



R&D intensity and international joint venture performance in an emerging market: moderating effects of market focus and ownership structure

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Abstract

In this study we examine the contingent relationship between R&D intensity and performance of international joint ventures (IJVs) in an emerging market context. Based on Teece's (1986) arguments regarding the appropriability of innovation, we identify two types of appropriability hazard related to IJVs' R&D activities in this context: local-market-related and local-partner-related hazards. We argue that a positive relationship between R&D intensity and IJV performance is more likely to occur if these appropriability hazards can be mitigated. Results using a sample of manufacturing IJVs in China provide support for these arguments. We find that R&D intensity is positively related to performance in export market-focused IJVs but not in local market-focused IJVs. In addition, using a configuration approach, we find that R&D intensity is positively related to performance in IJVs that have an export market focus and in which the multinational companies (MNCs) have a majority ownership, but not in other market focus-ownership structure configurations. These findings contribute to our knowledge of R&D activities of MNCs' overseas subsidiaries. *Journal of International Business Studies* (2007) 38, 944–960.

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Introduction

Recent research has emphasized the increasing internationalization of R&D activities and their importance to multinational corporations (MNCs) (e.g., Birkinshaw, 1997; Kuemmerle, 1999; Belderbos, 2003). Driven by increased market competition and rapid technological changes, MNCs need to invest in R&D activities in ways that maximize innovation and enhance their global competitiveness. Many MNCs are diffusing headquarters functions geographically and moving R&D activities to locations abroad (Cantwell, 1989; Cheng and Bolon, 1993; Kuemmerle, 1999; Zhao, 2006). Several scholars have argued that R&D investment in overseas subsidiaries can help MNCs exploit their firm-specific resources, improve their local responsiveness, and ensure sustainable competitive advantages globally (Ghoshal and Bartlett, 1988; Birkinshaw, 1997; Kuemmerle, 1999; Luo, 2002).

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Unfortunately, there is little empirical evidence to support the assertions of a positive relationship between R&D investment and performance of MNC overseas subsidiaries. While several studies have examined the factors that may affect R&D investment of MNC overseas subsidiaries (e.g., Mansfield and Romeo, 1980; Zejan, 1990; Belderbos, 2003), few have examined the performance consequences of R&D investment in MNC overseas subsidiaries. Indeed, the existing innovation literature has yet to provide consistent evidence on the relationship between R&D intensity and firm performance (Li and Atuahene-Gima, 2001). Some studies have found that R&D investment is positively related to firm performance (e.g., Franko, 1989; Lichtenberg and Siegel, 1991; Eberhart *et al.*, 2004). Others, however, have found that R&D investment has either no direct relationship or a negative relationship with firm performance (e.g., Morbey, 1989; Graves and Langowitz, 1993).

Teece's (1986) argument on the appropriability of innovation helps to explain the inconsistent results of prior research. According to Teece (1986: 287), appropriability refers to firms' ability to capture the rents generated by their innovation activities. Appropriability hazards originate from the pervasive presence of behavioral uncertainty, combined with the difficulties of specifying intellectual property rights and monitoring and enforcing contracts (Teece, 1986; Gulati and Singh, 1998). Following this logic, firms can capture rents from their R&D investments only if they can effectively address the appropriability hazards that exist for innovation. Relative to developed markets, appropriability hazards are more salient in emerging markets which typically lack effective institutional support such as the protection of property rights. Even if such support exists, it rarely meets the standards in developed markets (Spicer *et al.*, 2000). In some cases, local government may even provide tacit support for local firms to expropriate MNCs' technologies (Delios and Henisz, 2000). In a survey of R&D globalization, the Economist Intelligence Unit (2004) reported that 84% of executives cited inadequate property rights protection in emerging markets as a challenge (cf. Zhao, 2006).

Using the concept of appropriability hazards, in this study we examine the relationship between R&D intensity and the performance of international joint ventures (IJVs) (i.e., MNCs' subsidiaries in which they share ownership with local partners) in an emerging market context. We propose that IJVs in an emerging market face two types of

appropriability hazard of innovation: local-market-related and local-partner-related. Local-market-related appropriability hazards arise for two major reasons. First, because of weak and ineffectual laws protecting intellectual property rights, IJVs' R&D activities in emerging markets may be leaked to local firms, and thus they may not be able to gain the full or even partial benefit from their R&D investments. Second, IJVs may face a steep learning curve in emerging markets, and they may not be good at adapting products/technology to the local contexts, which can also limit the IJVs' ability to capture rents from their R&D activities.

