FLEXIBILITY VERSUS COMMITMENT:

MNES' OWNERSHIP STRATEGY IN CHINA

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ABSTRACT

We investigate the following important questions in international business: How do MNEs choose ownership strategies when facing strong uncertainty in foreign market entries? How are the choices affected by industry contingencies? Following the key tenets of real options theory, we propose that, under a high level of market uncertainty, MNEs choose more flexible (rather than more committed) ownership strategies that allow adjustment of investment decisions in future. We further suggest that using flexible strategies in response to uncertainty becomes less valuable for MNEs when the industry they enter in the host country enjoys strong sales growth potential, requires less irreversible investments, and has intense competition. Empirically, we analyze the ownership strategies (ownership structure and equity share) of over 5,000 new foreign investments in manufacturing industries in China during 2000-2006. We find qualified support for our hypotheses and discuss the industry boundary conditions of adopting flexible ownership strategies in foreign market entries.

Key words: uncertainty, ownership strategy, real options, flexibility, commitment, China.

INTRODUCTION

Investing overseas presents substantial challenges for multinational enterprises (MNEs). One fundamental challenge is how to design an appropriate ownership strategy when MNEs make new investments in a foreign market. MNEs can commit to the market by establishing wholly owned subsidiaries (WOSs) or taking higher equity shares; or MNEs can resort to more flexible strategies by forming joint ventures (JVs) with local partners or taking lower equity shares. One stream of research has often framed such a choice as determined by the need for *control* to minimize transaction costs arising from asset specificity and potential partner opportunism (Anderson & Gatignon, 1986; Williamson, 1985). Another stream of research has suggested that such a choice is shaped by the institutional environment and proposed that MNEs may exchange ownership for *legitimacy* in the host country (Chan & Makino, 2007; Yiu & Makino, 2002). The current study posits that in addition to control and legitimacy, MNE ownership strategy is also fundamentally concerned with the choice between flexibility and commitment, an aspect that has received increasing attention in recent foreign direct investment (FDI) research (Buckley & Casson, 1998; Chi & McGuire, 1996; Kouvelis, Axarloglou, & Sinha, 2001).

This study examines the choice between a flexible and a committed ownership strategy from a real options perspective. This choice is important because MNEs typically face substantial uncertainty regarding the host country market, which makes the future profit streams unpredictable (Buckley & Casson, 1998). We propose that under highly volatile market conditions in a host country, MNEs prefer a flexible strategy (e.g., JVs or lower equity share) over a committed strategy (e.g., WOSs or higher equity share). We further suggest that a flexible ownership strategy, despite its value under high market uncertainty, can incur significant opportunity costs in certain circumstances. Three such industry contingency conditions are growth potential, investment irreversibility, and market competition (Dixit & Pindyck, 1994, 2000; Smit & Trigeorgis, 2004). We analyze how these industry conditions may increase or decrease the value of an ownership strategy in response to market uncertainty.

The current study contributes to real options research on international investment strategies in at least two aspects. First, our study builds on and extends a limited number of real options studies on

MNEs' ownership strategies. Existing literature has examined MNEs' ownership strategies by focusing on either switch options or growth options.[1] Kouvelis and colleagues analyze how MNEs switch across different ownership strategies in response to exchange rate volatility and adjustment costs (Axarlogiou & Kouvelis, 2007; Kouvelis, Axarloglou, & Sinha, 2001), whereas other studies investigate how MNEs choose an initial entry mode such as the JV under uncertainty in order to capture growth opportunities in a host country in the future (Brouthers, Brouthers, & Werner, 2008; Chi & McGuire, 1996; Cuypers & Martin, 2010). Our study falls in the second line of research, which suggests that MNEs tend to take a smaller equity share or choose a JV over a WOS in response to uncertainty. We extend this line of research by examining important industry contingency conditions (growth potential, irreversibility, and competition) that affect the growth option value of an ownership strategy.

By testing boundary conditions of real options value embedded in an ownership strategy, our study also helps to differentiate real options predictions from other theoretical predictions. Alternative theoretical perspectives on risk aversion and information asymmetry (Driver & Whelan, 2001; Ghosal & Loungani, 2000) may partially explain the negative relationship between uncertainty and investment.[2] It is thus important to examine how options value under uncertainty further depends on industry contingency conditions (e.g., Campa, 1993; Driver, Temple, & Urga, 2006; Folta & O'Brien, 2004; Guiso & Parigi, 1999).

Second, our analysis contributes to the broader real options literature on international investment strategy by emphasizing the impact of industry competition. A survey of the empirical research suggests that the contingent effect of competition on the options value of an international investment remains underexplored as compared with that of irreversibility (Li, 2007; Li, James, Madhavan, & Mahoney, 2007). We propose that competition is a critical contingency condition in the choice of international ownership strategies under uncertainty because intense competition may reduce the exclusiveness of an owner's right to exercise an option and thus reduce the option value of a flexible ownership strategy in response to uncertainty (Kester, 1984; Rivoli & Salorio, 1996; Trigeorgis, 1988). While theoretical research has discussed the importance of examining real options and international investment strategy

under different competitive conditions (Chi & Seth, 2009; Rivoli & Salorio, 1996), to our best knowledge, the current study represents one of the first empirical attempts.

Our empirical analysis is based on the information of over 5,000 new foreign investments in China's manufacturing industries during 2000-2006. The empirical results provide largely corroborative evidence for the real options view of MNE ownership strategy that focuses on the choice between flexibility and commitment and the role of industry contingency conditions in shaping the choice. Specifically, we find that MNEs are inclined to choose a more flexible ownership strategy (e.g., a minority JV) over a more committed strategy (e.g., a WOS) under high demand volatility. However, MNEs' sensitivity to demand volatility in making their ownership choice is reduced in industries with strong growth potential or intense competition. Under these industry conditions, using a flexible ownership strategy to deal with demand volatility is less valuable for MNEs.

The remainder of the study is organized as follows. We first review the literature on MNE ownership strategies and discuss the application of real options theory to international strategy. Next, we present our theory and hypotheses. We then discuss the methods and present the empirical results. We conclude with a discussion of the implications of our research for theory and practice.

THEORY AND HYPOTHESES

Theoretical background

Existing research has extensively examined MNEs' ownership strategies, mainly using transaction cost economics (TCE) as the theoretical tool (e.g., Anderson & Gatignon, 1986; Hennart, 1988). The central tenet of TCE is to align transactions that differ in their attributes with ownership structures in a way that minimizes transaction costs (Williamson, 1985). According to TCE, for investments characterized by high asset specificity, integrated ownership structures, such as WOSs, should be used to enhance MNEs' strategic and operational control over the assets (Anderson & Gatignon, 1986) and to protect MNEs from the risk of knowledge dissemination to their partners (Davidson & McFetridge, 1985; Hill, Hwang, & Kim, 1990). Thus, TCE advocates the use of *ex ante* control

mechanisms to minimize transaction costs arising from asset specificity and potential partner opportunism (Williamson, 1985).

More recent research has emphasized the importance of the institutional environment and its effect on ownership structure. When foreign ownership is not prevalent or well accepted in the host country industry, MNEs can partner with local firms or keep the ownership level lower (Chan & Makino, 2007). By doing so, MNEs can show the local communities that their activities are not ethnocentric or harmful to local firms, and they also obtain the local identity and legitimacy to acquire the resources that they need in the local environment (Xu & Shenkar, 2002). On the other hand, when FDI is well accepted in the local market, MNEs can pursue integrated ownership structures and high equity shares. Choice of an ownership structure thus does not necessarily reflect MNEs' deliberate efforts to economize on transaction costs for an efficient governance mechanism but may rather be a response to pressures from the institutional environment (Yiu & Makino, 2002).

This study offers a real options perspective on MNEs' ownership strategy. Different from the existing transaction cost studies that focus on control and the institutional studies that focus on legitimacy, real options theory suggests that MNEs' ownership strategy is also fundamentally concerned with the choice between flexibility and commitment under uncertainty (Dixit & Pindyck, 1994; Trigeorgis, 1996). Making international investments creates real options when managers in MNEs obtain the right but not the obligation to take a future action (e.g., deferring, expanding, contracting, or abandoning). Real options are valuable because they provide management with the flexibility to increase commitment or to control losses according to the resolution of uncertainty in the business environment (Dixit & Pindyck, 1994; Trigeorgis, 1996). Such flexibility allows MNEs to respond to future changes more quickly and smoothly and has been considered a key to MNEs' international competitiveness under market turbulence (Buckley & Casson, 1998).

Existing literature that adopts a real options perspective has offered insights concerning MNEs' ownership strategies (for a review, see Li, 2007). Among the studies that focus on switch options, Kouvelis et al. (2001) found that MNEs are less responsive to exchange rate changes in switching among

WOSs, JVs, and exporting when exchange rate volatility is high, or when adjustment costs are high. Axarlogiou & Kouvelis (2007) observed that MNEs are less likely to increase equity share in the presence of high adjustment costs, and that this hysteresis effect of adjustment costs is stronger with higher exchange rate volatility but weaker with higher sales growth. While the Kouvelis studies focus on the influence of adjustment costs on subsequent ownership changes conditional on exchange rate volatility (Axarlogiou & Kouvelis, 2007; Kouvelis, Axarloglou, & Sinha, 2001), our study examines the effects of demand uncertainty on the initial choice of ownership strategies for new foreign investments conditional on growth potential, investment irreversibility, and industry competition.

