Available online at www.sciencedirect.com
ScienceDirect
International Business Review 16 (2007) 687–712
INTERNATIONAL BUSINESS REVIEW
www.elsevier.com/locate/ibusrev

Real options and the theory of foreign direct investment

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Received 4 January 2007; received in revised form 17 May 2007, 23 July 2007; accepted 31 August 2007

Abstract

We extend applications of real options theory to foreign direct investment (FDI) research regarding choice of location and choice of market entry mode under uncertainty. Our study is motivated by the regional configuration of multinational enterprises (MNEs), as well as observed deviations from the stages model in internationalization theory. We shed light on these issues using real option modeling and computer simulations. The results suggest that from the standpoint of pursuing business opportunities and generating real options, building a subsidiary in a nonhome region could be more beneficial than in a home region. However, high option exercise cost may reduce the option value of a nonhome-region location. Our models also imply that choice of entry mode depends on the *magnitude* (high vs. low) and the *type* (exogenous vs. endogenous) of uncertainty. When uncertainty is high and endogenous, MNEs may prefer high-commitment entry modes because they contribute to the reduction of uncertainty and provide valuable growth options.

Keywords: FDI theory; Market entry mode; Option modeling; Real options theory; Regional location

1. Introduction

It has been recognized in international business (IB) that uncertainty, which often exposes multinational enterprises (MNEs) to unfavorable conditions or favorable

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0969-5931/$ - see front matter
doi:10.1016/j.ibusrev.2007.08.004

opportunities, plays an important role in their strategic decision making. These challenges and opportunities in the international environment demand a theory, which helps to analyze MNEs' strategies under uncertainty. Real options theory has enriched foreign direct investment (FDI) theory by introducing a new way of thinking—MNEs can strategically benefit from uncertainty because uncertainty is not only associated with downside risks but also with potential future opportunities (Li, 2007). To strategically benefit from uncertainty, MNEs need to *create* real options (such as the option to abandon and the option to grow) to maintain flexibility in adjusting decisions, as well as to *exercise* these options in response to opportunities or challenges. Real options theory, which effectively conceptualizes and quantifies the determinants of real options, has contributed to the development of theories in MNEs' decision making under uncertainty (Buckley & Casson, 1998; Buckley, Casson, & Gulamhussen, 2002; Chi & McGuire, 1996; Kogut & Kulatilaka, 1994; Tong & Reuer, 2007). In this article, we further extend this stream of research by considering MNEs' choice of location and choice of market entry mode under uncertainty.

Since the 1970s, researchers in IB have devoted substantial efforts to analyzing investment behavior of multinational firms. IB researchers have recognized that "where" (choice of location) and "how" (choice of market entry mode) decisions are of primary importance for firms to consider in their foreign investment (Dunning, 1980, 2000). Correspondingly, a bulk of research has theoretically and empirically examined the rationale for locational choice and the conditions under which market entry modes such as licensing, export, joint ventures (JVs), and wholly owned subsidiaries (WOSs) are optimal (e.g., Buckley & Casson, 1976, 1996, 1998; Dunning, 1980, 1998; Madhok, 1998; Rugman, 1981). However, the literature, mainly based on transaction cost economics, has not fully incorporated the role of uncertainty in influencing the where and how decisions of MNEs; in particular, it is not entirely clear how MNEs incorporate the option value of a location or a market entry mode in international investment decisions. Therefore, using real options theory, we intend to derive new insights in this regard.

The first question we address in this study regards MNEs' location choice between home and nonhome regions for market-seeking FDI, motivated by the empirical observation that most MNEs operate within their home regions of the NAFTA–EU–Asia triad by Rugman (2005) and Rugman and Verbeke (2004). Based on sales information of 380 MNEs among *Fortune* Global 500 companies, Rugman and Verbeke (2004) found that only 9 companies are adopting global strategies (defined as MNEs with sales of 20% or more in each of the three parts of the triad). Only 25 companies use bi-regional strategies (defined as MNEs with at least 20% of their sales in each of two regions in the triad, but less than 50% in any one region), while the majority of the companies—320 out of 380 MNEs—use a home region-oriented strategy (defined as MNEs with at least 50% of their sales in their home region). In this paper, we leverage real options theory to provide a theoretical explanation for this regionalization phenomenon. Using real options modeling, we suggest that from the standpoint of pursuing business opportunities and generating real options, building a subsidiary in a nonhome region could be more beneficial than in the home region. However, the option exercise cost is likely to be higher in a nonhome region, which may substantially reduce the nonhome region's option value and in turn the MNE's incentives to build subsidiaries outside its home region.

Second, we enrich the application of real options theory to the IB literature on choice of market entry mode under uncertainty. There are two motivations for our study. The first originates from some debates in internationalization theory, which suggest that MNEs

often adopt low-commitment entry modes, such as export, when uncertainty is high at an early stage of international expansion, and then use high-commitment entry modes, such as JVs and WOSs, when uncertainty is low at a later stage (Johanson & Vahlne, 1977). However, one can easily find exceptions to the staged path of expansion supported by internationalization theory (Buckley & Tse, 1996; Delios & Henisz, 2003; Fina & Rugman, 1996). For example, MNEs may adopt high-commitment entry modes such as JVs, even when they face high uncertainty about the business environment. In this paper, we utilize a real options approach to explain these inconsistent results. Our second motivation is from the literature review on applications of real options theory to IB; the existing literature emphasizes the option value presented by a JV (e.g., Buckley & Casson, 1998; Chi, 2000; Chi & McGuire, 1996; Tong & Reuer, & Peng, 2008) while underemphasizing the option value of export, licensing, or a WOS (a notable exception is Capel, 1992). In our model, we assume that these market entry modes all exhibit similar types of real options: the option to grow (spot and exploit market opportunities) and the option to abandon (spot market disadvantages and withdraw from the market). However, we emphasize that these market entry modes differ in their ability to obtain and realize the two types of options. We find that the option value of a market entry mode is contingent on the magnitude of uncertainty (high vs. low), as well as the types of uncertainty (endogenous vs. exogenous) that an MNE faces in a host country. Our results provide partial support for internationalization theory, as well as justify the validity of using high-commitment market entry modes, even under a high level of uncertainty.

In this article, we begin by briefly reviewing the recent applications of real options theory to IB. Next, we introduce two simplified real options models, one for choice of location and the other for choice of market entry mode. The models in our study provide an example for IB researchers who are interested in utilizing the rapid advances in the modeling and solution techniques of real options theory. We then simulate the models and advance five propositions derived from the simulation. Finally, we conclude the paper and provide directions for future studies.

2. Applications of real options theory to IB

Real options theory has contributed to the development of theories in MNEs' decision making under uncertainty (Buckley & Casson, 1998; Chi & McGuire, 1996; Kogut & Kulatilaka, 1994; Tong & Reuer, 2007). Traditional theories of IB based on transaction cost economics have not thoroughly considered the role of uncertainty in firms' decision making. For example, internalization theory suggests that the imperfections of intermediate product markets for technology and brand provide an incentive for MNEs to internalize the knowledge market by building WOSs in foreign markets (Buckley & Casson, 1976; Hennart, 1982; Rugman, 1981). However, internalization theory largely ignores the possibility that by committing to WOSs that usually incur large irreversible investments, MNEs lose flexibility in adjusting their decisions when more information becomes available. Although further applications of transaction cost economics to IB consider the role of uncertainty in firm investment decisions, these applications tend to view uncertainty as a source of transaction costs and thus emphasize the use of high-control market entry modes to minimize these costs. For example, Buckley and Casson (1988) argued that one main purpose of using JVs as an entry mode is to minimize quality uncertainty on collaborative research and training. Other IB theories, such as

internationalization theory, also view uncertainty as a negative influence in the foreign market entry decision (Johanson & Vahlne, 1977). By contrast, real options theory instills new insights into the existing IB theories: Uncertainty implies risks as well as opportunities, and firms are able to benefit from uncertainty by creating real options to maintain flexibility in response to new information (Buckley & Casson, 1998; Li, 2007; Rivoli & Salorio, 1996).

Real options theory has been applied to four main research subjects in IB: the impact of multinationality on corporate performance, the advantages of using JVs to enter a market, dynamic choice of market entry mode, and the optimal timing of investment decisions (Li, 2007). The first category takes a real options approach to explain the relationship between multinationality, operational flexibility, and performance. Real options theory suggests that choice of location can be used to enhance an MNE's operational flexibility (Buckley & Casson, 1998; Kogut, 1983; Kogut & Kulatilaka, 1994). Specifically, a network of subsidiaries provides an MNE with the flexibility to switch sourcing, production, or distribution within the network when the environment changes (Kogut & Kulatilaka, 1994; Mello, Parsons, & Triantis, 1995). Theoretically, such an option to switch has a positive impact on market valuation of an MNE and a negative effect on corporate risk and corporate exposure. However, empirical studies indicate mixed results regarding the benefits of being multinational; only under certain conditions will multinationality increase market valuation and reduce corporate risks (e.g., Allen & Pantzalis, 1996; Miller & Reuer, 1998; Rangan, 1998; Reuer & Leiblein, 2000; Tong & Reuer, 2007). In this paper, we provide some insights into these inconsistent results.

The second category of studies based on a real options approach considers whether JVs can be viewed as real options, as well as the conditions under which JVs have higher option values. These studies suggest that a JV can be viewed as real options because it provides a firm with the ability to exploit upside potential by acquiring the partner's equity (i.e., the option to grow), or to avoid downside losses by selling the equity to its partner or dissolving the JV (i.e., the option to abandon), contingent on how uncertainty is resolved in the future (Buckley & Casson, 1998; Chi & McGuire, 1996; Tong et al., 2008). Furthermore, Chi and McGuire (1996) built a real options model to suggest that the real options value of a JV depends on how partners forecast the future value of the JV—the option value is higher when partners have divergent expectations. Intuitively, the partner with a higher expected valuation is willing to pay a higher price than the other partner to purchase the JV, which will result in a mutually beneficial trade in their stakes. The studies on JVs suggest that valuation of a market entry mode should include not only the net present value of future profits this entry mode can bring about, but also its option value—the value of switching to other entry modes in response to new information. Our valuations of JVs, WOSs, export, and licensing in this study follow this principle by incorporating the option value of each entry mode.