Local-partner-related appropriability hazards arise for two major reasons that are associated with local partners of IJVs. First, in general, local partners of IJVs in emerging markets technologically lag their MNC partners. Because institutional legal frameworks have not been well developed in these markets, local firms may misuse the MNCs' proprietary technologies that are transferred to the IJVs, and they may also use the IJVs' R&D resources for their own interests (e.g., Luo and Park, 2001). Second, because of their weak technology position, local partners generally have limited technological contributions to the IJVs, which can limit the IJVs' absorptive capacity for their R&D activities (if the IJVs do not have strong support from the MNC partners) (Lane *et al.*, 2001). The local partners' opportunistic behaviors and relative technological incompetence thus can limit the extent to which the IJVs can benefit from their R&D investments.

Therefore the relationship between R&D intensity and IJV performance is likely to depend on the level of the appropriability hazards that exist, and a positive relationship is more likely to occur when these appropriability hazards are mitigated. In this study, we focus on two defensive mechanisms: (1) an IJV's market focus and (2) ownership structure. Market focus refers to the extent to which an IJV sells its products to export markets *vis-à-vis* the local markets. The choice of export market focus (*vis-à-vis* the local market focus) helps IJVs to mitigate the local-market-related appropriability hazards. To the extent that an IJV focuses more on export markets, the probability of the local firms imitating the IJV's R&D activities is reduced. Further, because an export-focused IJV serves the MNC partner's existing international market, it tends to be more efficient in using its R&D investment. Ownership structure reflects the partner firms' commitment to an IJV as well as their relative ability to control IJV activities (Yan and

Gray, 1994). We argue that MNC majority ownership (greater than 50%) can help mitigate the local-partner-related appropriability hazards. When MNCs have a majority ownership of IJVs, they tend to have strong motivation to support the IJVs' R&D activities (thus the local partners' technological incompetence becomes less relevant). They also have greater control over how the IJV's R&D resources are used, which can limit the local partners' opportunistic behaviors related to the IJVs' R&D resources. Using a contingent approach, we examine how the relationship between R&D intensity and IJV performance is moderated by the IJV's market focus and ownership structure, respectively. Further, taking a configurational approach (Ketchen *et al.*, 1993; Miller, 1996), we also examine how this relationship varies across different configurations of IJV market focus and ownership structure.

The rest of the paper is organized as follows. First, we present our theory and research hypotheses. Second, we discuss the research methods used, including the sample, time frame, and operational measures. Third, we present the empirical results. Finally, we discuss the implications of our research and identify limitations and directions for future research.

Research background and hypothesis development

R&D activities of IJVs in emerging markets

Market liberalization and economic growth in emerging markets have created attractive market opportunities for MNCs. IJVs with local firms represent an important entry mode for MNCs to explore these market opportunities and to respond to local market requirements. An IJV is an entity in which partner firms pool their resources and capabilities to achieve their objectives (Harrigan, 1986; Kogut, 1988). Typically, for IJVs in an emerging market the MNC partners provide technological, marketing and managerial resources and capabilities, whereas the local partners offer human capital, connections with local government, and knowledge of the local markets (Yan and Gray, 1994; Hitt *et al.*, 2000). Because the MNC partners and the local partners typically have asymmetric technological capabilities (i.e., the MNC partners are more technologically advanced than the local partners), the IJVs' R&D activities are largely derived from the MNCs' technologies.

According to Belderbos (2003: 235), the benefits of MNCs' overseas R&D activities can be divided into two basic categories: (1) demand-side benefits, in which an MNC exploits its technology abroad through adaptation of the technology to local market needs; and (2) supply-side benefits, in which an MNC creates new technologies through access to local market technology and know-how. In an emerging market context, IJVs may receive both demand-side and supply-side benefits from their R&D activities. On the demand side, through R&D investment, IJVs can internalize the technological know-how offered by the MNCs and develop new capabilities, which can then be exploited to achieve competitive advantages (Steensma and Lyles, 2000). Such capabilities can help the IJVs to compete effectively with both local firms and other foreign-invested firms (Tallman, 1991; Luo, 2002). In particular, many emerging markets are characterized by high volatility and complexity. Innovation enables IJVs to develop new market opportunities and to respond to market and regulatory uncertainties. Thus it can increase the IJVs' strategic alignment with the environment and produce better performance (Luo and Park, 2001: 145). On the supply side, although local firms in emerging markets have relatively weak technology positions, these markets offer opportunities for IJVs to obtain access to human resources for their R&D activities at a fairly low cost (Li and Zhong, 2003). As Zhao (2006: 1186) noted, 'Even after taking the extra coordination costs into consideration, many companies estimate that their R&D costs can be more than halved by going offshore.'