Empirical tests of real options predictions on MNEs' initial entry modes are rather limited, even though existing theoretical research has elaborated on the options features of JVs compared with other investment modes (Buckley & Casson, 1998; Chi, 2000; Lee, 2004; Pennings & Sleuwaegen, 2004). Cuypers and Martin (2010) observed that foreign investors are inclined to take a smaller equity share in a JV when they face strong exogenous uncertainty (e.g., exchange rate uncertainty) rather than endogenous uncertainty (e.g., cultural uncertainty). Brouthers et al. (2008) showed that, in choosing international entry modes, MNEs tend to adopt JVs (over WOSs) under high demand uncertainty. In this study, we have a finer-grained analysis of MNEs' ownership strategies by considering a full spectrum of ownership strategies: choice of minority JVs, majority JVs, and WOSs as well as choice of equity share. More important, our study focuses on industry contingencies under which firms design their ownership strategies in response to uncertainty. We discuss our hypotheses below.

Uncertainty and ownership strategy

International investments are usually made under conditions of uncertainty about host-country market developments. Real options theory suggests that it is important to keep options open and maintain flexibility whenever an investment entails significant uncertainty and cannot be costlessly reversed (Dixit & Pindyck, 1994; Kogut & Kulatilaka, 1994; McDonald & Siegel, 1986). It follows that, under strong

7

market uncertainty, there is a value to an ownership strategy that provides MNEs with the flexibility to act upon new information and to change the course of action in the future. With a flexible ownership strategy, MNEs have the opportunity to capitalize on the upside potential by increasing their level of resource commitment if market conditions turn favorable, but to contain downside losses to the initial sunk investment if market conditions turn adverse. On the other hand, if MNEs adopt a strategy with strong initial commitment, they forgo the possibility of adjusting decisions in response to new information in the future and may suffer significant losses if the environment becomes hostile. We thus expect that market uncertainty will motivate MNEs to choose an ownership strategy that affords strong flexibility in foreign investments.

One flexible strategy is for MNEs to use less integrated ownership structures such as JVs (Buckley & Casson, 1998; Chi & McGuire, 1996; Reuer & Tong, 2005).[3] Compared with more integrated ownership structures such as WOSs, JVs typically require less initial resource commitment, which affords more managerial flexibility for MNEs to adjust future decisions (for a review, see Cuypers & Martin, 2007). JVs allow MNEs to build their local presence and accumulate local experience while waiting for further resolution of market uncertainty (Kouvelis, Axarloglou, & Sinha, 2001). If uncertainty from market environment resolves to MNEs' favor, MNEs can increase their investment level or acquire local partners' equity (Chi & McGuire, 1996). It is worth noting that WOSs can also enable MNEs to expand their businesses without incurring extra costs. Thus, the major difference between JVs and WOSs is that JVs provide MNEs with a stronger capability to contain downside losses when market conditions turn hostile; MNEs can contain their losses to the initial investment (typically smaller than that in WOSs) or sell their equity stakes to local partners (Chi & McGuire, 1996). Local JV partners provide a ready market for divested assets from MNEs (Buckley & Casson, 1998). As insiders in the JVs, local partners understand better the value of MNEs' assets in the JVs than other potential outside buyers in an imperfect market; with less information asymmetry, local partners have a higher propensity to acquire or to pay higher prices for MNEs' equity stakes (Akerlof, 1970; Buckley & Casson, 1998; Chi & McGuire, 1996;

Nanda & Williamson, 1995). Compared with divesting equity shares in JVs, divesting WOSs will likely involve higher transaction costs due to the lack of insider buyers.

The above arguments taken together suggest that JVs provide higher options value for MNEs than WOSs in a volatile market because JVs offer a more valuable combination of growth and abandonment options. JVs not only serve as platforms for business expansions but also limit MNEs' investment losses when the future unfolds unfavorably (Buckley & Casson, 1998; Kogut, 1991; Kouvelis, Axarloglou, & Sinha, 2001). Thus, we expect that, as the level of market uncertainty increases, so is the likelihood of choosing a JV over a WOS.

MNEs can also improve their flexibility in response to a volatile environment by taking smaller equity shares in their subsidiaries. Besides the above mentioned benefits provided by JVs, smaller stakes in foreign subsidiaries (or minority JVs) can further limit the downside risk of exploration for MNEs due to the mere fact that investment costs are smaller, especially if MNEs have to abandon their subsidiaries (Tong, Reuer, & Peng, 2008). Meanwhile, smaller stakes (or minority JVs) still allow MNEs to take advantage of future growth opportunities; MNEs may take actions to increase their commitment by taking larger equity stakes, becoming majority shareholders in their JVs, or acquiring their JVs, when growth opportunities arise. Thus, relative to more committed ownership strategies, smaller stakes (or minority JVs) allow MNEs to be more responsive to environmental uncertainty and offer management more flexibility to act upon new information. In a theoretical model, Lee (2004) showed that, among other things, higher uncertainty leads to a lower optimal share of MNEs in their foreign subsidiaries. Similarly, Cuypers and Martin (2007) suggested that an investor who intends to capture the option value of JVs will take a smaller share, and Cuypers and Martin (2010) found that exogenous uncertainty leads foreign firms to take lower equity shares in JVs in China.

The above arguments lead us to propose the following two hypotheses to capture 1) the impact of uncertainty on MNEs' choice on entry mode (a minority JV, majority JV, or WOS) and 2) the impact of uncertainty on MNEs' equity stakes in foreign subsidiaries. Formally,

Hypothesis 1a: When the level of market uncertainty in a host country increases, the likelihood of choosing a minority JV by an MNE for a new investment is higher than that of choosing a majority JV, which in turn is higher than the likelihood of choosing a WOS, other things being equal.

Hypothesis 1b: The higher the level of market uncertainty in a host country, the lower the equity shares in a new investment by an MNE, other things being equal.

H1a and H1b discuss the benefits of adopting flexible strategies under market uncertainty—that is, the ability to adjust decisions contingent upon new information in the future. However, the option value of a flexible ownership strategy is affected not only by market uncertainty but also by other industry factors. Following theoretical real options studies, we consider three industry contingency factors which affect the value of flexibility embedded in an international investment and thus alter an MNE's propensity to use flexible strategies under uncertainty. These industry factors include growth potential (Dixit & Pindyck, 1994; Kouvelis, Axarloglou, & Sinha, 2001), investment irreversibility (Abel, Dixit, Eberly, & Pindyck, 1996; Dixit & Pindyck, 2000), and industry competition (Kester, 1984; Smit & Ankum, 1993; Smit & Trigeorgis, 2004). Prior real options studies have examined how one or more of these factors and their interaction with uncertainty influence investment level (Guiso & Parigi, 1999), market entry (Folta & O'Brien, 2004), foreign entry (Campa, 1993), and ownership adjustments (Axarlogiou & Kouvelis, 2007; Kouvelis, Axarloglou, & Sinha, 2001). We discuss below how each factor moderates an MNE's propensity to use a flexible ownership strategy in response to market uncertainty.

Industry growth potential

Industry growth potential has been found an important factor in affecting the value of MNE ownership strategy. For example, Axarlogiou & Kouvelis (2007) observed that the hysteresis in adjusting the ownership structure of a foreign subsidiary becomes weaker in the presence of high demand in the foreign market. Belderbos & Zou (2007) found that foreign affiliates grow faster under greater demand growth in the host country. In our context, MNEs expect higher payoffs from their investments in industries with high growth potential. While forming a minority JV or taking a lower equity share in

10

response to uncertainty may still be sensible in a high-growth scenario, such a flexible strategy can incur significant opportunity costs. This is because MNEs are not able to capture fully the upside potential of their investments; they have to share the profits with their local partners or may even obtain a smaller portion of the profits (Belderbos & Zou, 2007). Moreover, in industries with strong growth potential, the possibility for downside scenarios to occur is relatively low, and thus downside loss protection, a major advantage of a flexible strategy over a committed one, becomes less valuable for MNEs. In a low-growth scenario, however, MNEs should be more concerned with the potential downside losses of their investments. Collaborating with local partners or having smaller equity shares will thus bring in more value for MNEs in terms of downside loss protection.

In summary, in industries with low growth potential, the opportunity costs of a flexible strategy are lower, and we expect that MNEs will be more concerned with the negative consequences associated with environmental shocks and be motivated to use more flexible strategies in order to deal with undesirable situations in the future. Formally, we have the following hypothesis.

Hypothesis 2: The positive relationships between market uncertainty and the use of flexible ownership strategies, as specified in H1, are stronger in industries with lower growth potential than in industries with higher growth potential.

Investment irreversibility

In addition to industry uncertainty and growth, the real options literature has also pointed to the importance of investment irreversibility (Dixit & Pindyck, 1994), defined as the extent to which the resale value of an asset decreases vis-à-vis the purchase price (Abel & Eberly, 1996). When international investments can be fully recovered or costlessly redeployed in an industry, MNEs can always choose a committed strategy to ensure the capture of any upside potential or competitive advantage, and disinvest should market conditions turn worse than anticipated (Rivoli & Salorio, 1996). If so, a flexible strategy will not offer any additional benefits over a committed strategy because the downside economic loss is completely contained with fully reversible investments. Thus, as the degree of irreversibility decreases, the benefits of using flexible strategies in response to uncertainty will also decrease. On the other hand, in

industries that require highly irreversible investments, high initial commitment will substantially limit managerial flexibility in dealing with uncertainty and may expose MNEs to significant losses if MNEs decide to contract the investment project or withdraw from the market. In fact, Campa (1993) found that for a given level of exchange rate volatility, when the irreversible investments necessary to enter the US market are higher, there is a lower likelihood of entry. Axarlogiou and Kouvelis (2007) and Kouvelis et al. (2001) also found that MNEs are less likely to make ownership adjustments under high adjustment costs (which increase investment irreversibility). Kogut and Kulatilaka (1994) observed that investment irreversibility (e.g., due to high switch costs from one location to another) lowers an MNE's ability to switch across locations in response to uncertainty and thus reduces the value of establishing a multinational network. Taken together, the above arguments suggest that adopting flexible strategies to deal with uncertainty is more valuable when there is high investment irreversibility in an industry. Hence, we reach the following hypothesis.