The third category of studies related to real options theory regard dynamic choice of market entry mode (Buckley & Casson, 1981, 1996; Capel, 1992; Kouvelis, Axarloglou, & Sinha, 2001). Buckley and Casson (1981) were the first to address the optimal timing to switch among three investment modes—licensing, export, and FDI. Although not directly employing a real options approach, Buckley and Casson (1981) found results consistent with the prediction of real options theory; that is, substantial irreversible set-up costs of FDI may induce postponement of the decision to switch to FDI, particularly when the size of the potential market is small. Extending Buckley and Casson's (1981) model, Capel (1992) examined a firm's choice of entry mode to a foreign market by introducing

uncertainty in real exchange rate and market growth rate into the model. The author adopted a real option approach and built a simple stochastic model. Future costs of an entry mode consist of production costs and adjustment costs when firms decide to switch to other entry modes. Capel (1992) found that uncertainty likely facilitates a "wait and see" attitude instead of switching to other entry modes, due to the existence of adjustment costs. Furthermore, a flexible market entry mode (contractual arrangement) is introduced in the study, characterized by high production costs but low adjustment costs. The author found that when uncertainty is high, it is optimal to choose the flexible market entry mode, even with higher production costs, because this mode likely leads to lower total costs. Similarly, Buckley and Casson (1996) compared the optimal conditions for three market entry modes—licensing, JVs, and merger—and argued that high uncertainty in technology pace in an industry makes low-commitment market entry modes such as licensing more desirable than JVs, which are preferred over merger. Kouvelis et al.'s (2001) empirical study on the impact of uncertainty on entry mode choice examined how exchange-rate volatility affects MNEs' choice of appropriate ownership structure for production facilities. Based on information from 187 US MNEs, Kouvelis et al. found strong support for the predictions of real options theory. That is, the high costs of switching between different entry modes forced a period of inaction, during which the MNE continued to use its current mode, even if the immediate profits favored switching strategies. Such inaction is reinforced when the volatility of exchange rates is high. In sum, existing studies on dynamic entry mode choice emphasize the value of the option to defer; when facing high uncertainty and irreversibility of investment, MNEs tend to choose low-commitment entry modes and hesitate to make switching decisions.

The fourth category of studies examines the optimal entry timing of MNEs to a foreign market (Campa, 1993; Dixit, 1989; Rivoli & Salorio, 1996). Similar to the previous category, this set of studies emphasizes that investment deferment provides an MNE with the option to wait for more relevant information before making decisions regarding whether to enter the market and how much to invest. The option to defer is particularly valuable if the MNE is likely to maintain its ownership advantages over a long period of time and if the investment is difficult to reverse. Differing from previous studies on market entry mode, studies on market entry timing also suggest that when the market becomes competitive and the option exercising right is not proprietary (e.g., many MNEs have similar options to enter the market), the MNE is more willing to exercise the option rather than delay it, in order to gain first-mover advantages and valuable growth options. In this paper, although we do not study the optimal entry timing of MNEs, the concept of growth options is extended to the study of choice of market entry mode. Specifically, when choosing market entry mode, previous studies such as Capel (1992) pay more attention to the option to defer while ignoring the option to grow, which might be produced through a high-commitment market entry mode. In this study, we recognize the value of growth options and introduce the case where a high level of uncertainty may not discourage firms from strong commitment to a market.

To examine the impact of uncertainty on firms' international investment decisions, we employ an option modeling approach by applying the binomial model in Cox, Ross, and Rubinstein (1979). A natural question is to what extent option pricing models can be applied to study phenomena in international investment. Financial economics has developed sophisticated theories describing the decisions of investors and the equilibrium prices of assets. There are two fundamental assumptions in valuing real options. First of all, the financial markets are free of arbitrage opportunities (Harrison & Kreps, 1979), and second, the financial markets are sufficiently complete (Arnold & Shockley, 2003; Duffie &

Huang, 1985). A complete market is one in which a portfolio can be constructed to insure against any particular future macroeconomic state (Arnold & Shockley, 2003). Given these assumptions, we can *always* replicate a new derivative's return and risk characteristics through a portfolio of existing traded assets in the financial market. To ensure that the introduction of a new derivative will not change investor hedging opportunities and the values of underlying assets, the price of the new asset must equal the market value of this portfolio. Otherwise, any discrepancy could be exploited by arbitrageurs. In our specific studies of international investment, the two assumptions of option pricing theory still apply, such that we can always find underlying assets in the financial market for a specific international investment, so as to evaluate the option value of the international investment. These assumptions enable us to apply option pricing models such as Cox et al. (1979) directly to our study on international investment.

Furthermore, Li (2007), in a critical review of applications of real option theory to IB, emphasizes that option pricing models are often relied on to identify rigorously the evolution of uncertainty and to specify the relationship between parameters of interest and the valuation of real options in international investment. Option pricing models are particularly useful when real-life data are absent. In these cases, establishing real options models and using simulation techniques can lead to meaningful empirical results. A nice application of option pricing models to IB is by Chi and McGuire (1996), who used the binomial model in Cox et al. (1979) to illustrate the dynamics of each partner's valuation of an international joint venture and further mode-switching decisions within the JV. Other similar applications of option pricing models to valuations of JVs include Chi (2000) and Li, Dhanaraj, and Shockley (2008). These applications bolster our confidence in using option pricing models to study international investment decisions.

To summarize, the existing applications of real options theory to the FDI literature are limited, and applying option pricing models to international investment decisions is appropriate and useful. We thereby intend to extend the exiting applications in this study by leveraging option pricing models to examine choice of location for market-seeking FDI and choice of market entry mode under uncertainty.

3. The real options models

This section presents two real options models for choice of location and choice of market entry mode. In the first model, we leverage real options theory to explain the empirical observation that most MNEs operate within their home regions of the triad (Rugman & Verbeke, 2004) by examining the conditions under which an MNE chooses a location in a home or nonhome region. The second model is to compare the option values of export, licensing, JVs, and WOSs.

3.1. Model I: choice of location

3.1.1. Assumptions

This is a two-period model.[2] At time 0, a US MNE plans to pursue sales opportunities internationally, and it chooses to locate a subsidiary either in its home or nonhome region.

[2]We relaxed this assumption by adding multiple periods to this model and found that our propositions derived from the present two-period model still hold. For simplicity of presentation, we kept the two-period assumption.

For simplicity, we assume that the MNE chooses between Canada and China at time 0. It will become clear later that we chose Canada and China in order to illustrate the dilemma of China representing a much larger economy than Canada while requiring higher option exercise costs. This assumption could be relaxed to any two countries not in the same region but with similar sets of characteristics. Establishing a subsidiary in any country at time 0 opens a real option for the MNE to sell its products in the country at time 1. When first entering a new market, whether China or Canada, the US MNE may face various kinds of market uncertainty. From the market demand side, the MNE is uncertain as to whether its products will be popular in the market and how much consumers will be willing to pay for them, because the popularity of the products might be determined by many factors (e.g., the income or preferences of local consumers). From the market supply side, the MNE is uncertain as to the intensity of future market competition. In addition, government policy plays a role in influencing the market supply, demand, or price. To capture the market volatility facing the MNE in a foreign country, we assume that at time 0, the uncertainty facing the MNE is the market price of the MNE's product in Canada and China, namely, P_1 and P_2, respectively.[3] At time 1, the information on market price is revealed; accordingly, the MNE decides whether to sell in the local market.

Although the US MNE faces market volatility in both Canada and China, it stands to reason that it likely faces more market volatility in China than in Canada, given that it has no previous experience in either country. If we use σ_i to represent the volatility of the market price P_i, the above assumption implies that $\sigma_1 < \sigma_2$. We can argue for this from three perspectives: market demand, market supply, and government intervention. First, the US MNE may be relatively less certain of the Canadian consumers' needs as compared with the needs of Chinese consumers, due to fewer barriers in economic, political, social, and cultural background. Second, China is an emerging market and many MNEs are interested in entering this market, which may make market supply of similar products less certain. Third, China is in a transitional period, moving from command economy to market economy, in which the government constantly changes policies towards FDI and businesses (Lieberthal & Lieberthal, 2003), which in turn leads to further market volatility.

We assume that the marginal production cost is zero in both countries. We make this assumption for the following reasons. In the present study, we intend to examine for a US MNE, which country, China or Canada, is a better location for *sales*. Since we are not interested in which country is a better location for production, we downplay the influence of production efficiency in influencing the MNE's locational decision. Moreover, many multinational firms have located their subsidiaries in low-labor-cost countries such as China and India to pursue production efficiency, and they may import products from these countries for sales in subsidiaries outside of these countries in order to save production costs and reach scale economies. It follows that we assume the production costs in China and Canada are similar; for simplicity, we assume the production costs to be zero.

Indeed, the marginal costs of sales in Canada and China, C_1 and C_2, respectively, are the main parameters of interest in our study (e.g., investments in building distribution channels, conducting market research, obtaining and understanding customer feedback). C_1 and C_2 may differ because the MNE faces different levels of political, economic, and cultural barriers to overcome in order to sell its products in China and Canada. We reason

[3]For simplicity, we assume away other types of uncertainty that may exist in Canada or China. Having more than one uncertainty would complicate the structure of the model without adding much insight.

that a typical US MNE, given no previous experience in either country, is likely to build a sophisticated sales network, understand local consumer needs, and master marketing knowledge in Canada more quickly and cost-effectively than in China; that is, $C_1 < C_2$. This is mainly due to the similarity in the dimensions of economic, cultural, social, and political background between the United States and Canada, as well as the existence of the regional free trade agreement—NAFTA. On the contrary, the greater distance between China and the United States in terms of culture, administration, geography, and economy likely makes the establishment of sales networks in China more costly and a thorough understanding of the needs of Chinese consumers more difficult.