While R&D investment can potentially create rents for IJVs from either or both the demand-side and the supply-side benefits, the IJVs may not be able to capture the rents because of appropriability hazards that they encounter. As Gulati and Singh (1998: 789) argued, 'In a tight appropriability regime, firms can retain the profits they earn from their proprietary resources, while in a loose regime, these profits are subject to involuntary leakage or spillovers to other firms.' Emerging markets are generally characterized by a loose appropriability regime and have weak intellectual property rights protection. Then the question is: Under what conditions can IJVs benefit from their R&D investment? To answer this question, we argue that IJVs in emerging markets face local-market-related and local-partner-related appropriability hazards of innovation, and they must find ways to overcome these hazards. Thus the profit potential of R&D

activities in IJVs is contingent upon the extent to which these appropriability hazards can be mitigated. We expect that an IJV's market focus and ownership structure can mitigate the appropriability hazards of its R&D activities in an emerging market. Thus market focus and ownership structure independently and jointly moderate the relationship between R&D intensity and performance in IJVs. In the following sections, we develop hypotheses to examine these contingent relationships.

The moderating role of IJV market focus

The market focus of overseas subsidiaries represents an important strategic choice for MNCs to operate in emerging markets (Pan and Chi, 1999; Luo and Park, 2001). In an emerging market, the host country government often pressures MNCs to export the outputs of their subsidiaries located in the country (Doz, 1981) because export growth is usually closely associated with the economic development of emerging markets. MNCs, however, based on their overall strategies, may choose to focus either on exporting their subsidiary outputs to international markets (i.e., export focus) or on penetrating local markets (i.e., local market focus). IJVs with an export market focus emphasize exporting a large portion of their products to overseas markets using the distribution and marketing capabilities of the MNCs. This type of IJV tends to exploit the resource endowments in the host country. In contrast, IJVs with a local market focus emphasize reaping benefits from pent-up indigenous demand in the local market (Pan and Chi, 1999; Luo and Park, 2001).

Different from prior work that has typically focused on how MNC subsidiaries' market focus affects their R&D intensity (e.g., Hewitt, 1980; Mansfield and Romeo, 1980; Hirschey and Caves, 1981; Zejan, 1990; Odagiri and Yasuda, 1996; Belderbos, 2003), this study examines how an IJV's market focus affects the relationship between its R&D intensity and performance. The central argument is that IJVs conducting R&D activities in an emerging market face local-market-related appropriability hazards to rent generation. To the extent that an IJV focuses on local markets *vis-à-vis* export markets, the local-market-related appropriability hazards become greater, making it more difficult for the IJV to appropriate rents from its R&D activities. In this way, the market focus affects the relationship between R&D investment and IJV performance.

As noted earlier, in an emerging market, local-market-related appropriability hazards exist because an IJV's R&D activities may be leaked to and imitated by the local firms. Drawing on Spencer's (forthcoming) recent work on MNCs' spillovers to local firms in developing countries we argue that there are three major mechanisms through which this may occur. First, a local market focus of an IJV can enhance demonstration effects (i.e., external observations) from the IJV to local firms. Demonstration effects occur when managers of a local firm are exposed to an IJV's product and service offerings, technologies, and strategies, allowing them to imitate the IJV's approach (Blomström and Kokko, 1998; Spencer, forthcoming). To the extent that an IJV focuses on local markets, local firms have more opportunities to observe what products and services the IJV offers, and how the IJV's offerings are innovative and distinct. Local firms then can imitate the IJV's innovations and offer similar (or the same) products and services. The demonstration effects not only help existing local competitors but also encourage new local entrants if the IJV's innovative products and services create new market demand. Relatively, if an IJV mainly focuses on export markets, its innovative offerings are less likely to be 'observed' in local markets, thus reducing the likelihood of local firms' imitation.