Hypothesis 3: The positive relationships between uncertainty and the use of flexible ownership strategies, as specified in H1, are stronger in industries with higher investment irreversibility than in industries with lower irreversibility.

Competition

Existing real options literature suggests that the more exclusive an owner's right to exercise a growth option, the more valuable the option is to the owner, and that competition can considerably reduce the exclusiveness of a firm's right to exercise a growth option and thus reduce the value of the growth option to the firm (Kester, 1984; Rivoli & Salorio, 1996; Trigeorgis, 1988). Therefore, we consider competition as an important force that moderates a firm's propensity to create growth options (by adopting a flexible ownership strategy) in response to market uncertainty. In industries with intense competition, creating an option under uncertainty is less valuable (than in industries with weak competition) because many incumbents share the same growth option, and shared options are less valuable "collective" opportunities (Kester, 1984: 156). When future market demand turns favorable, the foreign entrant can exercise its growth option by increasing the investment level or equity share in its JV

subsidiary, but many incumbent competitors can take similar actions, which ultimately lowers the value of the growth option possessed by the foreign entrant. It follows that in a competitive industry, the foreign entrant will be less concerned about adopting flexible ownership strategies under uncertainty to obtain future growth opportunities (but be more concerned about the net present value of an investment strategy). In contrast, when entering industries with weak competition, the foreign firm will find growth options more valuable and will thus more likely adopt flexible ownership strategies in dealing with market uncertainty. Hence, we have the following hypothesis.

Hypothesis 4: The positive relationships between uncertainty and the use of flexible ownership strategies, as specified in H1, are stronger in industries with lower competition than in industries with higher competition.

METHOD

Data and sampling

We test our hypotheses in the context of foreign direct investments in China. China, as an emerging market, represents a proper setting to test real options predictions because MNEs usually face significant environmental uncertainty (Luo, 2005; Puck, Holtbrugge & Mohr, 2009; Tong & Reuer, 2007; Xu, Zhou & Phan, 2009) and because the uncertainty MNEs face varies across different industries and across different time periods. For instance, market and technological uncertainties have remained significant in China due to evolving industry structures and technological standards.

We construct a sample with 5,055 new foreign investments in manufacturing industries in China during 2000–2006, using the 2000-2006 editions of China's *Annual Census of Industrial Enterprises*. The census data, compiled by the National Bureau of Statistics of China (NBSC), contain detailed information about a company's operational profile including total equity, equity possessed by domestic and foreign owners, founding year, industry type, and so on. The companies included have an assessed sales capacity of at least five million Chinese Yuan per year. The NBSC has maintained high consistency in data collection across time, industries, and regions, and existing international business studies have used the census data (e.g., Buckley, Clegg, & Wang, 2002; Zhou & Li, 2008).

13

We choose the time period, 2000-2006, due to data availability. For this time period, the census dataset includes detailed information about how much equity share is owned by foreign and domestic investors. We need such information to measure the main variables of interest (i.e., ownership structure and foreign equity share). During 2000-2006, government restrictions on foreign ownership in manufacturing industries are very limited, and MNEs can thus choose their ownership strategies in most cases. We revisit the issue of government ownership restrictions in the robustness checks. We identify new foreign entries according to their founding-year information in China contained in the census data. Note that these new entries are not necessarily MNEs' first-time investments in China, and the census data do not have information about the identity of MNEs. We manually collect information on the home countries of MNEs, but we do not have other parent level information such as R&D and advertising investments for our analysis. This remains a limitation of our dataset.

Our data suggest that WOSs are used in 64% of the new foreign entries in China during 2000-2006. Recent research studies (e.g. Xia, Tan, & Tan, 2008) also suggested that WOSs represent a more frequently adopted entry mode than JVs in recent years in China. Specifically, WOSs became a predominant entry mode in 1997, accounting for more than half of all FDI in terms of both number and value, and the ratio of the number of WOSs to the number of JVs has increased steadily since 1997 (Xia, Tan, & Tan, 2008). Our sample thus indicates a similar overall trend of foreign entry modes as found in existing studies.

Dependent variables

We use two dependent variables to measure an MNE's ownership strategy for a new foreign investment. *Foreign equity share* is constructed as the ratio of foreign equity investment divided by total equity in a subsidiary.[4] For ownership structure, we construct a categorical variable, *mode*, which takes the value one if foreign equity share is no less than 95% in a subsidiary (i.e., a WOS), two if foreign equity share is between 50% and 95% (i.e., a majority JV), and three if foreign equity share is less than 50% (i.e., a minority JV). In the robustness checks shown later, we deal with the issue whether classifying

50/50 JVs in the majority JV category leads to biased results. Since existing studies have primarily examined the choice of ownership structure and research on equity share has been relatively modest (for exceptions, see Chan & Makino, 2007; Cuypers & Martin, 2010; Delios & Beamish, 1999), our study provides further analysis on the determinants of equity share.

Explanatory variables

Uncertainty. There are multiple sources of uncertainty that account for the randomness in a market. We focus on demand uncertainty because it drives the fluctuation of product price which in turn largely determines profitability (Brouthers, Brouthers, & Werner, 2008; Dixit & Pindyck, 1994). Existing real options literature suggests that the uncertainty measure should capture the unpredictable and volatile components of environmental uncertainty (Carruth, Dickerson, & Henley, 2000; Dixit & Pindyck, 1994; Ghosal & Loungani, 2000). The empirical implication is that we need to forecast a trend in demand in order to obtain the unpredictable component in market demand. The China census data available to us contain three-digit industry information only for 2000-2006. Therefore, we do not have enough data points to forecast the demand trend or obtain volatility for years such as 2000. We decide to use another data source (*China Statistical Yearbook*, 1995-2006)[5] published by NBSC, which is publicly available and gives us at least five years to predict demand (e.g., using data between 1995 and 1999 to predict the demand in 2000). The drawback of the yearbook data is that it only provides sales information at the two-digit industry level.

We generate a time-varying and industry-specific measure of demand volatility. For each two-digit industry, we first regress sales growth on its lagged value and on a linear time trend recursively from 1995-2006 (i.e., using the 1995-1999 data to predict sales growth for 2000, then using the 1995-2000 data to predict sales growth for 2001, and so on). The forecasting equation is a variant of the rational expectations model with a linear trend (Favero, Pesaran, & Sharma, 1994; Ghosal & Loungani, 2000). We then measure *demand volatility* as the squared standard error of the regression (Favero, Pesaran, & Sharma, 1994). Such residual-based measures of uncertainty are commonly used in real options literature

(Ferderer, 1993; Ghosal & Loungani, 2000; Henley, Carruth, & Dickerson, 2003; Hurn & Wright, 1994). We consider an alternative uncertainty measure for robustness checks.

Industry growth potential. We focus on current demand growth in an industry. Accordingly, we compute industry-level *sales growth* by first calculating the sales growth of each firm in a three-digit industry at year *t* relative to year *t-1* and then taking the average of the sales growth of all firms in the industry.

Irreversibility. We follow previous literature (Campa, 1993) and use *fixed asset ratio* to capture industry investment irreversibility. Campa (1993) suggested that an industry with a higher average fixed asset ratio requires more sunk cost investments, possibly resulting in higher irreversibility of investments. We first calculate the ratio of fixed assets to total assets of all firms in a three-digit industry at year *t* and then take the average. We consider an alternative irreversibility measure for robustness checks.

Competition. We employ a Herfindahl measure for market concentration by utilizing firm-level sales information contained in the census data. Due to strong regional segmentation and variation in China (Luo, 2007), we take into consideration different provinces and municipalities in calculating industry competition. It is reasonable to expect that foreign firms entering Beijing will be more affected by industry competition in Beijing than by competition in Guangdong.[6] We thereby use industry-level Herfindahl index for each province or municipality to measure market competition. For a given province (or municipality) and a given three-digit industry with *n* firms, we compute the Herfindahl measure as follows:

$$\text{Market concentration} = \sum_{j=1}^{n} \left[\frac{Sales_j}{\sum_{j=1}^{n} Sales_j} \right]^2 .$$

Our competition measure is thus time varying, industry specific, and province specific. As a high value of market concentration indicates a low level of market competition, we measure market *competition* as (1 − market concentration).

Control variables

While our main variables of interest are derived from real options theory, we also control for the important determinants of ownership strategy examined by other theoretical perspectives such as TCE and the institutional theory.