Also, suppose market demand is Q_1 and Q_2 in Canada and China, respectively. Therefore, in order to realize the sales objectives at time 1, P_1Q_1 or P_2Q_2, the MNE has to take into consideration the option exercise costs, C_1Q_1 or C_2Q_2. Our main question is in which location should the MNE establish its subsidiary at time 0—that is, which location provides the MNE with a higher option value?

3.1.2. Risk-neutral valuation method

To generate the option value of a location, we employ the risk-neutral valuation method. This method does not require information on the subjective belief that managers hold regarding the true state of uncertainty (Shockley, 2006; Trigeorgis, 1996). Indeed, using the subjective probabilities for future payoffs of an international investment will not facilitate the valuation of the option in the investment because of the absence of risk-adjusted discount rates for possible future states (Shockley, 2006). This is a common problem of the traditional discounted cash flow method.

Option pricing methods such as risk-neutral valuation can solve this problem in an ingenious manner. Specifically, the risk-neutral valuation method is based on the principle that there are no arbitrage opportunities in the financial market. As we have explained earlier, it is always possible to find underlying assets in the financial market to replicate the future payoffs of an investment. Uncertainty is already characterized by the range of possible future values of the underlying assets. These future values can be input into a simple equation to derive appropriate weights, referred to as risk-neutral probabilities, and ensure that the option value of an investment will leave no opportunities for free arbitrage (Shockley, 2006). The current value of the option in the investment can be obtained from its expected future values (using risk-neutral probabilities), discounted at the risk-free interest rate. In the risk-neutral valuation method, although we price the option value relative only to the underlying assets, we have *implicitly* captured the probabilities of future states through the use of the payoffs of the underlying assets (Shockley, 2006; Trigeorgis, 1996).

3.1.3. Structure of uncertainty

In our model, market price, P_i, is a stochastic variable. Suppose the market price follows a binomial distribution (Cox et al., 1979). From time 0 to time 1, P_i, where $i = 1$ or 2, can change from its starting value $P_i(0)$ to one of only two possible future values (a higher or lower value, as compared with $P_i(0)$); that is,

$$P_i(1) = P_i(0) \times u_i \text{ or } P_i(1) = P_i(0) \times d_i, \tag{1}$$

where $u_i = e^{\sigma_i}$, $d_i = e^{-\sigma_i} = 1/u_i$, and σ_i is the volatility of the market price P_i. The risk-neutral probabilities are $q_i = e^{\sigma_i} - d_i/u_i - d_i$ for $P_i(1) = P_i(0) \times u_i$ to occur and $1-q_i$ for $P_i(1) = P_i(0) \times d_i$ to occur (Shockley, 2006).

3.1.4. Real options value of location

To obtain the real options value of building a subsidiary in each location, backward induction is required; that is, we first calculate the MNE's profit at time 1, followed by the real options value of each location at time 0. Supposing the MNE builds a subsidiary in country i at time 0, its profit in country i at time 1 is

$$V_i = \max[(P_i(1) - C_i) \times Q_i, 0]. \tag{2}$$

Eq. (2) shows that the MNE either exercises the option to sell Q_i in country i and earns $(P_i(1) - C_i) \times Q_i$, or does not sell anything in country i with zero profit. When $P_i(1) > C_i$, the MNE will exercise the option; when $P_i(1) \leqslant C_i$, the MNE will not exercise the option.

Therefore, the option value of establishing a subsidiary in country i at time 0 is

$$RO_i(0) = \frac{q_i \times V_i[P_i(0) \times u_i] + (1 - q_i) \times V_i[P_i(0) \times d_i]}{e^r}. \tag{3}$$

Here, e^{-r} is the discount rate, where r is the risk-free interest rate. Recall that $P_i(1)$ has two possible values: $P_i(0) \times u_i$ or $P_i(0) \times d_i$. Correspondingly, the MNE's profits in period 1 under the two possible scenarios are $V_i[P_i(0) \times u_i]$ and $V_i[P_i(0) \times d_i]$, which can be calculated per Eq. (2). Eq. (3) shows that to discount the period 1 profits to period 0, we first multiply $V_i[P_i(0) \times u_i]$ and $V_i[P_i(0) \times d_i]$ by the risk-neutral probabilities q_i and $1-q_i$, and then adjust the sum of the MNE's period 1 profits by the risk-free discount rate e^{-r}. Recall that this method is called risk-neutral valuation, which is frequently used in real options valuation (Trigeorgis, 1996).

At time 0, the MNE compares the real options value of establishing a subsidiary in the two countries and chooses the location, which provides a higher option value. Formally, the MNE's optimal profit is

$$\Pi(0) = \max[RO_1(0), RO_2(0)]. \tag{4}$$

3.2. Model II: choice of market entry mode

3.2.1. Assumptions

To further examine the US MNE's choice of market entry mode in a foreign market at time 0, we retain the assumption of Model I that the market price, P, is the underlying stochastic variable and follows the same binomial distribution. We also assume this is a two-period model and new information on the market price is revealed at time 1. Suppose the MNE has three alternatives to enter the market at time 0: a JV, a WOS, or export/licensing.[4] In our model, we assume that a JV provides option value because the MNE could enlarge its investment by acquiring its partner's equity so as to realize its full capacity, as in a WOS, while limiting losses by selling its equity to its partner or withdrawing from the partnership. A WOS provides option value because the MNE can realize the full capacity of a WOS to explore market opportunities, while limiting its losses to the initial investments of establishing the WOS. Export or licensing creates real options for the MNE to expand its investment to build a WOS when future opportunities arise,

[4]Here we do not distinguish between the MNE's use of Greenfield investment or acquisition to form a WOS. We do not distinguish between export and licensing either because we are mainly interested in comparing the two groups of market entry modes: low-commitment (export/licensing) and high-commitment (JV/WOS) entry modes. Even if we included the differences between export and licensing (seeBuckley & Casson, 1981), our present results would still hold.

while limiting possible losses to initial investments. Hence, these market entry modes all provide two similar types of options: the option to grow and the option to abandon. However, there are three main differences among these market entry modes that may influence their option value. First, these market entry modes require different levels of initial market entry investments to generate the real options at time 0. We use I_{JV}, I_{WOS}, and $I_{e/l}$ to represent market entry investments of a JV, a WOS, and export/licensing, respectively. It is reasonable to assume that at time 0, a WOS requires higher investments than a JV, and a JV needs higher investments than export/licensing; that is, $I_{WOS} > I_{JV} > I_{e/l}$. This assumption is consistent with that of Buckley and Casson (1981).

Second, these market entry modes have different option exercise costs. To exercise the option to grow at time 1, a WOS does not require any capacity expansion costs. Expanding from export/licensing to a WOS requires an additional investment at $(I_{WOS} - I_{e/l})$. Expanding from a JV to a WOS requires acquisition of the local partner's equity, valued at $(I_{wos} - I_{JV}) + A$, where $(I_{wos} - I_{JV})$ is the book value of the local partner's equity, and A represents the premium (or discount) paid for the local partner's equity. The magnitude of A depends on the respective valuation of the JV by the MNE and its local partner, as well as their bargaining power in price negotiation. A can be greater or less than zero; $A > 0$ implies that the firm pays a premium to its partner for the partner's equity in a JV, while $A < 0$ implies the opposite. The worst scenario is one in which the JV partners cannot agree on their transactions and the MNE withdraws from the JV and establishes a WOS by investing I_{WOS}. Therefore, there is an upper limit to what the MNE is willing to pay its partner; that is, $A \leqslant I_{JV}$.

Furthermore, to exercise the option to abandon at time 1, the MNE with export/licensing or a WOS simply withdraws from the market and makes no profit. We make this assumption to emphasize the irreversibility of initial investment in a foreign market. Such irreversibility may result from asset specificity that characterizes the MNE's investments in a foreign country, because asset specificity increases the difficulty in selling them in the market (Williamson, 1985). Moreover, irreversibility may be exacerbated by government regulation and institutional arrangements. For example, capital controls may make it impossible for foreign investors to sell assets and reallocate their funds (Pindyck, 1991). The irreversibility problem may be less severe within a JV because the MNE can exercise the option to abandon by selling its equity to the local partner at $(I_{JV} - S)$. Similar to A, S can be positive or negative, depending on partners' valuation of the JV and their negotiation. A positive S implies a discount in selling a firm's equity to its partner, while a negative S implies the opposite. Here, $S \leqslant I_{JV}$ because the bottom line is that the MNE makes no profit by dissolving the JV at time 1. When a firm has to pay high premiums for the partner's equity in a JV or sell its equity at a large discount—that is, when A or S is large—the option exercise cost in a JV is high.

The third difference among different market entry modes lies in their ability to obtain information and reduce uncertainty, contingent on the uncertainty type. Roberts and Weitzman (1981) and Folta (1998) distinguished between two types of uncertainty: exogenous and endogenous. Exogenous uncertainty is not affected by a firm's actions and can only be revealed over time. Uncertainty in the macroeconomic environment, such as political and macroeconomic conditions, mainly belongs to this type. Endogenous uncertainty can be decreased by an individual firm through investments. Uncertainty in the microeconomic environment, such as market demand and competition conditions—and at the firm level, such as relationships in partnerships—mainly belongs to this type. In our

study, we assume that market price can be influenced by both exogenous and endogenous factors. For example, when the market price of a product is frequently influenced by the host government's regulations and interventions, market price volatility is mainly exogenous. When the MNE is able to invest in the host environment to discover the trend of market demand and supply, market price volatility is mainly endogenous.