Second, a local market focus of an IJV increases its local business linkages. Spencer (forthcoming) argues that, when MNCs become embedded in their host economy, local suppliers and distributors can act as conduits facilitating the diffusion of an MNC's knowledge to local firms through networks of interactions. Relative to those with an export market focus, IJVs with a local market focus are more embedded in the host economy because they use local distributors and marketing agents. These IJVs have strong incentives to share knowledge with their local distributors and marketing agents in order to penetrate the local markets. They also need to train their local distributors and marketing agents in sales techniques and assist them to develop a management infrastructure (Meyer, 2004). The extensive interaction and information exchange between IJVs with a local market focus and their local distributors and marketing agents can leak the IJVs' innovation activities and knowledge generated to the local competitors as local distributors and marketing agents pass their new-found knowledge on to other firms in the industry (Spencer, forthcoming). In contrast, when IJVs

focus mainly on export markets, they sell a majority of their products through their existing international distribution channels. As a result, they have less interaction and information exchange with local distributors and marketing agents (Luo and Park, 2001), which can reduce the leakage of their R&D activities to local firms.

Third, a local market focus of an IJV makes its R&D activities more relevant and applicable to the local firms. As Spencer (forthcoming) notes, spillovers from MNCs to local firms depend not only on a local firm's *access* to an MNC's knowledge, but also on the *relevance* and applicability of that knowledge to the local firm. A local firm's absorptive capacity (Cohen and Levinthal, 1990) to capture knowledge from MNCs varies based upon the amount of 'common knowledge' (overlapping knowledge) it shares with the MNCs (Spencer, forthcoming). In IJVs with a local market focus, the major reason for R&D investment is to support the sales and marketing activities in the host country by modifying the technologies and products developed originally in the home country to the needs and tastes of the local market, and by providing technical services to the local customers (Mansfield and Romeo, 1980; Hirschey and Caves, 1981; Odagiri and Yasuda, 1996). Local-market-oriented R&D activities are more relevant and applicable to local firms because they have 'common knowledge' regarding these markets. In this case, local firms can utilize the IJVs' innovation outcomes and incorporate them into their own operation systems. In contrast, IJVs with an export market focus have the responsibility for regional or world markets in a product area so that their R&D activities are to support the regional or world markets rather than the more limited local market (Belderbos, 2003). Hence local firms have less 'common knowledge' with these IJVs, making it more difficult for them to appropriate the IJVs' innovation.

These arguments suggest that a local market focus *vis-à-vis* an export market focus makes an IJV's R&D activities more *accessible* to local firms (through the first two mechanisms) and more *relevant* to local firms (through the third mechanism). Thus a local market focus of an IJV can facilitate the leakage of its R&D activities to local firms, which limits the IJV's ability to appropriate rents from its R&D investment. Equally important, due to institutional, cultural and other differences between emerging markets and the MNCs' home markets (Hitt *et al.*, 2000), local-market-related appropriability

hazards may also be associated with an IJVs' adaptability to local environments. It is possible that IJVs with a local market focus may not be able to fully utilize their R&D investment because they face a steep learning curve when they operate in a new and different market context. These IJVs have difficulty in adapting their products/technologies to the local conditions. In contrast, IJVs with an export market focus mainly exploit the resource endowments in the host country to serve the MNCs' existing international markets. R&D activities enable these IJVs to improve their technologies and products and meet the higher standards that often exist in international markets. Also, MNCs are more familiar with these markets, have better access to foreign marketing and distribution networks (Blomström and Kokko, 1998), and may understand the overseas consumers better. Thus they can make IJVs more efficient in using their R&D investment, which in turn leads to higher performance.

R&D activities are costly and risky. All else being equal, if IJVs are unable to appropriate necessary value from their R&D activities because of the local-market-related appropriability hazards, high R&D investment can adversely affect their performance. It appears that local-market-related appropriability hazards are less significant to the IJVs with a greater export market focus. These IJVs are more likely to retain the rents generated from their R&D activities and achieve better performance. Based on these arguments, we propose the following hypothesis:

Hypothesis 1: In an emerging market, R&D intensity is positively related to the performance of IJVs with an export market focus, but not with a local market focus.

The moderating role of ownership structure

In addition to the local-market-related appropriability hazards discussed above, IJVs in emerging markets also face local-partner-related appropriability hazards for conducting R&D activities. Of course, IJVs with local partners allow MNCs to combine their knowledge with complementary knowledge provided by the local partners to achieve higher performance than they can alone. As London and Hart (2004) argued, emerging markets are dominated by informal rules, deep social contracts, and idiosyncratic expectations; as a result, MNCs will be most successful when they have deep relationships with local partners

and 'co-invent' locally appropriate products, services, and organizational practices.