Transaction cost considerations. TCE suggests that when asset specificity is high, safeguarding specific assets and minimizing the potential opportunistic behavior of transacting partners become crucial for the success of MNEs. For the purpose of gaining control, MNEs would choose integrated ownership structures (e.g., WOSs) or high equity shares for foreign investments characterized by great asset specificity (Anderson & Gatignon, 1986). Since technology-intensive industries typically involve high asset specificity and require strong intellectual property protection from partner opportunism (Brouthers, 2002; Gomes-Casseres, 1989; Hennart, 1991), we examine whether MNEs prefer to enter the Chinese market using a WOS or higher equity share in such industries. We use a dummy variable, *high tech industry*, to capture whether an industry is technology-intensive. We follow the classification by the Ministry of Science and Technology of China to categorize the following as high technology industries: medical and pharmaceutical products, special purpose equipment, transport equipment, electronic equipment and machinery, electronics and telecommunications, and instruments and meters.[7]

We further control for transaction cost considerations by including *industry R&D intensity* and *industry adv intensity* (industry advertising intensity) in China (Gomes-Casseres, 1990). Because our census data contain firms' R&D and advertising expenditure information only for 2005 and 2006 (not for all the other years), we generate two time-invariant intensity measures. Specifically, we first calculate the mean level of R&D intensity (advertising intensity) for each three-digit industry in 2005 and 2006, respectively. We then take the average of the 2005 and 2006 means to obtain a proxy for industry R&D intensity (industry advertising intensity) for 2000-2006. We finally take a natural logarithm of the measures for industry R&D intensity and industry advertising intensity to normalize their distributions.

Institutional concerns. Institutional studies suggest that MNEs may exchange ownership for legitimacy in the host country (Chan & Makino, 2007; Yiu & Makino, 2002). To capture FDI legitimacy in an industry, we use *foreign presence,* which is calculated as the ratio of the employment by all foreign firms in operation, including JVs and WOSs, to the employment by all domestic and foreign firms in a three-digit industry i at year t (Zhou & Li, 2008). Foreign presence in an industry may, to some extent, reflect government ownership restrictions in the industry. However, as shown in the robustness checks later, we find similar results after removing industries with government restrictions.

Other controls. We include a number of country, industry, and firm level variables that are likely to influence MNEs' ownership strategy in China. Since the census data do not contain home country information, we collect such information from Baidu.com and Google.com (see the Appendix for more details). As a result, we are able to include three sets of variables to control for home country characteristics of each foreign firm in our sample. First, we include sixty-one country dummies in the regressions. Second, we control for *patent number,* that is, the number of patent applications of each home country. Since patents are indicative of national technological capabilities (Furman, Porter, & Stern, 2002), transaction cost economics would suggest that firms that are from countries with more patents are more likely to choose integrated ownership strategies in China in order to better protect their intellectual properties. We obtain the annual patent information from the World Intellectual Property Organization, and our patent measure is country-specific and time-varying. Third, we control for *exchange rate volatility.* Real options theory predicts that exchange rate volatility may lead to the use of flexible ownership strategies. Following existing research (e.g., Belderbos & Zou, 2009), we measure exchange rate volatility using the coefficient of variation of the monthly real exchange rate of the home currency against the US dollar for each year during 2000-2006. We collect the monthly exchange rate data from the Federal Reserve Bank Reports available in Wharton Research Data Services. Due to the Yuan-dollar peg until 2005, we use the exchange rate between the US dollar and the home currency to proxy the exchange rate between the Chinese Yuan and the home currency. One drawback of the exchange rate

volatility measure is its reduced variation due to the fact that firms from the United States face almost zero volatility during 2000-2006.

Besides the home country characteristics of foreign investors, we include four subsidiary-level variables. First, we include the *size* of a foreign investment, measured as the log of total assets. A large investment may motivate an MNE to use a JV or lower equity share to enter the market in order to reduce risks. Second, we include a dummy variable, *coastal,* to capture whether a foreign investment is located in a coastal or inland region. Coastal takes the value one if the foreign entry is in Shanghai, Beijing, Tianjin, Liaoning, Shandong, Jiangsu, Zhejiang, Fujian, Guangdong, or Hainan. An MNE may use high-commitment strategies in these regions due to better infrastructure and higher foreign legitimacy. Third, we include *state partner,* which takes the value one if the foreign invested companies have local partners that are owned by the state and zero otherwise. State partners in China may have stronger incentives to impose political objectives upon foreign ventures, and foreign firms may thus be inclined to pursue majority owned JVs (for more control on corporate decisions) over minority owned JVs. Fourth, we include a dummy variable, *multiparty*, which is equal to one if a firm in our sample has more than one foreign partner and is zero otherwise. Since a larger number of foreign partners can reduce risks, the foreign share in total is likely higher in JVs with multiple foreign partners.

We would like to control for firm-specific experience in using a particular ownership strategy or experience in entering China. Data constraints prevent us from generating such measures.[8] Instead, we control for *average experience* of all foreign firms in a specific year. For each foreign subsidiary in China at year *t* (newly founded or not), we first calculate the number of years the subsidiary has been present in China (year *t* minus the founding year of the firm in China). We then measure average experience as the average years of experience of all foreign subsidiaries in China at year *t*. In addition, cost rather than demand factors may drive investment decisions in China because China is an important export platform for MNEs. We include an industry-level control variable called *labor cost growth* following Belderbos and Zou (2007). Labor cost growth is measured as the annual average wage growth rates of all firms in a

three-digit industry. Finally, we include thirty-seven two-digit industry dummies and six year dummies in all the estimations to control for unobservable industry- and time-varying effects.

Estimation models

We employ multinomial logit regression techniques to analyze the impact of uncertainty and other factors on the choice among a minority JV, a majority JV, and a WOS. Multinomial logit models should be used in cases where the alternative choices are conceptually dissimilar (Amemiya, 1981; Long & Freese, 2006; McFadden, 1973). Our theory suggests that minority JVs, majority JVs, and WOSs are distinct choices. Hausman tests on the assumption of the independence of irrelevant alternatives show that eliminating one alternative does not affect the coefficient estimates specific to the remaining alternatives, suggesting that the multinomial logit model is appropriate for our analysis.

We specify Tobit estimation models to analyze the determinants of foreign equity share. A foreign firm chooses its equity share in a foreign subsidiary in order to maximize its profitability subject to the constraint that the equity share cannot be larger than 100%. The constraint leads to a corner solution where many foreign firms choose ones (in our sample 64% of the observations have 100% equity share). Tobit models can be used to address the corner solution issue (Wooldridge, 2002).

To examine the impact of demand volatility under different industry conditions, we perform split sample tests.[9] We divide the full sample into two subsamples according to the mean or median values of the industry conditions (*sales growth*, *fixed asset ratio*, or *competition*) and examine the effect of demand volatility in each subsample. We further conduct Wald tests with the seemingly unrelated estimation procedure to examine whether the coefficients of demand volatility are significantly different for different subsamples.

RESULTS

We report the descriptive statistics and correlations in Table 1. As expected, demand volatility is negatively correlated with foreign equity share, but positively with choice of a JV over a WOS. The

average foreign equity share in new foreign investments across different industries is 80%; 64% of new investments use WOSs, 14% use majority JVs, and 22% use minority JVs, all suggesting strong commitment of MNEs to the Chinese market during 2000-2006. Table 1 also suggests that none of the correlations are concerns for multicollinearity.

INSERT TABLE 1 ABOUT HERE

We report the results on the main effects of uncertainty in Table 2. Model 1 reports the multinomial logit regression results, and Model 2 the Tobit estimation results. Model 1 shows that demand volatility positively affects the likelihood of choosing a majority JV over a WOS and that of choosing a minority JV over a majority JV, but the effects are statistically insignificant. Model 1 also shows that demand volatility has a significant positive effect on the propensity of using a minority JV over a WOS, which is consistent with the prediction in H1a. Model 2 shows that demand volatility has a significant negative effect on foreign equity share in a subsidiary, suggesting that an MNE commits lower equity share to an industry with higher demand volatility. H1b thus receives empirical support. Taken together, Table 2 provides some support for the core prediction of real options theory; that is, market volatility encourages MNEs to choose a more flexible strategy.

INSERT TABLE 2 ABOUT HERE

We report in Tables 3a, 3b, and 3c the choice of ownership structure contingent on sales growth potential, irreversibility, and competition, respectively. Table 3a presents how demand volatility affects the choice of ownership structure in industries with high versus low sales growth (depending on whether *sales growth* is above the mean value or not). Model 3 shows that in industries with low sales growth, industry demand volatility significantly increases the likelihood of choosing a majority JV over a WOS as

21

well as the likelihood of choosing a minority JV over a WOS. However, as shown in Model 4, these significant relationships disappear in industries with high sales growth. We also conduct a Wald test to compare the coefficients of demand volatility for the two subsamples. The hypothesis that the effects of demand volatility are the same in the subsamples with high and low sales growth is rejected ($Chi^2 = 8.26$, $p<0.02$). Taken together, these results support H2, that is, the positive relationships between market uncertainty and the use of flexible ownership strategies are stronger in industries with lower growth potential.

In Table 3b, Models 5 and 6 present the effects of demand volatility on choice of ownership structure in low versus high industry investment irreversibility (depending on whether *fixed asset ratio* is above the median value or not). We do not find any significant differences between the effects of demand volatility in the two subsamples ($Chi^2 = 0.23$, $p<0.89$). Models 5-6 offer no evidence supporting H3 that industry investment irreversibility strengthens the positive effect of uncertainty on the use of a flexible ownership strategy.