When market price uncertainty is exogenous, non-equity and equity market entry modes have similar ability to understand the local market and thereby reduce market uncertainty. However, when market price uncertainty is endogenous, equity entry modes such as a JV or WOS likely contribute more to information collection and uncertainty reduction than export/licensing, due to ownership advantages (Buckley & Casson, 1998). Specifically, we assume that using a JV or WOS helps the MNE obtain market information earlier than using export/licensing; hence, the MNE can respond to new information quickly by exercising the option to grow. We introduce a parameter, B, to capture the additional benefits of uncertainty reduction brought about by a JV or WOS, as compared with export/licensing.[5] A smaller B means that using a JV/WOS only generates a small amount of additional profits. In other words, market-price volatility is mainly exogenous and is not influenced by the MNE's presence in the foreign market. On the contrary, a larger B implies that market-price volatility is mainly endogenous, and using a JV/WOS contributes to the MNE's information collection.

3.2.2. *Real options value of market entry mode*

We used backward induction to find out the real options value of each market entry mode; that is, we calculated the MNE's profit under each market entry mode at time 1, followed by the option value at time 0. The MNE's profit at time 1 when it uses a WOS is

$$V_{\mathrm{WOS}} = \max[(P(1) - C) \times Q + B, 0]. \tag{5}$$

Eq. (5) shows that, depending on the revelation of $P(1)$, the MNE can exercise the option to grow by selling Q in country i and realize the full capacity of a WOS; that is, $(P(1)-C) \times Q$, where C refers to the marginal cost of sales in a WOS. In addition, the MNE realizes the benefits of information collection and uncertainty reduction, which is B. An alternative is that the MNE exercises the option to abandon and earns zero profit.

Similarly, the MNE's profit when it uses a JV in country i at time 1 is

$$V_{\mathrm{JV}} = \max[(P(1) - C) \times Q - ((I_{\mathrm{WOS}} - I_{\mathrm{JV}}) + A) + B, (I_{\mathrm{JV}} - S), 0]. \tag{6}$$

Eq. (6) shows that with an additional investment at $(I_{\mathrm{WOS}} - I_{\mathrm{JV}}) + A$, the MNE can exercise the option to grow and realize the profit at $(P(1) - C) \times Q$. In addition, the MNE realizes the benefits of uncertainty reduction (B). Alternatively, the MNE can exercise the option to abandon by selling its equity to the local partner to earn $(I_{\mathrm{JV}} - S)$ or withdrawing from the market with zero profit.

Last, the MNE's profit when it uses export/licensing in country i at time 1 is

$$V_{\mathrm{e/l}} = \max\left[(P(1) - C) \times Q - (I_{\mathrm{WOS}} - I_{\mathrm{e/l}}), 0\right]. \tag{7}$$

[5]Note that our model setup is different from that of Buckley and Casson (1981), in that in their model, the advantage of FDI over licensing or export is that FDI leads to lower recurrent costs. In our model, we assume that the recurrent (or production) cost is the same among different entry modes. Instead, the advantage of FDI over licensing/export is manifested in the parameter B. If we were to employ the same assumption on the recurrent costs as Buckley and Casson (1981), it would further strengthen our propositions on market entry mode.

Eq. (7) shows that with an additional investment at $(I_{WOS} - I_{e/l})$, the MNE can exercise the option to grow and realize the profit at $(P(1) - C) \times Q$. Meanwhile, the MNE controls its losses by exercising the option to abandon and making no profit.

Therefore, the option value of a market entry mode, j, where j = WOS, JV, or *export/licensing*, at time 0, is

$$RO_j(0) = \frac{q \times V_j[P(0) \times u] + (1-q) \times V_j[P(0) \times d]}{e^r} - I_j. \quad (8)$$

Eq. (8) shows that to calculate the real options value of each market entry mode, we first multiply the MNE's profits under the two possible future scenarios of the market price by the risk-neutral probabilities, then discount the sum of the MNE's adjusted future profits by the risk-free rate, and finally deduct the initial investment of each market entry mode. We used Eqs. (5)–(7) to obtain $V_j[P(0) \times u]$ and $V_j[P(0) \times d]$.

At time 0, the MNE chooses a market entry mode to maximize the option value. Formally, the MNE's optimal profit is

$$\Pi(0) = \max[RO_{WOS}(0), RO_{JV}(0), RO_{e/l}(0)]. \quad (9)$$

4. Simulations

We conduct two sets of simulations, based on Microsoft Excel macros, corresponding to the two models in the previous section. Relying on Eqs. (2) and (3), we first simulate the options value of a location and then simulate the MNE's choice of market entry mode according to Eqs. (5)–(9).

For the first set of simulations on choice of location, we assume that the MNE chooses its location at the beginning of year 0, and when the information of the market price reveals itself at the beginning of year 1, the MNE decides whether to exercise its option to sell in the local market. The model ends at the close of year 1. Our main purpose in the first set of simulations is to find out the option value of a location under different combinations of market price volatility (σ) and the marginal cost of sales (C). Before conducting formal simulations, we first use simple examples to illustrate the evolution of market price, as well as the impact of σ and C on profits of subsidiaries in Canada and China, as summarized in Figs. 1a–c. Fig. 1a shows how market price volatility affects the evolution of P_i. Recall that P_1 and P_2 refer to the prices of the same product in Canada and China, respectively. Both P_1 and P_2 are stochastic variables, and their difference is that the volatility of P_2 is higher than that of P_1 (that is, $\sigma_2 > \sigma_1$). In Fig. 1a, we assume that at year 0, the starting value of P_1 and P_2 is the same (that is, $P_1(0) = P_2(0) = 40$) and the volatility of P_1 is 50% while that of P_2 is 90%. Based on Eq. (1), $P_1(1)$ can go up to 65.9 when the market becomes optimistic or down to 24.3 when the market becomes pessimistic. Similarly, $P_2(1)$ can go up to 98.4 or down to 16.3. These numbers imply that when the market is optimistic in both Canada and China at year 1, $P_2 > P_1$; when the market is pessimistic in both countries at year 1, $P_2 < P_1$. This simple example illustrates the high volatility of the market (high upside potentials and high downside risks) in China as compared with Canada.

Fig. 1b further illustrates how such difference in market price volatility affects subsidiary profit. The subsidiary profits are calculated based on Eqs. (2) and (3). Note that we assume the market demand for the final product at 60 and the risk-free interest rate at 5%. Holding the marginal cost of sales constant in both Canada and China ($C_1 = C_2 = 20$),

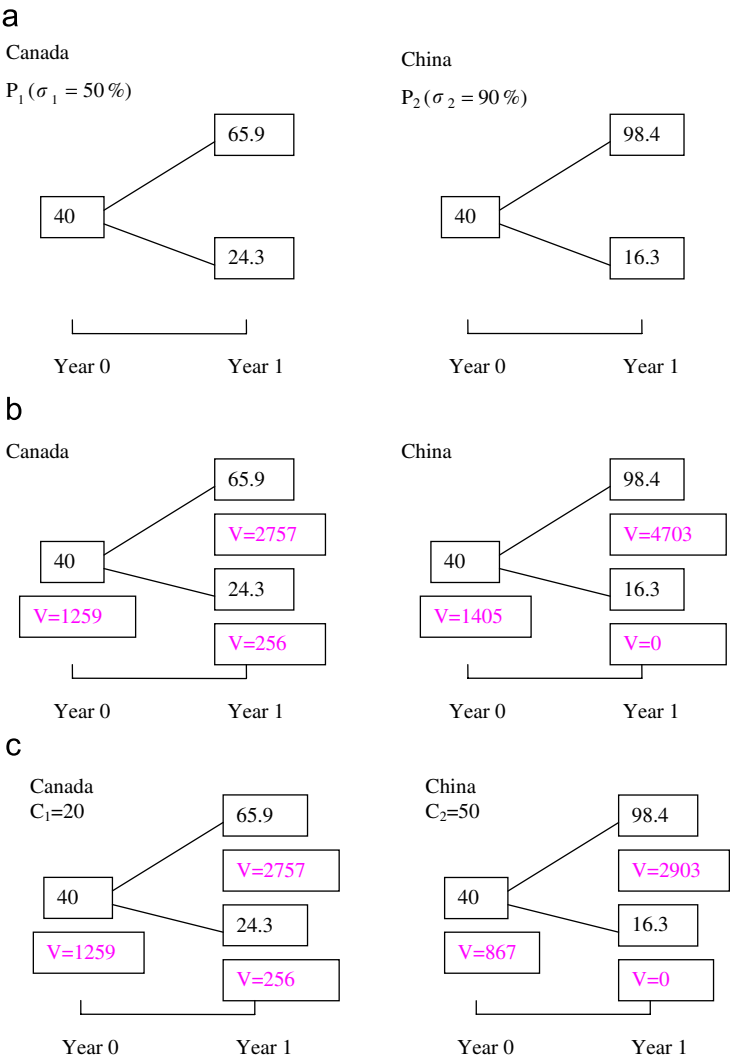

Fig. 1. (a) An example of evolution of the market prices in Canada and China when $\sigma_1 < \sigma_2$. (b) An example of profits in Canada and China when $C_1 = C_2 = 20$. (c) An example of profits in Canada and China when $C_1 < C_2$.

Fig. 1b shows that establishing a subsidiary in China brings in more profits than in Canada in year 0 (1405 vs. 1259). The main reason for this difference is that the subsidiary in China produces much more profits than in Canada (4703 vs. 2757) when the year-1 market price becomes favorable, whereas the subsidiary in China locks its losses by not exercising the option to sell in China (0 vs. 256) when the year-1 market price becomes unfavorable. Fig. 1b illustrates that higher volatility of the market price in China leads to higher profits when the cost to exercise the option remains similar in both countries.

Fig. 1c further illustrates how the marginal cost of sales affects subsidiary profits in Canada and China: When the marginal cost of sales in China is much larger than that in Canada (that is, $C_1 = 20$ and $C_2 = 50$), the subsidiary in China will bring in less profit than

that in Canada in year 0 (867 vs. 1259). The main reason for this is that when the market price turns favorable in year 1, the profit of the subsidiary in China is only slightly higher than that in Canada due to the high marginal cost of sales (2903 vs. 2757), which substantially reduces the option value of a subsidiary in China, as compared with the case in Fig. 1b. The implication is that the high option exercise cost diminishes the option value of a location.

