included
N	10799	5399	5400	10799	5399	5400
Log Likelihood	-20240.56	-9046.74	-10941.23	-20233.16	-9044.46	-10933.71
Log Likelihood Ratio Test (χ^2)						
Expanded model vs. basic model [b]				14.81***	4.56	15.05***

[a] Both industry and year fixed effects are jointly significant at p<0.01 (two-tailed test).

[b] For Columns 4(5,6), the basic model is Columns 1(2,3). For Columns 7(8,9), 10(11,12), and 13(14,15), the basic model is Column 4(5,6).

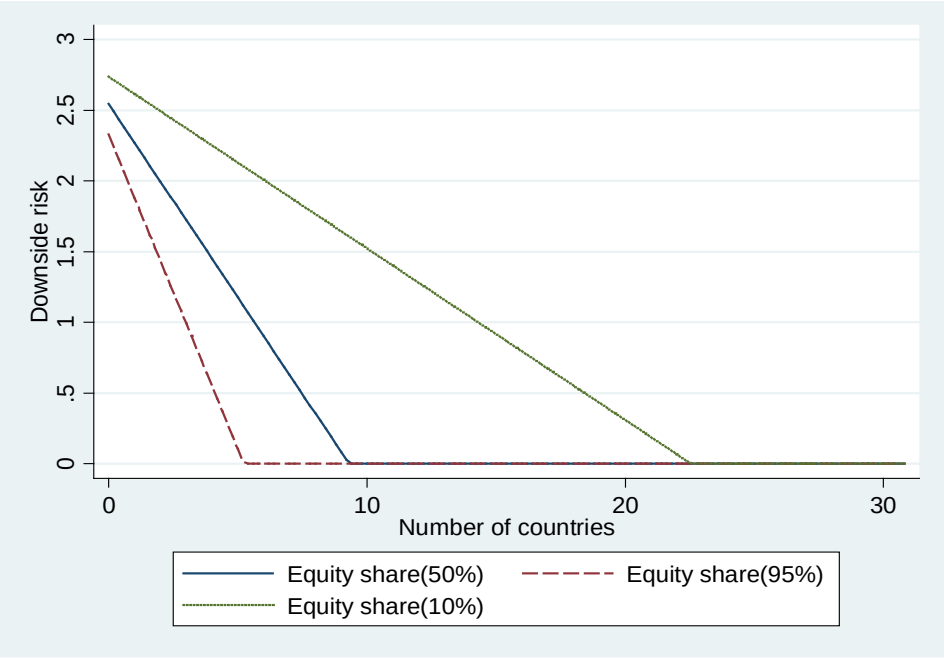
* p<0.10, ** p<0.05, *** p<0.01 (two-tailed test).