In Table 3c, Models 7 and 8 summarize how demand volatility affects ownership structure choice in low versus high competition (depending on whether *competition* is above the median value or not). Model 7 shows that, for an industry in a province with weak competition, demand volatility has significant positive effects on the likelihood of choosing a majority JV over a WOS as well as on the likelihood of choosing a minority JV over a WOS, whereas Model 8 does not provide evidence for such effects under strong competition. Our Wald test also rejects the hypothesis that the effects of demand volatility are the same in the two subsamples with high and low competition ($Chi^2 = 4.81$, $p<0.09$). These results offer support for our prediction in H4, that is, market competition reduces the positive effect of uncertainty on the use of a flexible ownership strategy.[10]

INSERT TABLES 3A, 3B, AND 3C ABOUT HERE

22

Table 4 reports the effects of demand volatility on foreign equity share in three different sets of subsamples. These results are based on Tobit estimations. Comparing results in Models 9 and 10 suggests that demand volatility has a significant negative effect on foreign equity share only in industries with low sales growth. We also test the hypothesis that the effects of demand volatility on equity share are statistically the same in the subsamples with high versus low sales growth, and we find this hypothesis rejected ($Chi^2 = 3.68$, $p< 0.06$). These results provide additional support for H2, that is, the effect of uncertainty on the use of a flexible ownership strategy is less salient in high-growth industries.

Models 11 and 12 do not show significant differences for the impact of demand volatility in industries with high versus low investment irreversibility ($Chi^2 = 0.10$, $p<0.75$). Thus, H3 is not supported. The overall insignificant results of the irreversibility measures probably reflect the significant difficulty in measuring irreversibility in practice, despite its theoretical importance (Campa, 1993).

Finally, Models 13 and 14 present the contrasting effects of demand volatility on foreign equity share under competition: Demand volatility has a significant negative effect only in the subsample with low competition. The Wald test also rejects the hypothesis that the effects of demand volatility on equity share are the same in the subsamples with high versus low market competition ($Chi^2 = 4.13$, $p< 0.04$). These results provide further support for H4, that is, competition reduces the attractiveness of using a flexible strategy such as lower equity share in response to market uncertainty.

INSERT TABLE 4 ABOUT HERE

To address more systematically the economic impact of demand volatility, we report in Table 5 the predicted probabilities at the mean values of all variables (Table 5a), marginal effects of demand volatility (Table 5b), and odds ratios in response to demand volatility (Table 5c). Marginal effects refer to how the predicted probabilities of choosing one entry mode over another changes with regard to changes in demand volatility. Odds ratios refer to how the relative probabilities of choosing one entry mode over

23

another change in response to one unit increase in demand volatility, where one unit increase roughly corresponds to one standard deviation change in demand volatility. Table 5c indicates that in industries with low sales growth potential, the odds of choosing a minority JV over a WOS increase by 33%, and the odds of choosing a majority JV over a WOS increase by 27%, with one unit increase in demand volatility. In industries with weak competition, the odds of choosing a minority JV over a WOS increase by 25%, and the odds of choosing a majority JV over a WOS increase by 21%, with one unit increase in demand volatility.

INSERT TABLE 5 ABOUT HERE

Several results on the control variables are worth noting. First, Table 2 shows that the *high tech industry* dummy is significantly and positively related to the choice of a WOS (Model 1). This result is consistent with the transaction cost prediction that high tech industries require more integrated ownership structures for tighter control of intellectual properties. Second, Table 2 shows that *foreign presence* in an industry has a negative effect on the likelihood of using a majority or minority JV over a WOS by an MNE (Model 1) and a significant positive effect on the level of foreign ownership (Model 2). These results lend support to the institutional argument about exchanging ownership for legitimacy. Third, the investment size has a positive effect on the use of a minority JV over a WOS and a negative effect on foreign equity share in a subsidiary, suggesting that firms tend to use minority JVs for sharing costs and risks. Finally, Table 2 suggests that MNEs investing in coastal regions (characterized by better investment environments for FDI) tend to choose more committed ownership strategies.

Robustness Checks

We conduct several robustness checks. First, we re-estimate the regressions after omitting the industries with government ownership restrictions. The Chinese government policies on entry modes of foreign firms have evolved over time. WOSs were first made lawful in China in 1986. Since 1997, the

24

foreign investments in WOSs have surpassed those in JVs in China partially due to relaxation of government restrictions on entry modes (Xia, Tan, & Tan, 2008). After China joined WTO in 2001, restrictions on FDI were further relaxed. In the manufacturing industries, the only explicit ownership restriction by the government is on auto assembly plants--foreign firms can only use JVs to enter this industry (*EIU Country Commerce*, 2005, Teng, 2004). According to *the 2002 Catalogue for Guiding Foreign Investment in Industries* in China, restricted foreign investments include projects in industries requiring central planning by the state (*EIU Country Commerce*, 2005). We suspect that, in these industries, foreign firms may face implicit ownership restrictions imposed by the government. We use the census data to determine which industries may have strong central planning. Specifically, we obtain the ratio of equity investments by the state to total equity investments in all firms in an industry. We define an industry as a central planning industry if the ratio is no less than 60% (we also use 70% as a cutoff point and obtain the same results). We drop twenty-six observations from the auto assembly industry and central planning industries and rerun our regressions for the remaining sample. The results remain unaltered.

Second, since exchange rate volatility represents an important type of macroeconomic uncertainty affecting an MNE's investment and divestment decisions (Belderbos & Zou, 2009; Kouvelis, Axarloglou, & Sinha, 2001), we examine how an MNE responds to exchange rate volatility under different industry conditions as an additional test of our hypotheses. We find that exchange rate volatility has a more significant positive effect on the use of flexible strategies in industries with lower sales growth potential, which provides support for H2.

Third, we test our hypotheses using an alternative measure of uncertainty.[11] Specifically, we regress sales growth on its lagged value and a linear time trend and use the standard deviation of the residuals for the past four years (Ghosal & Loungani, 2000). We find additional supportive evidence for H2 and H4; that is, industry growth potential and competition weaken the positive relationship between uncertainty and the use of flexible strategies.

Fourth, we use an industry's minimum efficient scale (MES) as an alternative measure of irreversibility. Folta et al. (2006) argued that irreversibility is related to the amount of capital required for entry which may be represented by the minimum efficient scale. We first rank all firms that compete in each three-digit industry for each year, based on total assets. MES is represented by the value of the 20th percentile of firm assets in an industry. We do not find any moderating effect of irreversibility on the relationship between uncertainty and choice of ownership strategies.

Finally, we conduct two additional robustness tests regarding the role of 50/50 JVs. We first exclude 50/50 JVs (191 observations) from the full sample and find consistent results in the subsample, that is, minority JVs are more likely to be chosen over WOSs under higher uncertainty, and the choice between minority and majority JVs as well as that between majority JVs and WOSs are not significantly affected by uncertainty. In the second test, we treat 50/50 JVs as a separate entry mode besides minority JVs, majority JVs, and WOSs. Using multinomial logit models, we do not find significant results with regard to the choice of 50/50 JVs over other entry modes in response to uncertainty changes. We thereby conclude that empirically treating 50/50 JVs as part of majority JVs does not alter our regression results.

DISCUSSION AND CONCLUSION

The current study theoretically and empirically addresses how MNEs design ownership strategies in response to market uncertainty in foreign market entry. We proposed from a real options perspective that MNEs' foreign ownership strategy under market uncertainty involves the choice between flexibility and commitment. This perspective complements existing views on MNE ownership strategies such as transaction cost economics and the institutional theory (Anderson & Gatignon, 1986; Chan & Makino, 2007; Yiu & Makino, 2002). Our study suggests that when choosing ownership strategies in foreign markets, MNEs should consider not only the need for control or legitimacy, but also the need for flexibility so as to respond to future opportunities or threats. Using the ownership information for over 5,000 new foreign investments in China during 2000-2006, we found supportive evidence for the real options view of MNE ownership strategy.

26

Our study contributes to the real options research on MNEs' ownership strategy. Prior studies have shown that an MNE is inclined to adopt a flexible ownership strategy in response to uncertainty (Buckley & Casson, 1998). We found consistent evidence in our study: High demand volatility motivates MNEs to choose a minority JV over a WOS and lower equity share over higher equity share. We extended prior research by further investigating industry contingencies that affect the value of a flexible ownership strategy under uncertainty. Our results suggest several industry boundary conditions for taking an options approach towards designing ownership strategies in foreign market entries: MNEs should be responsive to host country market uncertainty primarily in industries with low growth opportunities or low competition. Future research can further explore the boundary conditions for the real options value of international investment strategy along this line.

Our study suggests the importance of considering the impact of competition on firms' international strategy under uncertainty. The result that using flexible ownership strategies (a minority JV or lower equity share) in response to market volatility is less valuable under intense competition indicates that adopting flexible ownership strategies to deal with market uncertainty is less beneficial for MNEs when the options are collective or shared opportunities in an industry.

Our study also complements the stages model of internationalization (Delios & Beamish, 1999; Johanson & Vahlne, 1977). This model predicts that as experiential learning about a foreign market increases, uncertainty reduces and MNEs can incrementally increase their commitment in the foreign market through a staged process (Johanson & Vahlne, 1977). Uncertainty in the stages model relates primarily to the lack of market knowledge and as such is largely reducible through experience and knowledge accumulation. Our study complements the internationalization theory by examining strategies to deal with uncertainty that is largely out of control of any individual firm and is revealed over time.

Our paper has important implications for a firm's international strategy. MNEs, when entering a foreign market, should consider multiple sources of factors in designing their ownership strategies. Besides concerns for transaction costs and legitimacy, MNEs must respond to market volatility and consider the choice between flexibility and commitment. MNEs can use a minority JV or lower equity

27

share to maintain flexibility in response to future information revelation. However, MNEs should also be aware that using a flexible ownership strategy to deal with uncertainty becomes less valuable in the presence of high growth potential or intense competition.