We then utilize simulation techniques to generate Table 1 in order to verify the above results in Figs. 1b and c. The values in Table 1 were generated by inserting the following numbers into Eqs. (2) and (3). We first chose a broad range of market price volatility—$\sigma = [5\%,90\%]$—to examine how the option value of a location varies as volatility increases from a low level (5%) to a high level (90%). We also chose a broad range of marginal cost of sales (that is, $C = [10,90]$) to capture the effect of both high and low values of option exercise costs. In addition, we assume the initial market price $P(0) = 40$, such that we are able to examine different cases where the market price is higher or lower than the marginal cost of sales, which may motivate or hinder a firm's decision to exercise the option to sell in a local market. We also use an initial market price of 30 or 50, which produces similar patterns of results as those based on 40. We assume the market demand for the final product to be 60 and the risk-free interest rate $r = 5\%$. We also chose alternative values for market demand and risk-free interest rate, but doing so did not change the pattern of results in Table 1.

The second set of simulation regards the MNE's choice of market entry mode. Similar to the first set of simulations, we assume a 2-year model in which the MNE chooses its market entry mode at year 0 and exercises its option to grow or abandon at year 1. We focus on the MNE's choice of market entry mode contingent on the magnitude of uncertainty (σ)

Table 1
The option value of a location under different combinations of market price volatility and the marginal cost of sales

Marginal cost of sales	Market price volatility																	
	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%
10	1829	1829	1829	1829	1829	1829	1829	1829	1829	1829	1829	1829	1829	1829	1829	1829	1829	1829
15	1544	1544	1544	1544	1544	1544	1544	1544	1544	1544	1544	1544	1544	1544	1544	1544	1544	1544
20	1259	1259	1259	1259	1259	1259	1259	1259	1259	1259	1259	1259	1259	1263	1299	1335	1370	1405
25	973	973	973	973	973	973	973	973	973	997	1038	1078	1119	1159	1199	1238	1277	1315
30	688	688	688	688	688	698	741	785	830	876	921	966	1011	1055	1099	1142	1184	1226
35	402	402	414	457	504	553	603	653	703	754	804	853	902	950	998	1045	1091	1136
40	117	176	234	292	350	407	464	521	577	632	687	741	794	846	898	948	998	1046
45	0	0	53	127	196	262	326	388	450	510	570	628	685	742	797	851	905	957
50	0	0	0	0	42	116	187	256	323	388	453	515	577	637	697	755	812	867
55	0	0	0	0	0	0	49	124	196	267	335	403	469	533	596	658	718	778
60	0	0	0	0	0	0	0	0	69	145	218	290	360	429	496	561	625	688
65	0	0	0	0	0	0	0	0	0	23	101	178	252	324	395	465	532	598
70	0	0	0	0	0	0	0	0	0	0	0	65	144	220	295	368	439	509
75	0	0	0	0	0	0	0	0	0	0	0	0	35	116	194	271	346	419
80	0	0	0	0	0	0	0	0	0	0	0	0	0	11	94	174	253	329
85	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	78	160	240
90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	67	150

and type of uncertainty (B). We thereby generated Figs. 2a–f to show the impact of B and σ on choice of market entry mode. These figures were generated based on the following common initial input values: $r = 5\%$, $P(0) = 40$, $Q = 60$, $\sigma = [5\%,1]$, $B = [0,600]$, $I_{WOS} = 1500$, $I_{JV} = 800$, $I_{e/l} = 200$, $C = 10$. We chose the above values for the risk-free interest rate r, initial market price $P(0)$, and market demand Q because these values were already proved to be appropriate for our analysis in the first set of simulations. Since we are interested in analyzing the impact of magnitude of uncertainty and type of uncertainty, we varied the values for σ and B in a wide range. We chose these values for the initial investments of a wholly owned subsidiary (I_{WOS}), a joint venture (I_{JV}), and export/licensing ($I_{e/l}$) in order to ensure the decreasing level of investment needed for the different types of entry modes. We also used alternative values for the initial investments, which generate similar patterns of results. The marginal cost of sales C is assumed to be the same

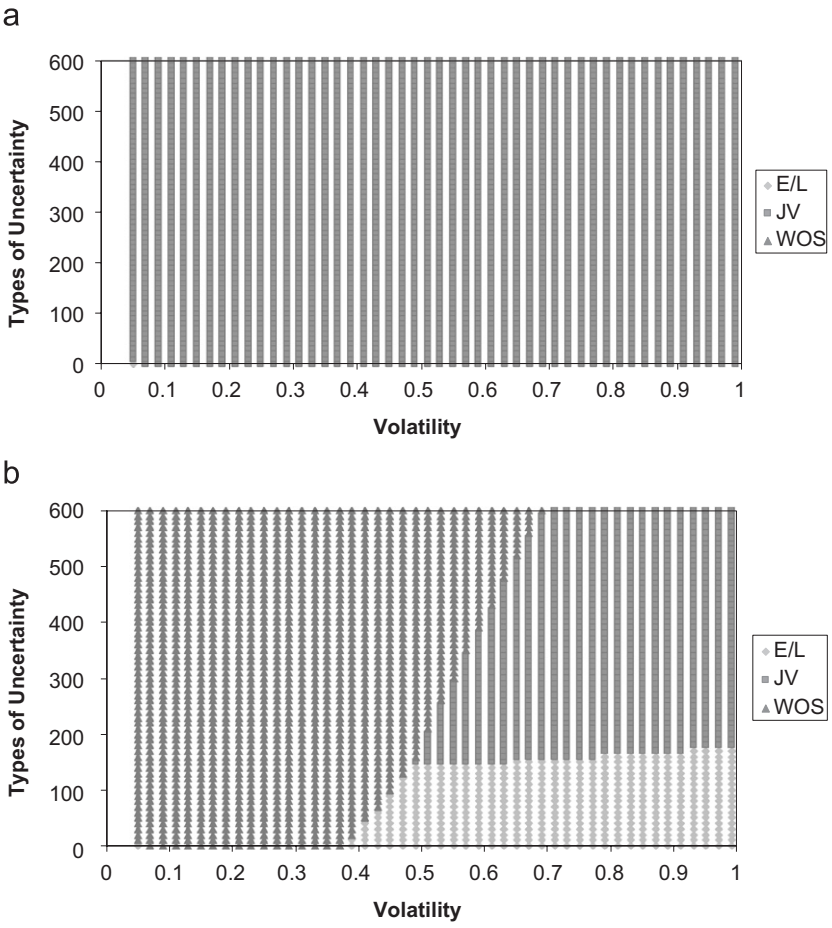

Fig. 2. (a) Choice of market entry modes under uncertainty when $A = 0$ and $S = 0$. (b) Choice of market entry modes under uncertainty when $A = 100$ and $S = 200$. (c) Choice of market entry modes under uncertainty when $A = 100$ and $S = 300$. (d) Choice of market entry modes under uncertainty when $A = 200$ and $S = 200$. (e) Choice of market entry modes under uncertainty when $A = 200$ and $S = 300$. (f) Choice of market entry modes under uncertainty when $A = 800$ and $S = 800$.

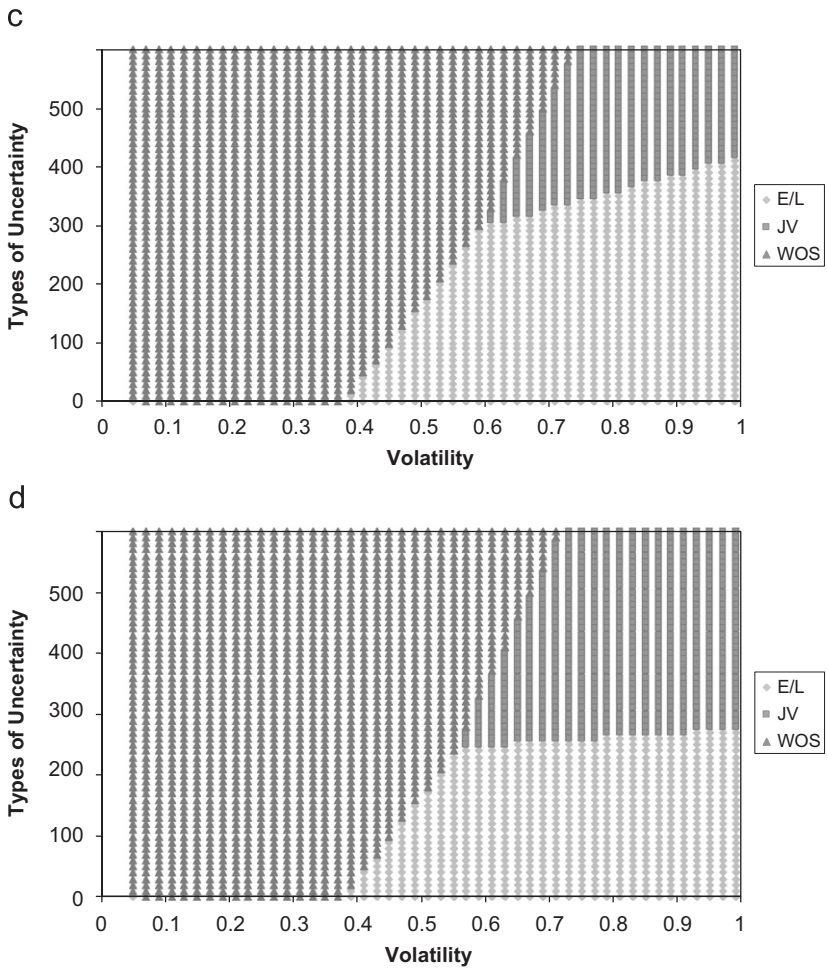

Fig. 2. (*Continued*)

for all types of entry mode and at a relatively low level, 10. Such an assumption ensures that the marginal cost of sales will not play a significant role in choice of entry mode, which enables us to focus on the effect of uncertainty.