Table 6 (continued). Random Effects Tobit Panel Estimation of Downside Risk

Variables	7	8	9	10	11	12	13	14	15
	Full Sample	High Cost Subadditivity	Low Cost Subadditivity	Full Sample	High Cost Subadditivity	Low Cost Subadditivity	Full Sample	High Cost Subadditivity	Low Cost Subadditivity
Export Intensity	-3.23***	-2.83***	-1.91***	-3.18***	-2.80***	-1.85***	-3.20***	-2.81***	-1.88***
	(0.31)	(0.35)	(0.57)	(0.31)	(0.35)	(0.57)	(0.31)	(0.35)	(0.57)
Firm Size	-0.23**	-0.13	-0.42*	-0.26**	-0.15*	-0.51**	-0.25**	-0.15*	-0.47**
	(0.11)	(0.09)	(0.23)	(0.11)	(0.09)	(0.24)	(0.11)	(0.09)	(0.23)
Organizational Slack	13.72***	6.43***	17.25***	13.74***	6.34***	17.31***	13.68***	6.30***	17.25***
	(0.47)	(0.60)	(0.66)	(0.47)	(0.61)	(0.66)	(0.47)	(0.61)	(0.66)
Tobin's q	-0.49***	-0.82***	-0.30**	-0.49***	-0.84***	-0.31**	-0.48***	-0.83***	-0.29**
	(0.09)	(0.11)	(0.15)	(0.09)	(0.11)	(0.15)	(0.09)	(0.11)	(0.15)
Product Diversity	-0.10	-0.11	0.00	-0.05	-0.09	0.12	-0.10	-0.11*	0.01
	(0.07)	(0.07)	(0.15)	(0.07)	(0.06)	(0.14)	(0.07)	(0.07)	(0.15)
International Experience	-0.03***	-0.04***	-0.02	-0.03***	-0.04***	-0.02	-0.03***	-0.04***	-0.02
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
GDP Growth	-1.32	-5.80***	1.03	-0.74	-5.45***	1.64	-1.35	-5.72***	0.96
	(0.84)	(1.33)	(1.22)	(0.82)	(1.32)	(1.20)	(0.84)	(1.33)	(1.22)
Multinationality	-0.09***	-0.03	-0.13**	-0.11***	-0.04	-0.16***	-0.09***	-0.03	-0.13**
	(0.03)	(0.03)	(0.06)	(0.03)	(0.03)	(0.06)	(0.03)	(0.03)	(0.06)
Equity Share	-0.91***	-0.40	-2.28***	-0.15	-0.28	-0.78***	-0.85***	-0.41	-2.16***
	(0.31)	(0.35)	(0.59)	(0.21)	(0.34)	(0.30)	(0.31)	(0.35)	(0.59)
Equity Share * Multinationality	-0.37***	-0.22	-0.61***				-0.30***	-0.18*	-0.54***
	(0.10)	(0.11)	(0.19)				(0.10)	(0.11)	(0.20)
Expatriate Ratio	0.03	-0.81	-0.36	-1.29**	-0.96	-2.52**	-1.07*	-0.99	-1.83
	(0.48)	(0.67)	(0.67)	(0.60)	(0.68)	(1.21)	(0.60)	(0.68)	(1.24)
Expatriate Ratio * Multinationality				-0.87***	-0.66***	-1.06**	-0.72***	-0.60**	-0.72
				(0.23)	(0.24)	(0.50)	(0.23)	(0.24)	(0.52)
Constant	-3.41***	0.39	-5.41***	-3.57***	0.35	-5.71***	-3.41***	0.41	-5.44***
	(0.53)	(0.54)	(0.74)	(0.53)	(0.54)	(0.74)	(0.53)	(0.54)	(0.74)
Firm Fixed Effects [a]	Included	Included	Included	Included	Included	Included	Included	Included	Included
Year Fixed Effects [a]	Included	Included	Included	Included	Included	Included	Included	Included	Included
N	10799	5399	5400	10799	5399	5400	10799	5399	5400
Log Likelihood	-20226.07	-9042.30	-10928.80	-20225.83	-9040.68	-10931.51	-20221.15	-9039.22	-10927.82
Log Likelihood Ratio Test (χ^2)									
Expanded model vs. basic model [b]	14.17***	4.32*	9.81***	14.65***	7.56**	4.41*	24.00***	10.49**	11.77***

[a] Both industry and year fixed effects are jointly significant at p<0.01 (two-tailed test).
[b] For Columns 4(5,6), the basic model is Columns 1(2,3). For Columns 7(8,9), 10(11,12), and 13(14,15), the basic model is Column 4(5,6).
* p<0.10, ** p<0.05, *** p<0.01 (two-tailed test).