There are several opportunities for future research to extend the current study and address some of its limitations. First, as Chi and McGuire (1996) suggested, the divergent valuations of partners over a JV's assets may enhance the option value provided by a JV. One can extend our study by comparing the characteristics of both partners in a JV (e.g., their relative size and capabilities) and analyzing how these characteristics may affect an MNE's preference for a JV in a volatile market. For example, the bargaining costs arising from JV partners' divergent objectives can hamper MNEs' ability to respond to future environmental changes and reduce the flexibility value of a JV (Belderbos & Zou, 2007; Chi & Seth, 2009).

Second, the effect of competition on options value has been a subject of discussion in both studies that adopt a real options perspective (Kester, 1984; Rivoli & Salorio, 1996; Trigeorgis, 1988) and studies that take a combined real options and game theoretical approach (Belderbos & Sleuwaegen, 2005; Chi & Seth, 2009; Kulatilaka & Perotti, 1998; Smit & Ankum, 1993; Smit & Trigeorgis, 2004). The first stream of studies emphasizes how competition may affect the exclusiveness of a firm's right to exercise an option and thus the value of the option to the firm. The second stream stresses how strategic commitment may generate strategic value by influencing the reactions of competitors or deterring entry by rivals, thus reducing the value of a flexible strategy in response to uncertainty (for a review, see Li *et al.*, 2007). Our study followed the first stream of literature in analyzing the moderating effect of competition in firms' adoption of a flexible ownership strategy under uncertainty. Future studies can examine more closely the impact of competitive rivalry on a foreign firm's choice of ownership strategy by adding a competitive dynamics perspective into real options analysis. In particular, future studies can examine the conditions under which commitment leads to positive strategic value, which may, in turn, motivate a foreign firm to adopt a committed ownership strategy despite strong market uncertainty.

28

Third, since our data do not contain parent firm information for an investment, future studies could incorporate such information as an MNE's previous experience and its firm specific advantages, and examine whether and how parent firm characteristics may alleviate the negative impact of market volatility on an MNE's commitment. We suspect that the experience effect would be minimal with regard to demand volatility because such volatility is largely out of control of individual firms.

Finally, one could extend our real options analyses of MNEs' ownership strategies in a specific location by considering networks of subsidiaries that MNEs have in other locations and the role of switch options in MNEs' ownership decisions (Belderbos & Zou, 2007). Indeed, there could be a tradeoff with joint ventures increasing local flexibility but potentially decreasing network flexibility (the use of switch options).

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APPENDIX

Since the census data do not contain home country information for the partners or owners of each company (i.e., a JV or WOS), we hired two RAs to collect the information on the country of origin of the foreign investors in each of the 7,180 companies in our sample. Using the company names contained in our data, the RAs searched the information for each company's foreign investor(s). The RAs mainly relied on two websites: google.com and baidu.com (the dominant web search engine in China). Originally, we also wanted to collect more firm-specific information, such as foreign investors' names, but such information is unavailable for many companies. With this data collection effort, we were able to obtain the nations of foreign investors for 5,326 companies (the final sample size is further reduced to 5,055 due to the missing values of other variables). We had the two RAs crosscheck 100 companies of each other's work and found highly consistent results (about 99%). We also randomly checked the country of origin information for the foreign investors of 100 companies and found a 100% consistency rate. One hundred and twenty companies in our sample have more than one foreign investor, and we used the nation of the partner with a higher equity share to represent the home country of the foreign investors. Because we lost almost 2000 observations after adding the home country information, we also examined whether our new sample has similar distributions in terms of industry, year, and ownership strategies (investment mode and equity shares) with the original sample. Chi^2 tests suggest no significant differences between the two samples.

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Table 1. Descriptive Statistics and Correlation

	Variables	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	Mode	1.57	0.82	1																	
2	Foreign equity share	0.80	0.29	-0.97*	1																
3	Demand volatility	3.96	0.85	0.08*	-0.08*	1															
4	Sales growth	0.15	0.07	-0.04*	0.04*	0.14*	1														
5	Labor cost growth	0.62	0.94	0.03	-0.03	-0.02	-0.09*	1													
6	Fixed asset ratio	0.42	0.32	0.05*	-0.05*	0.02	0.08*	0.02	1												
7	Competition	0.97	0.08	-0.09*	0.10*	-0.01	-0.01	0.02	-0.01	1											
8	High tech industry	0.27	0.44	-0.03	0.03	0.23*	0.08*	-0.07*	-0.10*	-0.06*	1										
9	Foreign presence	0.38	0.19	-0.19*	0.19*	-0.17*	-0.16*	-0.03	-0.14*	0.08*	0.21*	1									
10	Industry R&D intensity	-6.94	1.43	0.02	-0.02	0.28*	0.11*	-0.09*	-0.05*	-0.11*	0.74*	0.01	1								
11	Industry adv intensity	-7.34	0.90	-0.02	0.02	-0.11*	-0.15*	0.02	-0.05*	-0.05*	0.31*	0.23*	0.32*	1							
12	Average experience	7.65	2.21	0.12*	-0.12*	0.00	-0.23*	0.13*	0.11*	-0.06*	-0.08*	-0.30*	-0.03*	0.05*	1						
13	Size	9.99	1.44	0.08*	-0.09*	0.14*	0.15*	0.03	0.04*	-0.11*	0.16*	-0.12*	0.24*	0.00	0.10*	1					
14	Multiparty	0.02	0.14	0.03	-0.02	0.02	-0.01	-0.01	-0.01	0.00	0.03	-0.01	0.04*	0.01	0.01	0.05*	1				
15	State partner	0.03	0.16	0.19*	-0.18*	-0.01	-0.07*	0.09*	0.07*	-0.08*	0.03	-0.11*	0.03	0.03	0.16*	0.15*	0.04*	1			
16	Coastal	0.83	0.38	-0.11*	0.12*	-0.01	0.03	-0.04*	-0.04*	0.25*	0.05*	0.13*	0.02	-0.03	-0.13*	-0.01	0.01	-0.11*	1		
17	Patent number	10.1	2.12	0.01	-0.01	0.06*	0.11*	-0.04*	-0.03	-0.01	0.09*	0.00	0.12*	0.04*	-0.09*	-0.01	0.06*	-0.03*	0.05*	1	
18	Exchange rate volatility	0.01	0.01	0.04*	-0.04*	0.07*	0.01	-0.04*	0.02	-0.05*	0.07*	-0.07*	0.10*	0.05*	-0.02	0.01	0.06*	0.01	0.01	0.40*	1

Note: * if $p < 0.01$.

Table 2. Main effects of uncertainty on choice of ownership structure and foreign equity share

	Model 1			Model 2
	Majority JV (vs. WOS)	**Minority JV (vs. WOS)**	**Minority JV (vs. majority JV)**	**Foreign equity share**
Demand volatility	0.06	0.13*	0.06	-0.04*
	(0.08)	(0.07)	(0.09)	(0.02)
Sales growth	-1.74*	-0.65	1.09	0.31
	(1.04)	(0.84)	(1.12)	(0.24)
Labor cost growth	-0.01	-0.03	-0.02	0.01
	(0.05)	(0.04)	(0.05)	(0.01)
Fixed assets ratio	-0.56	-0.20	0.36	0.02
	(0.71)	(0.56)	(0.77)	(0.16)
Competition	-0.72	-1.37***	-0.65	0.45***
	(0.55)	(0.45)	(0.56)	(0.13)
High tech industry	-31.87***	-26.19**	5.68	0.61
	(1.32)	(12.07)	(11.98)	(2.57)
Foreign presence	-0.91*	-1.35***	-0.44	0.46***
	(0.50)	(0.42)	(0.55)	(0.12)
Industry R&D intensity	0.01	0.05	0.04	-0.02
	(0.07)	(0.07)	(0.08)	(0.02)
Industry adv intensity	-0.06	-0.05	0.01	0.02
	(0.09)	(0.08)	(0.10)	(0.02)
Average experience	0.04*	0.00	-0.04*	0.00
	(0.02)	(0.02)	(0.02)	(0.01)
Size	0.04	0.07***	0.04	-0.02***
	(0.03)	(0.03)	(0.04)	(0.01)
Multiparty	0.94***	-0.04	-0.98***	-0.12*
	(0.25)	(0.29)	(0.30)	(0.07)
State partner	3.98***	3.38***	-0.60***	-0.49***
	(0.48)	(0.48)	(0.20)	(0.06)
Coastal	-0.34***	-0.32***	0.01	0.10***
	(0.12)	(0.10)	(0.13)	(0.03)
Patent number	-0.11	0.07	0.17	0.00
	(0.14)	(0.12)	(0.15)	(0.01)
Exchange rate volatility	-0.24	6.10	6.34	-1.17
	(7.54)	(6.69)	(8.23)	(0.91)
McFadden's R^2	0.10			0.07
Count R^2	0.67			-
Chi^2	896.98***			543.97***

Notes: The table reports multinomial logit results for Model 1 and Tobit results for Model 2. N=5055 (1,096 minority JVs, 693 majority JVs, and 3,262 WOSs). Home country, industry, year dummies, and constant are all included but not reported due to space limitation. Measures concerning the host country (China) include demand volatility, sales growth, labor cost growth, fixed asset ratio, competition, foreign presence, industry R&D intensity, and industry adv intensity. Standard errors appear in parentheses; *** if p<0.01, ** if p<0.05, * if p<0.10.