Despite these similar initial input values for Figs. 2a–f, some differences exist among them; the values of A and S vary across the figures. Recall that A refers to the acquisition premiums and S refers to the divestiture discounts in a JV. Specifically, in Fig. 2a, $A = 0$, $S = 0$, which implies that in exercising the options in a JV, the MNE pays no premiums to acquire the partner's equity, or divests its own equity to its partner at no discount; in Fig. 2b, $A = 100$, $S = 200$; in Fig. 2c, $A = 100$, $S = 300$; in Fig. 2d, $A = 200$, $S = 200$; in Fig. 2e, $A = 200$, $S = 300$; in Fig. 2f, $A = 800$, $S = 800$. An increase in the value of A or S makes it more expensive to exercise the option to expand or abandon in a JV. We chose different combinations of A and S in order to have a robustness check on the results that hold for only one set of A and S, as well as to examine the influence of A and S on the option value of a JV. To sum up, we expect to obtain two levels of information from

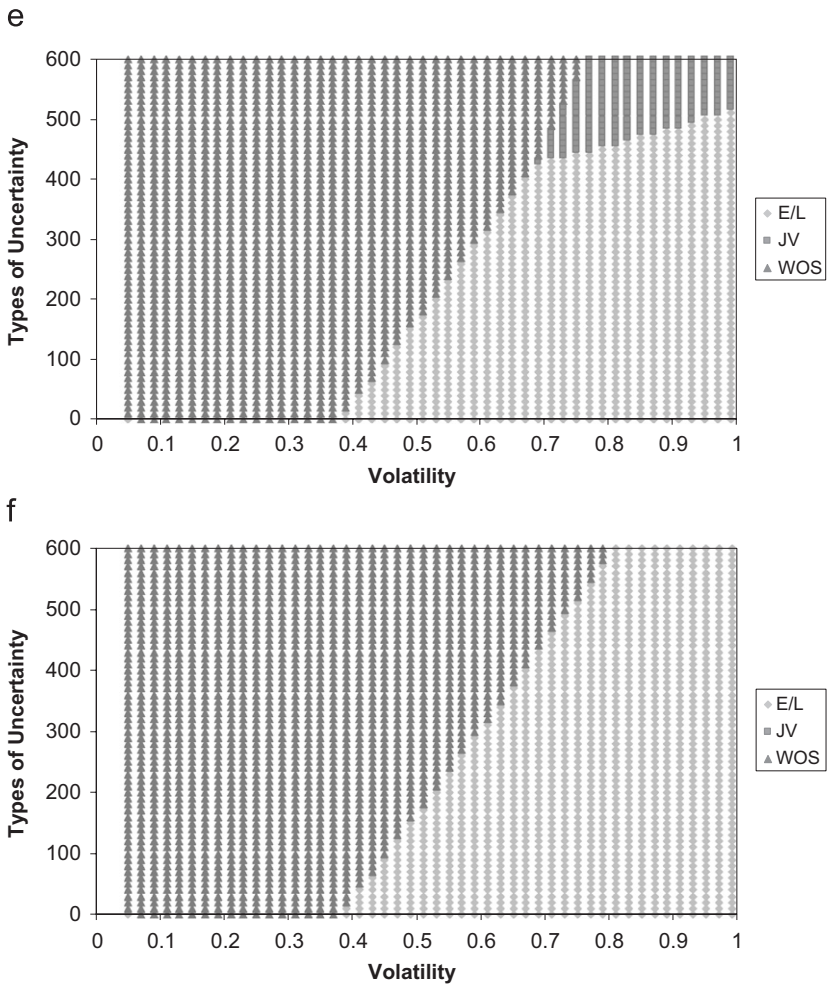

Fig. 2. (*Continued*)

Figs. 2a–f: (1) how A and S influence the option value of a JV, and (2) how B and σ influence the MNE's choice among export/licensing, a JV, and a WOS.

5. Results and discussions

In this section, we first discuss the US MNE's choice of location based on Table 1, and then examine the MNE's choice of market entry mode based on Figs. 2a–f. We derive five propositions based on the analyses.

5.1. Choice of location

There are two dimensions in Table 1. The horizontal dimension is the market price volatility, which increases from low (5%) to high (90%), while the vertical dimension is the

marginal cost of sales, which increases from 10 to 90.[6] Through Table 1, we are able to analyze the option value of a location from two perspectives: the potential for option value appropriation, and the cost of option exercise. Here, the horizontal axis (the volatility of market price) influences the potential for option value appropriation, while the vertical axis (the marginal cost of sales) affects the cost of option exercise.

We first examine how market price volatility affects the potential for option value appropriation of each location. Recall that we assume that the US MNE likely faces more market volatility in China than in Canada, given that it has no previous experience in either country. Then Canada is more likely to be located at the "western" side of Table 1, where market price volatility is smaller, while China is more likely to be positioned at the "eastern" side of the table, where market price volatility is larger. This table tells us that holding the marginal cost of sales constant, market price volatility likely increases the option value of a subsidiary, and the option value of building a subsidiary in China is thereby likely to be higher than that in Canada. Intuitively, the MNE can pursue potentially higher market prices in China, while controlling potential losses by not exercising the option to sell. Therefore, from the perspective of pursuing the potential for option value appropriation, the US firm has more incentives to locate its subsidiary in China.

Although generating options for future value appropriation is important, of equal importance to MNE performance is the exercise of real options; a high option exercise cost will reduce the attractiveness of a location as an investment destination. Hence, to find out the optimal location to build a new subsidiary, we should also scrutinize the capability of an MNE in exercising the option to sell products in a market. This is why we need to examine the vertical dimension of Table 1—the marginal cost of sales, which is determined by the advancement of the US MNE's sales network and marketing knowledge of each country. The lower the marginal cost of sales, the greater the MNE's ability to exercise the option to sell and realize its potential sales objectives. Recall that we assume the US MNE will have a lower marginal cost of sales in Canada than in China. Therefore, to the US MNE, Canada is more likely to be located at the "northern" part of Table 1, where the marginal cost of sales is smaller, while China is more likely to occupy the "southern" part of this table, where the marginal cost of sales is larger. The option value of building a subsidiary in China is strictly lower than that in Canada, given the same market price volatility.

In summary, if Canada is a country located in the "northwestern" corner of Table 1 and China is positioned in the "southeastern" corner of the table, the US MNE is more likely to choose to build a subsidiary in Canada because the extra benefits from potential market opportunities in China cannot exceed the additional option exercise costs in China. Therefore, to choose a location, the US MNE has to compare two dimensions in Canada and China—the potential opportunities brought about by each country, and the ability to exercise options and to realize sales when opportunities arrive in each country. It sounds tempting to pursue a new subsidiary in China from the standpoint of seeking a potentially large market. However, only when the MNE has the ability to exercise real options without involving substantial investments should it build the subsidiary in China.

[6]Note that for our analysis, we intend to use Table 1 to compare the impact of different levels of marginal costs of sales on the option value of a location. Therefore, what matters for our analysis is the existence of different levels of marginal costs of sales. In other words, the absolute value or the unit of the marginal cost of sales does not matter much.

Formally, we have the following propositions.

Proposition 1. *The lower the potential to generate real options in nonhome-region locations, the greater the likelihood that an MNE will choose to establish a location in its home region.*

Proposition 2. *The lower the capability that an MNE has in exercising real options in nonhome-region locations, the greater the likelihood that an MNE will choose to establish a location in its home region.*

Propositions 1 and 2 imply that generation and exercise of real options are equally important in determining an MNE's strategy and in creating value for an MNE. This idea provides a theoretical explanation for the regionalization phenomenon (Rugman & Verbeke, 2004): Many MNEs pursue a strategy of expanding within the home region because the extra benefits from generating real options outside the home region cannot justify the extra option exercise costs, compared with building a subsidiary in the home region.

Reorganizing Table 1, we have the classifications of MNEs' strategies in Table 2. The horizontal dimension is the potential to generate real options in nonhome regions, which can be low or high, whereas the vertical dimension is an MNE's ability to exercise real options, which also can be low or high. The potential to generate real options in nonhome regions is likely to be greater when market volatility is high. An MNE is more capable of exercising real options when the marginal cost of sales is low. Contingent on the potential to generate real options and the ability to exercise real options, we have several types of firm strategies. MNEs are most likely to become globally or biregionally oriented in quadrant 3 when they can generate real options outside their home region, and when they can exercise these real options and realize potential sales in these markets. MNEs in quadrants 1, 2, and 4, however, are more likely to become home-region oriented for the following reasons. First, firms have no incentives to explore their firm specific advantages in regions with low option potential (quadrants 1 and 2). Second, when firms are constrained in exercising their options to sell products to nonhome-region markets, they are not interested in expanding in these markets, even though these markets may present handsome potential opportunities (quadrant 4).

Propositions 1 and 2 can also be applied to reconcile some inconsistent results in the literature. First, Tong et al. (2008) found that having real options in developing countries does not lead to a higher growth option value for an MNE, although the existing theoretical reasoning points to the opposite. Our propositions indicate that their result is not surprising. Without appropriate ability to exercise real options to realize growth opportunities, expanding businesses into developing countries does not necessarily provide real growth options. Second, the literature review section has revealed that, theoretically,

Table 2
MNE strategy under different combinations of real option potential and the ability to exercise real options

Ability to exercise real options	Real option potentials in nonhome regions	
	Low	High
High	1. Home region firms	3. Global/bi-regional firms
Low	2. Home region firms	4. Home region firms

multinationality increases market valuation and decreases corporate risks; however, empirical evidence does not show unconditional support for such theoretical reasoning. Applying the idea in the propositions, we could reason that having multinational subsidiaries does not automatically lead to better performance; multinationality improves an MNE's performance only when the MNE is able to exercise the options in the multinational network and realize the switch of raw materials, production, and sales across subsidiaries when opportunities arise.