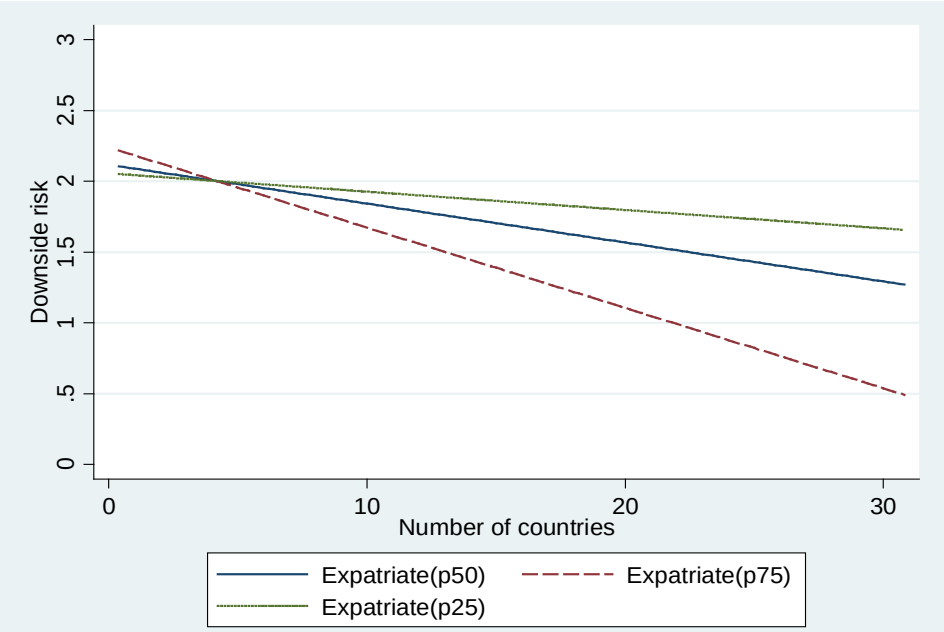
Figure 1. The Effect of Multinationality on Downside Risk at Different Levels of Equity Share for the Low Cost Subadditivity Subsample



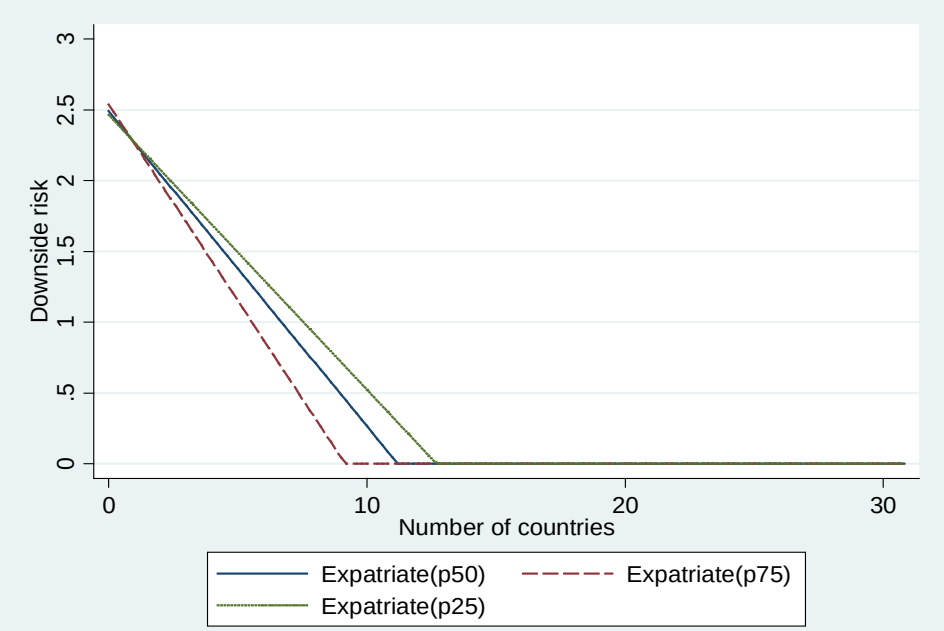
Note: The graph was drawn based on results reported in Column 15 in Table 5 at three representative levels of *Equity Share*: 10%, 50%, and 95%. The vertical axis denotes *Downside Risk*, and the horizontal axis denotes the number of host countries in which the firm operates manufacturing affiliates (i.e., *Multinationality*).

Figure 2. The Effect of Multinationality on Downside Risk at Different Levels of Expatriate Ratio

2A. High Cost Subadditivity Subsample



2B. Low Cost Subadditivity Subsample



Note: Figures 2A and 2B were drawn based on results reported in Columns 14 and 15 in Table 5, respectively, at three different levels of *Expatriate Ratio*: 25%, 50%, and 75%. The vertical axis denotes *Downside Risk*, and the horizontal axis denotes the number of host countries in which the firm operates manufacturing affiliates (i.e., *Multinationality*).