Table 3a. The impact of uncertainty on ownership choice: high versus low sales growth potential

	Model 3 (Low growth)			Model 4 (High growth)		
	Majority JV (vs. WOS)	Minority JV (vs. WOS)	Minority JV (vs. majority JV)	Majority JV (vs. WOS)	Minority JV (vs. WOS)	Minority JV (vs. majority JV)
Demand volatility	0.24**	0.29***	0.04	-0.17	-0.04	0.13
	(0.11)	(0.11)	(0.13)	(0.15)	(0.13)	(0.17)
Sales growth	-0.48	2.50	2.98	-0.15	0.76	0.91
	(2.85)	(2.48)	(3.11)	(1.60)	(1.26)	(1.73)
Labor cost growth	0.00	-0.04	-0.04	-0.06	-0.05	0.01
	(0.05)	(0.05)	(0.05)	(0.17)	(0.15)	(0.20)
Fixed assets ratio	-0.55	-0.17	0.39	-0.78	-0.26	0.53
	(1.44)	(1.20)	(1.52)	(0.84)	(0.67)	(0.93)
Competition	-1.66*	-1.88**	-0.23	0.02	-1.42**	-1.44*
	(0.88)	(0.75)	(0.84)	(0.80)	(0.60)	(0.83)
High tech industry	17.64	15.78	0.10	-30.61	-22.66	7.94
	(6300)	(3100)	(6100)	(5200)	(5200)	(14.44)
Foreign presence	-1.26	-1.47**	-0.22	-0.47	-1.64***	-1.17
	(0.80)	(0.68)	(0.84)	(0.73)	(0.60)	(0.85)
Industry RD intensity	-0.03	-0.01	0.02	0.05	0.05	0.00
	(0.12)	(0.10)	(0.13)	(0.10)	(0.09)	(0.12)
Industry adv intensity	0.02	0.17	0.14	-0.25	-0.09	0.16
	(0.15)	(0.14)	(0.16)	(0.16)	(0.13)	(0.18)
Average experience	0.07**	0.03	-0.03	-0.01	-0.09*	-0.08
	(0.03)	(0.03)	(0.02)	(0.06)	(0.05)	(0.07)
Size	0.08	0.09*	0.01	0.00	0.07*	0.07
	(0.06)	(0.05)	(0.06)	(0.05)	(0.04)	(0.05)
Multiparty	0.86**	-0.11	-0.96**	0.95***	0.05	-0.90**
	(0.39)	(0.42)	(0.45)	(0.35)	(0.40)	(0.42)
State partner	3.79***	3.39***	-0.40	4.37***	3.56***	-0.81**
	(0.63)	(0.63)	(0.28)	(0.75)	(0.75)	(0.32)
Coastal	-0.25	-0.25	0.00	-0.38**	-0.34**	0.05
	(0.18)	(0.16)	(0.19)	(0.17)	(0.14)	(0.18)
Patent number	-0.19	-0.08	0.11	0.75	0.43	-0.32
	(0.17)	(0.14)	(0.18)	(1.09)	(0.72)	(1.18)
Exchange rate volatility	3.35	2.45	-0.90	-1.40	10.37	11.76
	(11.80)	(10.15)	(12.09)	(10.95)	(9.63)	(12.59)
Observations	2159			2896		
McFadden's R^2	0.13			0.11		
Count R^2	0.67			0.68		
Chi^2	534.72***			543.18***		

Notes: The table reports multinomial logit results. N=5055. Model 3 has 498 minority JVs, 327 majority JVs, and 1,334 WOSs, and Model 4 has 598 minority JVs, 369 majority JVs, and 1,929 WOSs. Home country, industry, year dummies, and constant are all included but not reported due to space limitation. Measures for the host country (China) include demand volatility, sales growth, labor cost growth, fixed asset ratio, competition, foreign presence, industry R&D intensity, and industry adv intensity. Standard errors appear in parentheses; *** if $p<0.01$, ** if $p<0.05$, * if $p<0.10$.

Table 3b. The impact of uncertainty on ownership choice: high versus low irreversibility

	Model 5 (Low irreversibility)			Model 6 (High irreversibility)		
	Majority JV (vs. WOS)	Minority JV (vs. WOS)	Minority JV (vs. majority JV)	Majority JV (vs. WOS)	Minority JV (vs. WOS)	Minority JV (vs. majority JV)
Demand volatility	0.05	0.19	0.14	0.09	0.14	0.05
	(0.13)	(0.12)	(0.16)	(0.12)	(0.11)	(0.14)
Sales growth	-5.12***	-1.94	3.18*	0.79	0.13	-0.66
	(1.68)	(1.29)	(1.86)	(1.50)	(1.23)	(1.59)
Labor cost growth	-0.14	-0.02	0.13	0.01	-0.01	-0.02
	(0.19)	(0.15)	(0.22)	(0.05)	(0.05)	(0.05)
Fixed assets ratio	3.76	-0.48	-4.24	-1.37*	-0.23	1.14
	(4.54)	(3.72)	(5.07)	(0.81)	(0.60)	(0.87)
Competition	0.18	-0.71	-0.89	-1.52**	-2.08***	-0.57
	(0.89)	(0.72)	(0.96)	(0.75)	(0.62)	(0.73)
High tech industry	14.51	-0.62	-15.13	-85.10***	-23.97	60.71***
	(1400)	(1.49)	(1400)	(1.61)	(36000)	(2.97)
Foreign presence	-1.33	-3.31***	-1.98**	0.21	-0.05	-0.27
	(0.86)	(0.76)	(0.99)	(0.70)	(0.56)	(0.76)
Industry RD intensity	0.03	0.05	0.03	0.06	0.01	-0.05
	(0.11)	(0.10)	(0.12)	(0.15)	(0.12)	(0.16)
Industry adv intensity	0.08	0.01	-0.07	-0.32*	-0.12	0.20
	(0.16)	(0.13)	(0.18)	(0.16)	(0.14)	(0.17)
Average experience	-0.02	0.04	0.06	0.05**	0.00	-0.05**
	(0.07)	(0.05)	(0.07)	(0.02)	(0.02)	(0.02)
Size	-0.04	0.09*	0.13**	0.12**	0.09**	-0.03
	(0.05)	(0.04)	(0.06)	(0.05)	(0.04)	(0.05)
Multiparty	1.04***	-0.15	-1.20***	0.83**	0.06	-0.77*
	(0.35)	(0.43)	(0.46)	(0.38)	(0.40)	(0.41)
State partner	5.19***	4.42***	-0.77**	3.32***	2.87***	-0.45
	(1.03)	(1.04)	(0.32)	(0.55)	(0.55)	(0.28)
Coastal	-0.43**	-0.31*	0.13	-0.24	-0.32**	-0.08
	(0.19)	(0.16)	(0.21)	(0.16)	(0.13)	(0.17)
Patent number	-0.15	0.16	0.32	-0.10	-0.02	0.09
	(0.21)	(0.18)	(0.23)	(0.19)	(0.16)	(0.20)
Exchange rate volatility	-2.65	8.83	11.47	3.98	4.71	0.73
	(11.05)	(9.97)	(12.40)	(10.85)	(9.41)	(11.52)
Observation	2549			2506		
McFadden's R^2	0.12			0.11		
Count R^2	0.70			0.64		
Chi^2	505.44***			505.26***		

Notes: The table reports multinomial logit results. N=5055. Model 5 has 492 minority JVs, 322 majority JVs, and 1,735 WOSs, and Model 6 has 604 minority JVs, 374 majority JVs, and 1,528 WOSs. Home country, industry, year dummies, and constant are all included but not reported due to space limitation. Measures concerning the host country (China) include demand volatility, sales growth, labor cost growth, fixed asset ratio, competition, foreign presence, industry R&D intensity, and industry adv intensity. Standard errors appear in parentheses; *** if p<0.01, ** if p<0.05, * if p<0.10.

Table 3c. The impact of uncertainty on ownership choice: high versus low competition