5.2. Choice of market entry mode

Figs. 2a–f examine the MNE's choice of market entry mode based on the magnitude and type of market price uncertainty. Each figure has two dimensions: The horizontal axis includes different levels of market price volatility, which ranges between 5% and 100%, and the vertical axis represents the nature of the market price uncertainty; the higher the number, the more likely that market uncertainty is endogenous. These figures differ in the values of A and S, where Figs. 2a and f present two extreme cases. In Fig. 2a, the MNE does not pay any premiums when acquiring its partner's equity ($A = 0$) or give any discounts when selling its own equity ($S = 0$). Under these conditions, Fig. 2a shows that a JV is the optimal entry mode, regardless of the magnitude and types of market uncertainty. Intuitively, compared with a WOS and export/licensing, a JV has a similar option value to grow but has a higher option value to abandon because the JV partner provides a ready market for an MNE to divest its equity. Fig. 2f shows the opposite case, where the MNE has to pay significant premiums to acquire its partner's equity ($A = 800$) and give significant discounts to sell its own equity ($S = 800$). Under these conditions, Fig. 2f implies that the MNE has no incentives to use a JV, regardless of the magnitude and types of uncertainty. Intuitively, when the option exercise cost is substantial, the option value of a JV becomes much smaller than that of a WOS or export/licensing, and thus the probability of using a JV decreases.[7] In the following discussion, we assume that the option exercise costs in a JV are between the two extreme cases represented in Figs. 2a and f, and we are interested in examining the conditions under which each market entry mode is optimal by referring to Figs. 2b–e.

Consistent with the above result, the first implication of Figs. 2b–e is that the option exercise cost in a JV decreases the likelihood that a JV is an optimal choice of entry mode. Holding other factors constant, when the divestiture discount S increases from 200 (Fig. 2b) to 300 (Fig. 2c), the areas for a JV to be optimal shrink, which implies that the option to abandon in a JV becomes less valuable. We can find similar patterns when comparing Fig. 2d with e. Holding other factors constant, when acquisition premium A increases from 100 (Fig. 2b) to 200 (Fig. 2d), the areas for a JV to be optimal also shrink, which implies that the option to grow in a JV becomes less valuable with high A. Similar patterns can be found by comparing Figs. 2c with e.

Second, Figs. 2b–e have implications regarding the relationship between the magnitude of market price volatility and choice of market entry mode. These figures indicate that

[7] In this paper, we do not examine what determines the exercise cost of the options in a JV. Chi and McGuire (1996) and Chi (2000) have precisely identified factors that influence the option exercise cost in a JV. First, as partners have divergent predictions of the value of the same joint assets, it is very likely that the transactions in a JV are less costly and more profitable. Second, when partners have low transaction costs, such as negotiation costs, the option exercise costs are likely to be lower.

when market price volatility becomes higher, export/licensing or a JV is likely to be a better market entry strategy than a WOS. Intuitively, in response to market growth, all the entry modes are capable of expanding capacity to catch up with growth opportunities. However, in response to market decline, the MNE faces more constraints than an exporter, a licensor, or a JV partner because the MNE devotes more irreversible investments to a WOS and faces more obstacles to withdraw from the market. Therefore, when market volatility increases, the option to grow is important, but all the entry modes do not differ significantly in their capability of taking advantage of growth opportunities. When market volatility increases, the option to abandon becomes important as well, but a WOS provides much less value in the option to abandon than export/licensing or a JV and therefore becomes less desirable for an MNE. Thus,

Proposition 3. *The higher the market uncertainty, the greater the likelihood that export/licensing and a JV are preferred over a WOS.*

This proposition lends support to internationalization theory: MNEs usually start from low-commitment market entry modes when facing significant uncertainty in a new market, and then switch to high-commitment market entry modes when uncertainty decreases (Johanson & Vahlne, 1977; Sullivan & Bauerschmidt, 1990). Low-commitment market entries at early stages provide an option to defer high-commitment market entries and work as platforms for MNEs to exercise growth options in later stages of internationalization. In the meantime, entering with a low-commitment entry mode avoids lump-sum, irreversible investment losses and helps an MNE persist longer in difficult markets and economic downturns.

Figs. 2b–e also present the relationship between the type of uncertainty and choice of entry mode. These figures consistently show that when market volatility is mainly exogenous (e.g., when $B<100$), committing to a large investment, such as a JV or WOS, is a less attractive strategy, while export/licensing is a better choice of entry mode. Intuitively, when facing exogenous uncertainty, a JV or WOS fails to bring in new information concerning the market price, while export/licensing involves a small amount of initial investments and provides the MNE with more flexibility to adjust its decisions in later stages. These figures also show that when market volatility is mainly endogenous (e.g., when $B>400$), building a JV/WOS is likely to be a better market entry mode. Intuitively, a JV/WOS is able to confer more information about the business environment and help MNEs to gain benefits by reacting quickly to changes in local markets.

To sum up, the tension between choosing export/licensing and a JV/WOS is essentially about which entry mode is able to provide a better combination of the option to abandon and the option to grow. When uncertainty is mainly exogenous, export/licensing is likely to provide a similar option value to grow but a higher option value to abandon, which makes export/licensing a better choice of entry mode. When uncertainty is mainly endogenous, a JV/WOS is likely to provide a much higher value of growth options, which makes it a better choice than export/licensing. Therefore, we have the following proposition.

Proposition 4. *When market uncertainty is endogenous, a JV/WOS is more likely to be preferred over export/licensing. When market uncertainty is exogenous, export/licensing is more likely to be preferred over a JV/WOS.*

The literature has provided some evidence to support this proposition. Delios and Henisz (2003) found that Japanese MNEs tend to choose JVs over distributional entries as

their initial market entry modes when policy uncertainty is high because MNEs may leverage the influence of their partners to reduce policy uncertainty in the host country. In addition, several studies have shown that entering the market with high commitment is likely to reduce uncertainty in market competition and to provide an MNE with a higher growth option value when the MNE is able to preempt potential entries of competitors or force existing competitors to "make room" for its entry (Folta & Miller, 2002; Folta & O'Brien, 2004; Kulatilaka & Perotti, 1998). For example, many MNEs made an initial move by way of JVs or WOSs to Eastern Germany immediately following the dismantling of the Berlin wall in order to preempt competitors and gain first mover advantages (Buckley & Tse, 1996).

Another implication of Figs. 2b–e regards when a JV or WOS is the best choice of entry mode. To examine the optimal conditions for a JV or WOS, we need to study the interaction effect between the magnitude and type of market uncertainty. Taking Fig. 2c as an example, it shows that when uncertainty is high and mainly endogenous (e.g., when $\sigma > 70\%$ and $B > 300$), a JV is likely to be the optimal entry mode. Intuitively, a JV likely provides a better combination of the option to grow and the option to abandon than other entry modes. Compared with export/licensing, a JV is able to contribute to a higher growth option by proactively reducing uncertainty. Compared with a WOS, a JV is able to provide a higher option value to abandon due to its lower initial investments, as well as having an alternative of selling out the equity to the partner. Such advantages of a JV over a WOS become salient under high market uncertainty.

Fig. 2c also shows that when market volatility is low and mainly endogenous (e.g., when $\sigma < 50\%$ and $B > 300$), a WOS is more likely to be the optimal entry mode. Intuitively, compared with export/licensing, a WOS is able to provide a higher option value to grow because it can proactively reduce endogenous uncertainty and bring additional benefits such as first mover advantages. Compared with a JV, the MNE with a WOS is likely to face lower costs of capacity expansion than a JV partner and provides a higher growth option value. Low market uncertainty makes the JV's advantage in divesting assets less valuable. Figs. 2b, d, and e also suggest similar patterns of results.

To sum up, we have the following proposition.

Proposition 5. *When market uncertainty is high and endogenous, a JV is more likely to be preferred over export/licensing and a WOS. When market uncertainty is low and endogenous, a WOS is more likely to be preferred over a JV and export/licensing.*

Folta's study (1998) lends some support to Proposition 5. Folta (1998) tested how uncertainty influences a firm's choice between equity collaboration and outright acquisition in order to obtain a desirable technology and found that high endogenous uncertainty, such as partner uncertainty, encourages the use of JVs over outright acquisition. Thus, JVs provide a higher option value to grow by reducing uncertainty about the targeting firm's resources and capabilities, as well as a higher option value to abandon, by limiting investments and deferring acquisition of a target firm.

6. Conclusions

We extend applications of real options theory to enrich the FDI literature on choice of location and choice of market entry mode under uncertainty. Our simplified real options models provide an example to illustrate how to apply option pricing models to topics in IB.

Specifically, by taking into consideration market volatility in IB, we have examined: (1) the conditions under which an multinational enterprises (MNE) prefers a location in its home region to that in a nonhome region for market-seeking FDI and (2) the conditions under which each market entry mode, such as export/licensing, a JV, or a WOS, is optimal.

We find that MNEs are inclined to establish a subsidiary in their home region when they perceive fewer opportunities to generate real options in nonhome regions, or when MNEs have a lower capability of exercising real options in nonhome regions. These conclusions help to explain the recently emerging regionalization theory: MNEs tend to capitalize on opportunities in their home region, as far as customer-end activities are concerned, rather than engaging in a path of rapid "global roll out" of their products and services, as evidenced by the fact that the majority of *Fortune* Global 500 firms have at least 70% of their sales in their home regions (Rugman, 2005; Rugman & Verbeke, 2004). Our study also implies that those MNEs interested in globalization should carefully investigate the option exercise costs, such as location-specific adaptation investments, in nonhome regions. Such investments are critical to the MNE's ultimate economic performance in terms of market penetration and profitability. MNEs have to decide whether the option value in a particular location can offset the cost of the location-bound investments. Solely paying attention to market opportunities in a country is not sufficient to justify market entry of an MNE.