However, IJVs also provide a rich opportunity for knowledge spillovers from MNCs to local partners (Steensma and Lyles, 2000; Lane *et al.*, 2001). Although MNCs may attempt to protect their proprietary knowledge from expropriation by local partners, it is difficult for them to shield the local partners from gaining some knowledge of their technologies, products, and organizational practices (Mansfield and Romeo, 1980). Indeed, the intense interaction and knowledge exchanges required in MNCs' and local partners' 'co-invention' process (London and Hart, 2004) can facilitate the local partners' access to the MNCs' proprietary knowledge, and also increase the local partners' ability to internalize the MNCs' proprietary technology (Spencer, forthcoming).

One may argue that joint R&D activities enable partners to attenuate the technology leakage problem via exchange of hostages. However, in emerging markets where the technological capabilities of the local partners are relatively weak, IJV R&D activities depend largely on the MNC partners' technologies. Because of this imbalance, exchange of hostages between MNC and local partners is unlikely. Therefore MNCs face the risk of opportunistic behaviors by the local partners (Hennart, 1988). The local partners might misuse or modify the MNCs' technologies in ways that were not intended in the IJV contract, and which are injurious to the MNCs. They could also acquire (learn) the technological capabilities and eventually become competitors of the MNCs in local and international markets (Hamel, 1991). Indeed, MNCs' IJVs with local partners in emerging markets can even lead to knowledge spillovers to other local firms (not local partners) via the local partners' network of interactions in the local environment (Spencer, forthcoming).

While these hazards are challenging, MNC majority ownership, relative to other ownership structures, provides the opportunity to mitigate local-partner-related appropriation hazards. There are two reasons. First, in IJVs with MNC majority ownership, it is more likely that MNC partners rather than local partners will provide support for and largely oversee the IJVs' R&D activities. Previous studies have shown that partners' contributions to IJVs determine their equity shares in the IJVs, in which partners that contribute technologies tend to have a majority ownership (Blodgett, 1991). This observation is consistent

with the premise of transaction cost economics that firms choose equity to promote knowledge-sharing and protection in an alliance (Pisano, 1989; Oxley, 1997; Kale *et al.*, 2000). For this reason, if the MNC partner has a majority ownership in an IJV, it is more likely to contribute more advanced technologies to the IJV, which can improve the IJV's absorptive capacity (Lane *et al.*, 2001). R&D activities represent a process of knowledge generation and accumulation, and therefore IJVs with stronger absorptive capacity (through the MNC partners' technological support) can better utilize their R&D investment and generate more rents from their R&D investment. In contrast, in IJVs with local majority ownership, because local firms in emerging markets lag behind foreign firms technologically (Hitt *et al.*, 2005), presumably the technologies contributed by local partners are not as advanced as those from MNC partners. In turn, this limits the IJVs' absorptive capability and learning. This argument is consistent with previous findings that MNC partners' support is crucial to the IJVs' learning (Steensma and Lyles, 2000; Lane *et al.*, 2001).

Second, equity ownership can be considered a proxy for IJV control, affecting partners' relative influence on how to use the IJV's R&D investment, having important implications for the performance outcome of IJV R&D investment. As Teece (1992: 20) argued, 'equity stakes provide a mechanism for distributing residuals when *ex ante* contractual agreements cannot be written to specify or enforce a division of returns.' In the IJV context, equity ownership provides the partners with legitimate authority over the IJV assets, and indicates the partners' control of the IJV (Hennart, 1988; Blodgett, 1991). Mjoen and Tallman (1997) argued that a partner with a dominant equity position has the ability to exercise more control. For this reason, we would expect that MNC majority ownership in an IJV might lower the probability that local partners can misappropriate the MNC's technologies and the IJV's R&D resources. As Takii (2005: 523) argued, in MNC majority-owned subsidiaries, 'it is usually relatively easy for the parent to control personnel assignments so as to prevent leakage of important knowledge and technology.' His findings of MNC subsidiaries in Indonesian manufacturing industries suggest that the greater presence of majority- or wholly foreign subsidiaries reduce the magnitude of spillovers.

It could be argued that MNC majority ownership may not be able to completely reduce the local

partner's access to the MNC's technological knowledge. Thus even IJVs with MNC majority ownership can expose the MNC's technology to the local partner and create the risk of developing a local competitor. Our argument, however, is that MNC majority ownership in an IJV can at least afford the MNC partner more control on how to use and manage the IJV's R&D investment. Because MNC partners are more experienced and have stronger capabilities to manage R&D activities than local partners, they are more likely to make 'optimal' R&D investments and conduct effective R&D activities within the IJV. Thus we would expect a positive relationship between R&D intensity and IJV performance when the R&D investment and activities are managed, guided, and controlled by the MNC partner rather than the local partner.