	Model 7 (Low competition)			Model 8 (High competition)		
	Majority JV (vs. WOS)	Minority JV (vs. WOS)	Minority JV (vs. majority JV)	Majority JV (vs. WOS)	Minority JV (vs. WOS)	Minority JV (vs. majority JV)
Demand volatility	0.19*	0.22**	0.04	-0.17	-0.02	0.14
	(0.11)	(0.10)	(0.13)	(0.14)	(0.13)	(0.18)
Sales growth	-2.56**	-0.60	1.96	0.35	-0.99	-1.34
	(1.31)	(1.09)	(1.38)	(2.01)	(1.59)	(2.28)
Labor cost growth	-0.03	-0.06	-0.03	0.01	0.06	0.05
	(0.05)	(0.05)	(0.06)	(0.13)	(0.12)	(0.13)
Fixed assets ratio	-1.69	-0.80	0.89	-0.14	0.66	0.79
	(1.17)	(0.96)	(1.23)	(1.01)	(0.77)	(1.11)
Competition	-0.04	-0.90*	-0.85	-120.00*	66.65	190.02**
	(0.63)	(0.49)	(0.64)	(69.45)	(57.95)	(78.64)
High tech industry	-49.89***	-35.78*	14.11	-2.16	15.94	19.53
	(2.45)	(19.60)	(19.26)	(1.39)	(4700)	(9200)
Foreign presence	-0.99	-1.07*	-0.07	-0.16	-1.54*	-1.38
	(0.67)	(0.57)	(0.72)	(1.05)	(0.80)	(1.16)
Industry RD intensity	0.01	0.08	0.08	-0.16	-0.21	-0.05
	(0.08)	(0.07)	(0.09)	(0.22)	(0.16)	(0.23)
Industry adv intensity	-0.13	-0.24**	-0.10	0.03	0.15	0.12
	(0.12)	(0.10)	(0.12)	(0.24)	(0.19)	(0.27)
Average experience	0.03	0.00	-0.03	0.09**	-0.02	-0.10**
	(0.03)	(0.03)	(0.02)	(0.04)	(0.04)	(0.04)
Size	0.07	0.05	-0.02	-0.04	0.10**	0.14**
	(0.04)	(0.04)	(0.05)	(0.06)	(0.05)	(0.07)
Multiparty	1.40***	-0.25	-1.65***	0.15	0.29	0.14
	(0.33)	(0.42)	(0.41)	(0.51)	(0.41)	(0.55)
State partner	3.79***	3.31***	-0.48**	5.06***	3.94***	-1.11**
	(0.54)	(0.54)	(0.24)	(1.13)	(1.14)	(0.46)
Coastal	-0.52***	-0.57***	-0.04	-0.06	0.02	0.08
	(0.15)	(0.13)	(0.16)	(0.22)	(0.18)	(0.25)
Patent number	-0.03	0.27*	0.30	-0.03	-0.16	-0.13
	(0.18)	(0.16)	(0.19)	(0.24)	(0.18)	(0.26)
Exchange rate volatility	1.48	8.29	6.81	9.44	3.93	-5.51
	(9.76)	(8.74)	(10.52)	(13.64)	(11.66)	(15.80)
Observations		2446			2609	
McFadden's R^2		0.12			0.11	
Count R^2		0.63			0.71	
Chi^2		581.51***			445.52***	

Notes: The table reports multinomial logit results. N=5055. Model 7 has 609 minority JVs, 406 majority JVs, and 1,431 WOSs, and Model 8 has 487 minority JVs, 290 majority JVs, and 1,832 WOSs. Home country, industry, year dummies, and constant are all included but not reported due to space limitation. Measures concerning the host country (China) include demand volatility, sales growth, labor cost growth, fixed asset ratio, competition, foreign presence, industry R&D intensity, and industry adv intensity. Standard errors appear in parentheses; *** if p<0.01, ** if p<0.05, * if p<0.10.

Table 4. Moderating effects of industry factors on the impact of uncertainty on foreign equity share

	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14
	Low growth	High growth	Low irreversibility	High irreversibility	Low competition	High competition
Demand volatility	-0.06***	-0.01	-0.05	-0.03	-0.06**	0.01
	(0.02)	(0.04)	(0.03)	(0.03)	(0.03)	(0.04)
Sales growth	0.18	-0.04	1.00***	-0.24	0.29	0.24
	(0.60)	(0.39)	(0.37)	(0.35)	(0.28)	(0.49)
Labor cost growth	0.01	-0.06	0.01	0.01	0.02	-0.01
	(0.01)	(0.04)	(0.04)	(0.01)	(0.01)	(0.03)
Fixed assets ratio	-0.14	0.02	0.48	0.08	0.17	-0.16
	(0.31)	(0.21)	(0.62)	(0.17)	(0.25)	(0.24)
Competition	0.49***	0.47**	0.16	0.67***	0.29**	-12.27
	(0.18)	(0.19)	(0.20)	(0.17)	(0.13)	(17.73)
High tech industry	0.46	0.48	0.10	1.85	3.04	0.53
	(0.40)	(3.22)	(0.54)	(2.73)	(3.91)	(0.43)
Foreign presence	0.40**	0.60***	0.87***	-0.05	0.38***	0.41*
	(0.16)	(0.19)	(0.19)	(0.16)	(0.15)	(0.25)
Industry R&D intensity	-0.01	-0.03	-0.03	0.01	-0.03	0.04
	(0.03)	(0.03)	(0.02)	(0.04)	(0.02)	(0.05)
Industry adv intensity	-0.02	0.05	0.01	0.05	0.06**	-0.03
	(0.03)	(0.04)	(0.04)	(0.04)	(0.03)	(0.06)
Average experience	0.00	0.029*	-0.01	0.00	0.00	0.00
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
Size	-0.03**	-0.02*	-0.03**	-0.03**	-0.02*	-0.03*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Multiparty	-0.08	-0.16	-0.18*	-0.06	-0.08	-0.17
	(0.10)	(0.10)	(0.10)	(0.11)	(0.08)	(0.13)
State partner	-0.45***	-0.62***	-0.63***	-0.37***	-0.47***	-0.63***
	(0.07)	(0.09)	(0.09)	(0.08)	(0.06)	(0.14)
Coastal	0.05	0.13***	0.11**	0.09**	0.16***	-0.03
	(0.04)	(0.04)	(0.04)	(0.04)	(0.03)	(0.05)
Patent number	-0.02***	0.02***	0.00	0.00	0.01*	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Exchange rate volatility	-1.09	-0.85	-1.40	-0.85	-0.31	-2.24
	(1.26)	(1.28)	(1.26)	(1.33)	(1.09)	(1.58)
Observations	2159	2896	2549	2506	2446	2609
McFadden's R^2	0.09	0.07	0.08	0.06	0.09	0.06
Chi^2	308.4***	283.0***	320.8***	203.9***	324.6***	230.8***

Notes: The table reports Tobit results. N=5055. Home country, industry, year dummies, and constant are all included but not reported due to space limitation. Measures concerning the host country (China) include demand volatility, sales growth, labor cost growth, fixed asset ratio, competition, foreign presence, industry R&D intensity, and industry adv intensity. Standard errors appear in parentheses; *** if p<0.01, ** if p<0.05, * if p<0.10.

Table 5. Effects of demand volatility under different industry conditions

Table 5a. Predicted probability

	Full sample	Sales growth		Competition	
		Low	High	Low	High
Minority JV	0.21	0.22	0.17	0.21	0.11
Majority JV	0.12	0.09	0.10	0.16	0.08
WOS	0.67	0.69	0.73	0.63	0.81

Table 5b. Marginal effect

	Full sample	Sales growth		Competition	
		Low	High	Low	High
Minority JV	0.020	0.044	-0.003	0.032	-0.001
Majority JV	0.003	0.014	-0.015	0.017	-0.012
WOS	-0.023	-0.058	0.018	-0.049	0.013

Table 5c. Odds ratio

	Full sample	Sales growth		Competition	
		Low	High	Low	High
Minority JV vs. WOS	1.13*	1.33**	0.96	1.25**	0.98
Majority JV vs. WOS	1.06	1.27**	0.84	1.21*	0.85
Minority JV vs. Majority JV	1.07	1.05	1.14	1.04	1.15

Notes: *** if $p<0.01$, ** if $p<0.05$, * if $p<0.10$. The predicted probabilities and marginal effects are calculated at the mean values of all variables.

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[1] Belderbos and Zou (2009) analyzed how portfolio redundancy influences the value of switch and growth options under exchange rate volatility, but the focus is on divestment of foreign subsidiaries.

[2] For example, Ghosal and Loungani (2000) found that uncertainty has a negative impact on investment level and suggested that risk aversion and financial constraints (asymmetric information in the financial market) are alternative explanations for these results.

[3] Several studies have suggested that JV contracts may not contain explicit option clauses (Reuer & Tong, 2005; Seth & Chi, 2005). Real options theory is often applied to study investment decisions embedded with *implicit* options (Mason & Merton, 1985; Trigeorgis, 1996).

[4] In cases with multiple foreign partners, we use total foreign equity investment divided by total equity to obtain foreign equity share.

[5] The yearbook does not provide comparable industry-level sales information prior to 1995. It is also worth noting that our sales measure includes both domestic and international sales (we are not able to distinguish the two). So the uncertainty measure we calculate captures demand volatility for both local and international sales. Thus, even for firms that are largely export oriented, our demand volatility measure can still capture the market environment they face and affect their ownership strategies.

[6] We thank the Editor for this insight.

[7] http://www.stats.gov.cn.

[8] We cannot track the parent firm's previous entry experience in China since the China Census data do not contain sufficient information (e.g., the name) for us to identify the parent firm of a foreign subsidiary. We believe that our results still hold even without a measure of firm-specific experience. Since demand volatility is largely out of control of an individual firm, firm-specific experience may play a limited role in affecting a firm's strategy under demand volatility. We conduct several additional robustness tests below.

[9] Results from analysis of the interaction terms between demand volatility and industry contingency factors are consistent with those of the split sample analysis. Wald tests suggest that the subsamples are

significantly different from each other. Thus, we report results from the split sample analysis when comparing the effects of our main variable (i.e., demand volatility) across different groups (Allison, 1999; Hoetker, 2007).

[10] We conducted another set of subsample analysis by dividing the full sample into one with perfect competition (i.e., market concentration≤0.01) and the other with imperfect competition (i.e., market concentration>0.01). We found results supporting H4, that is, a foreign firm is more likely to use flexible ownership strategies to respond to uncertainty in industries with imperfect competition than in industries with perfect competition.

[11] Another uncertainty measure that is commonly used in real options studies is the conditional variance of stock market returns based on GARCH models (e.g., Folta & O'Brien, 2004). It is not possible for us to obtain such a measure for the Chinese industries because, unlike the more developed U.S. stock market, the Chinese stock market is still at an emerging stage and does not have sufficient time series data for a GARCH analysis.