The second contribution of this article is to provide insights into choice of market entry mode under uncertainty. The stages model of internationalization theory proposes that firms gradually increase commitments to foreign markets; firms often begin by exporting to a foreign market, then setting up a selling or distribution subsidiary, and finally forming a production subsidiary, such as a joint venture or a wholly owned subsidiary (Johanson & Vahlne, 1977; Sullivan & Bauerschmidt, 1990). However, one can easily find exceptions to the stages path of expansion supported by internationalization theory (Buckley & Tse, 1996; Delios & Henisz, 2003; Fina & Rugman, 1996). Our study suggests that the limitation of internationalization theory is partially due to its emphasis on only one dimension of uncertainty; that is, the magnitude of uncertainty. However, the theory ignores the other dimension of uncertainty—the type of uncertainty (exogenous vs. endogenous). Our results indicate that choice of market entry mode essentially depends on both the magnitude of uncertainty and the type of uncertainty. When uncertainty is high, firms are inclined to invest in low-commitment entry modes such as export/licensing because these modes provide valuable options to abandon. However, if uncertainty that an MNE faces is mainly endogenous, firms may change their decisions by investing in high-commitment market entry modes such as a JV or a WOS because such high-commitment entry modes are likely to provide valuable growth options, such as first mover advantages. Particularly, we find that, provided uncertainty that an MNE faces is high *and* endogenous, a JV is likely to be the optimal choice of entry mode because it provides the best combination of the option to abandon and the option to grow. Compared with export/licensing, using a JV provides the MNE with the opportunity to reduce endogenous uncertainty and obtain the growth option. Compared with a WOS, using a JV defers the initial large investment and thus exposes the MNE to less risk in the future.

For future research, empirical studies are needed to examine the relationship between MNEs' decision making, such as choice of location and market entry mode, and the magnitude and type of uncertainty. Since empirical studies based on a real options approach are limited in IB research (Li, 2007), such studies will make meaningful

contributions to applications of real options theory to IB. The main challenge in the empirical studies is to obtain information on the magnitude and type of uncertainty. Since it is managers who generate and exercise real options in IB, their perceptions of the uncertainty may be an accurate measurement, which can be obtained through qualitative methods such as interviews or survey (Guiso & Parigi, 1999; Sanchez-Peinado & Pla-Barber, 2006).

References

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

Arnold, T., & Shockley, R. (2003). Real options, corporate finance, and the foundations of value maximization. *Journal of Applied Corporate Finance*, *15*(2), 82–88.

Buckley, A., & Tse, K. (1996). Real operating options and foreign direct investment: A synthetic approach. *European Management Journal*, *14*(3), 304–314.

Buckley, P. J., & Casson, M. C. (1976). *The future of the multinational enterprise*. New York: Holmes & Meier Publishers.

Buckley, P. J., & Casson, M. C. (1981). The optimal timing of foreign direct investment. *Economic Journal*, *91*, 75–87.

Buckley, P. J., & Casson, M. C. (1988). A theory of cooperation in international business. In F. J. Contractor, & M. Lorange (Eds.), *Cooperative strategies in international business: JVs and technology partnerships between firms*. Lexington, MA: Lexington Books.

Buckley, P. J., & Casson, M. C. (1996). An economic model of international joint venture strategy. *Journal of International Business Studies*, *27*(5), 849–876.

Buckley, P., & Casson, M. (1998). Models of multinational enterprise. *Journal of International Business Studies*, *29*(1), 21–44.

Buckley, J. P., Casson, M., & Gulamhussen, M. A. (2002). Internationalisation—real options, knowledge management and the Uppsala approach. In V. Havila, M. Forsgren, & H. Håkansson (Eds.), *Critical perspectives on internationalisation* (pp. 229–261). Amsterdam, The Netherlands: Elsevier Science Ltd.

Campa, J. M. (1993). Entry by foreign firms in the United States under exchange rate uncertainty. *Review of Economics and Statistics*, *75*(4), 614–622.

Capel, J. (1992). How to service a foreign market under uncertainty: A real option approach. *European Journal of Political Economy*, *8*, 455–475.

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

Chi, T., & McGuire, D. J. (1996). Collaborative ventures and value of learning: Integrating the transaction cost and strategic option perspectives on the choice of market entry modes. *Journal of International Business Studies*, *27*(2), 285–307.

Cox, J. C., Ross, S. A., & Rubinstein, M. (1979). Option pricing: A simplified approach. *Journal of Financial Economics*, *7*(3), 229–263.

Delios, A., & Henisz, W. J. (2003). Political hazard, experience, and sequential entry strategies: The international expansion of Japanese firms, 1980–1988. *Strategic Management Journal*, *24*(10), 1153–1164.

Dixit, A. (1989). Entry and exit decisions under uncertainty. *Journal of Political Economy*, *97*(3), 620–638.

Duffie, D., & Huang, C. (1985). Implementing Arrow–Debreu equilibria by continuous trading of few long lived securities. *Econometrica*, *53*, 1337–1356.

Dunning, J. H. (1980). Toward an eclectic theory of international production: Some empirical tests. *Journal of International Business Studies*, *11*(1), 9–31.

Dunning, J. H. (1998). Location and the multinational enterprise: A neglected factor? *Journal of International Business Studies*, *29*(1), 45–66.

Dunning, J. H. (2000). The eclectic paradigm as an envelope for economic and business theories of MNE activity. *International Business Review*, *9*(2), 163–190.

Fina, E., & Rugman, A. M. (1996). A test of internalization theory and internationalization theory: The Upjohn company. *Management International Review*, *36*(3), 199–213.

Folta, T. B. (1998). Governance and uncertainty: The tradeoff between administrative control and commitment. *Strategic Management Journal*, *19*(11), 1007–1028.

Folta, T. B., & Miller, K. D. (2002). Real options in equity partnerships. *Strategic Management Journal*, *23*(1), 77–88.

Folta, T. B., & O'Brien, J. P. (2004). Entry in the presence of dueling options. *Strategic Management Journal*, *252*, 121–138.

Guiso, L., & Parigi, G. (1999). Investment and demand uncertainty. *Quarterly Journal of Economics*, *114*, 185–227.

Harrison, J. M., & Kreps, D. M. (1979). Martingales and arbitrage in multiperiod securities markets. *Journal of Economic Theory*, *20*(3), 381–408.

Hennart, J.-F. (1982). *A theory of multinational enterprise*. Ann Arbor: University of Michigan Press.

Johanson, J., & Vahlne, J.-E. (1977). The internationalization process of the firm—A model of knowledge development and increasing foreign market commitments. *Journal of International Business Studies*, *8*(1), 23–32.

Kogut, B. (1983). Foreign direct investment as a sequential process. In C. P. Kindelberger, & D. Audretsch (Eds.), *The multinational corporations in the 1980s*. Cambridge, MA: MIT Press.

Kogut, B., & Kulatilaka, N. (1994). Operating flexibility, global manufacturing and the option value of a multinational network. *Management Science*, *40*(1), 123–139.

Kouvelis, P., Axarloglou, K., & Sinha, V. (2001). Exchange rates and the choice of ownership structure of production facilities. *Management Science*, *47*(8), 1063–1080.

Kulatilaka, N., & Perotti, E. C. (1998). Strategic growth options. *Management Science*, *44*(8), 1021–1031.

Li, J. (2007). Real options and international strategy: A critical review. *Advances in Strategic Management*, *24*, 67–101.

Li, J., Dhanaraj, C., & Shockley, R. (2008). Joint venture evolution: Extending the real options approach. *Managerial and Decision Economics*, forthcoming.

Lieberthal, K., & Lieberthal, G. (2003). The great transition. *Harvard Business Review*, *81*(10), 70–81.

Madhok, A. (1998). The nature of multinational firm boundaries: Transaction costs, firm capabilities and foreign market entry mode. *International Business Review*, *7*(3), 259–290.

Mello, A. S., Parsons, J. E., & Triantis, A. J. (1995). An integrated model of multinational flexibility and hedging policies. *Journal of International Economics*, *39*, 27–51.

Miller, K., & Reuer, J. J. (1998). Firm strategy and economic exposures to foreign exchange rate movements. *Journal of International Business Studies*, *29*(3), 493–513.

Pindyck, R. S. (1991). Irreversibility, uncertainty, and investment. *Journal of Economic Literature*, *29*(3), 1110–1148.

Rangan, S. (1998). Do multinationals operate flexibly? Theory and evidence. *Journal of International Business Studies*, *29*(2), 217–237.

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

Rivoli, P., & Salorio, E. (1996). Direct investment and investment under uncertainty. *Journal of International Business Studies*, *27*(2), 335–354.

Roberts, K., & Weitzman, M. L. (1981). Funding criteria for research, development, and exploration projects. *Econometrica*, *49*(5), 1261–1288.

Rugman, A. (1981). *Inside the multinationals: The economics of internal markets*. New York: Columbia University Press.

Rugman, A. (2005). *The regional multinationals: MNEs and "Global" strategic management*. Cambridge, UK: Cambridge University Press.

Rugman, A., & Verbeke, A. (2004). A perspective on regional and global strategies of multinational enterprises. *Journal of International Business Studies*, *35*(1), 3–18.

Sanchez-Peinado, E., & Pla-Barber, J. (2006). A multidimensional concept of uncertainty and its influence on the entry mode choice: An empirical analysis in the service sector. *International Business Review*, *15*(3), 215–232.

Shockley, R. (2006). *An applied course in real options valuation*. South-Western College Pub.

Sullivan, D., & Bauerschmidt, A. (1990). Incremental internationalization: A test of Johanson and Vahlnes's thesis. *Management International Review*, *30*(1), 19–30.

Tong, T. W., & Reuer, J. J. (2007). Real options in multinational corporations: Organizational challenges and risk implications. *Journal of International Business Studies*, *38*(2), 215–230.

Tong, T. W., Reuer, J. J., & Peng, M. W. (2008). International joint venture and the value of growth options. *Academy of Management Journal,* forthcoming.

Trigeorgis, L. (1996). *Real options: Managerial flexibility and strategy in resource allocation*. Cambridge, MA: MIT Press.

Williamson, O. E. (1985). *The economic institutions of capitalism: Firms, markets, relational contracting*. New York, London: Free Press; Collier Macmillan.