These arguments suggest that MNC majority ownership increases the IJVs' absorptive capacity (through the MNC partner's technological support) and grants the MNC partner more control of how to use the IJVs' R&D investment. Thus, all else being equal, IJVs with MNC majority ownership can better generate rents from their R&D investment, thus leading to a positive relationship between IJV R&D investment and performance. Therefore we propose the following hypothesis:

Hypothesis 2: In an emerging market, R&D intensity is positively related to the performance of IJVs in which the MNC parents have a majority ownership.

The configuration of market focus and ownership structure

Based on the contingent arguments presented previously, we examine the configurational effect of market focus and ownership structure on the relationship between R&D intensity and IJV performance. Configuration scholars have argued that organizational performance can be better understood by identifying commonality among distinct, internally consistent sets of firms than by seeking to uncover relationships that hold across all organizations (Ketchen *et al.*, 1993; Miller, 1996). As a consequence, integrative mechanisms that ensure complementarity among a firm's various dimensions can better explain the firm's performance (Black and Boal, 1994; Miller, 1996). Empirically, configurations can be represented by the simultaneous interaction of three variables (e.g., Baker and Cullen, 1993).

Using a configurational approach, we argue that the strongest positive relationship between R&D intensity and performance occurs in IJVs with a high export market focus and with majority ownership by the MNC partner, compared with other market focus-ownership structure configurations (i.e., export market focus and local majority ownership, local market focus and MNC majority ownership, or local market focus and local majority ownership). As noted earlier, when IJVs have a greater export market focus, their R&D activities have less exposure to local firms (e.g., lower demonstration effects), they are less embedded in local business linkages, and their R&D activities are less relevant and applicable to local firms – all of these factors can reduce the potential for spillovers to local firms. Meanwhile, R&D activities enable these IJVs to improve their technologies and products and to meet the higher standards that often exist in international markets. Further, when the MNC partners have a majority ownership in the IJVs, the IJVs' R&D activities are likely based on the MNC partners' technologies and are managed and controlled by the MNC partners. In this configuration, the IJV's export market focus allows the MNC to integrate the operations of the IJV into its global business networks, and its majority ownership further provides legitimate authority to this action. As such, the IJVs operate in a manner similar to a wholly owned subsidiary of the MNC partners, and therefore the IJVs can benefit the most from their R&D investments.

Relatively, IJVs with other market focus-ownership structure configurations find it difficult to retain rents from their R&D investments. More specifically, in the configuration of local majority ownership and export market focus, the IJVs' R&D activities are based on the local partners' less advanced technologies but are trying to serve the more sophisticated international markets. It is unlikely that the IJVs' R&D activities can meet the higher standards of international markets. In the configuration of local majority ownership and local market focus, the IJVs' R&D investment may not enhance their performance because their R&D investment is managed and performed by the less advanced local partners. Further, in the configuration of MNC majority ownership and local market focus, although the IJVs' R&D activities are based upon the MNC partners' advanced technologies, such activities may not improve their performance because costly R&D provides greater value than necessary in a less sophisticated market.

Based on these arguments, we propose the following hypothesis:

Hypothesis 3: In an emerging market, R&D intensity has the strongest positive relationship with the performance of IJVs that have both an export market focus and MNC majority ownership, compared with other market focus–ownership structure configurations.

Methods

Sample

We use China, a leading emerging market, as the research setting. China has become one of the largest recipients of foreign direct investment in the world. UNCTAD (2001) reported that among the 400,000 foreign-invested firms founded in China during the period 1979–2000, 65% were structured as joint ventures. These foreign-invested firms (including joint ventures) have played a major role in R&D investment in China. For example, of \$62.1 billion of exports of high-tech products from China in 2003, 84.6% were from foreign-invested firms (*The Economist*, 2003). Also, academic scholars and the business press have expressed serious concerns about intellectual property rights protection in China (*Business Week*, 2005; Zhao, 2006). Thus China represents a valid empirical setting to examine how IJVs can benefit from their R&D investment.

Data for this study came from China's Third Industrial Census conducted by the State Statistics Bureau (SSB) of China in 1996. All manufacturing firms, both local and foreign, were required by law to complete the census survey, which covered data on profit and loss, assets and depreciation, human resources, and product market, among others. The SSB made special efforts to ensure the quality of the data by using a logic-testing method that linked related variables together in order to identify illogical data (Pan *et al.*, 1999). The data provided by the SSB have been used in scholarly research, and have been shown to be internally consistent and to have appropriate construct validity (e.g., Pan *et al.*, 1999).

Data were purchased from the SSB on manufacturing IJVs in three industries: the electric machinery industry, the electronics and communication industry, and the office equipment industry (i.e., precision instruments, meters, and business machines). These are relatively technology-intensive industries in which IJV R&D activities are more

likely to occur, enabling us to explore the research questions posed for this study; at the same time they are all manufacturing IJVs. IJVs that focus only on R&D activities differ from manufacturing IJVs significantly, so they were not included. There were 264 IJVs in these industries in the census survey. After deleting observations with missing values, the sample consisted of 243 IJVs: 104 in the electric machinery industry, 116 in the electronics and communication industry, and 23 in the office equipment industry. The average age of the IJVs was 6.51 years, the average number of employees was 851, and the average of the IJVs' total investment was US\$13.1 million.

Measures

IJV performance was measured using the IJV's return on assets (ROA) (Pan and Chi, 1999), adjusted for industry. Industry-adjusted ROA has been widely used as a performance measure in the strategic management literature. Because the sample included IJVs in three industrial segments, individual IJVs' ROA was adjusted for industry by subtracting the industry median ROA (using data points from sample IJVs only and excluding the focal IJV) from the focal IJV's ROA (Huson *et al.*, 2004).¹

R&D intensity was measured by an IJV's R&D expenditure divided by sales (Belderbos, 2003), adjusted for industry. Individual IJVs' R&D intensity was adjusted for industry by subtracting the industry median R&D intensity (using data points from sample IJVs only and excluding the focal IJV) from the focal IJV's R&D intensity. We used industry-adjusted R&D intensity in order to remove any industry-specific effects from the IJVs' R&D investments.

Export market focus was measured by the ratio of the value of an IJV's export sales relative to its total sales (Odagiri and Yasuda, 1996; Pan and Chi, 1999). A large ratio of sales in export markets *vis-à-vis* sales in China indicates a greater export market focus, whereas a small ratio of sales in export markets *vis-à-vis* sales in China indicates a greater local market focus.

MNC majority ownership was coded 1 if the MNC partners had ownership larger than 50% and 0 otherwise (Yan and Gray, 1994; Mjoen and Tallman, 1997). In order to control for the differences between split ownership and local majority ownership, we also created a control variable, *split ownership*, coded 1 if the MNC partners and the local partners had 50–50 ownership and 0 otherwise.

In supplementary analyses we dropped the split ownership control variable, because it had no effect on the results. After eliminating this variable, the results remained unchanged.

We controlled for several variables that might influence R&D intensity and the performance of IJVs. *IJV size* was measured by the natural log of an IJV's total number of employees. *IJV age* was measured by the number of years since the IJV was founded. We created two dummy variables for the origin of the MNC. *Origin 1* was coded 1 if the MNC was headquartered in Greater China, including Hong Kong, Taiwan, or Macau, and 0 otherwise. MNCs from these three regions were grouped together because the regions share common histories, cultures, and languages with China, and because they are also geographically proximate and politically linked to China. *Origin 2* was coded 1 if the MNC was headquartered in other Asian countries, such as Japan or Singapore, and 0 otherwise. Compared with non-Asian regions, these regions are closer to China, both culturally and geographically. These two groups of IJVs were compared with those whose MNC parents were headquartered in non-Asian countries.

Finally, two location dummy variables were created. Location matters because there can be differences in local needs and tastes, technology development, legal regimes, etc. Also, Pan and Chi (1999) noted that foreign direct investment varies considerably across regions in China. *Location 1* was coded 1 for southeast coastal provinces (such as Guangdong and Fujian) and 0 otherwise. This part

of China pioneered in opening its markets to foreign direct investment, and foreign-invested firms focused more on export markets. *Location 2* was coded 1 for other coastal provinces (such as Shanghai, Jiangsu, and Tianjin) and 0 otherwise. This part of China has relatively well-developed industrial bases. These two groups of IJVs were compared with those located in the inland provinces, which represent the less-developed part of China.

Data analyses and results

Table 1 presents means, standard deviations, and correlations between variables examined in this study. Table 2 presents the regression results.² Model 1 includes only controls, and Model 2 adds the main effects of R&D intensity, export market focus, and MNC majority ownership. Model 3 adds R&D intensity's interaction with export market focus and its interaction with MNC majority ownership, respectively. Model 4 adds the three-way interaction between R&D intensity, export market focus, and MNC majority ownership. Based on Aiken and West (1991), all of the three lower-level interaction terms are also included in this model. Prior to creating the interaction terms, variables were mean-centered in order to reduce the potential problem of multi-collinearity (Aiken and West, 1991). We further applied the residual centering procedure (Lance, 1988; Jong *et al.*, 2005) to handle multi-collinearity between the interaction term (e.g., X_1X_2) and its constituent parts (e.g., X_1 and X_2). This procedure had two stages: first, each

Table 1 Means, standard deviations, and correlations (N=243)

Variables	Mean	s.d.	1	2	3	4	5	6	7	8	9	10
1. IJV performance ^a	0.01	0.97	—									
2. R&D intensity	0.01	0.03	0.04	—								
3. Export market focus	0.32	0.37	-0.06	-0.13*	—							
4. MNC majority ownership	0.45	0.50	-0.04	-0.07	0.08	—						
5. Split ownership	0.05	0.22	0.07	0.01	-0.04	0.26**	—					
6. IJV age	6.65	6.52	0.15*	0.06	-0.10	-0.19**	-0.06	—				
7. IJV size	6.23	1.05	0.21**	-0.02	0.02	0.06	0.06	0.16**	—			
8. Location 1: Southeast coastal provinces	0.31	0.46	0.09	-0.10	0.23**	-0.06	-0.08	0.19**	0.18**	—		
9. Location 2: Other coastal provinces	0.56	0.49	-0.15*	0.04	-0.14*	0.14*	0.01	-0.18**	-0.19**	-0.76**	—	
10. Origin 1: Hong Kong, Taiwan, and Macau	0.48	0.50	0.15*	-0.04	0.08	-0.24**	-0.09	0.17**	0.18**	0.34**	-0.36**	—
11. Origin 2: Other Asian countries	0.23	0.42	-0.04	-0.08	0.12*	0.17**	0.14*	-0.16**	-0.05	-0.13*	0.13*	-0.54**

Significance level: * $P < 0.05$, ** $P < 0.01$.

^aIJV performance is defined as industry-adjusted return on assets (ROA).

Table 2 Regression analysis results of IJV performance^{a,b,c}

Variables	Model 1	Model 2	Model 3	Model 4
<i>Explanatory variables</i>				
R&D intensity	0.04	0.03	0.03	0.03
Export market focus		-0.06	-0.06	-0.05
MNC majority ownership		-0.01	0.00	0.00
<i>Interactions</i>				
R&D intensity × Export market focus			0.13*	0.14*
R&D intensity × MNC majority ownership			0.08	0.09
Export market focus × MNC majority ownership				0.08
R&D intensity × Export market focus × MNC majority ownership				0.13*
<i>Controls</i>				
Split ownership	0.07	0.07	0.06	0.04
IJV age	0.11 [†]	0.10	0.11 [†]	0.09
IJV size	0.16**	0.17**	0.16**	0.15*
Location 1: Southeast coastal provinces	-0.08	-0.07	-0.07	-0.07
Location 2: Other coastal provinces	-0.13	-0.12	-0.13	-0.15
Origin 1: Hong Kong, Taiwan, and Macau	0.10	0.11	0.10	0.09
Origin 2: Other Asian countries	0.04	0.05	0.05	0.02
F-value	2.96**	2.45**	2.55**	2.68***
Model R ²	0.09	0.09	0.11	0.13
Change in R ²	—	0.00	0.02*	0.02*

N = 243.

Significance level: [†] $P < 0.10$, * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$ (two-tailed tests).

^aStandardized coefficients are reported.

^bSince the measures of performance were adjusted for industry, we did not include industry dummies in the empirical models. In separate analyses, we included industry dummies, but the results did not change. These results are available from the authors upon request.

^cIJV performance is defined as industry-adjusted return on assets (ROA).

interaction term was regressed on its components; second, we saved the residuals and used these instead of the original interaction terms (Jong *et al.*, 2005). We checked the variance inflation factors (VIFs) associated with each regression coefficient. VIFs associated with the two location dummy variables and the two origin dummy variables are below 2.6, and the other VIFs are below 1.2, suggesting that there are no problems with multicollinearity in our analyses.

The results in Model 3 show that the coefficient for the interaction term of R&D intensity and export market focus is positive and statistically significant ($\beta = 0.13$, $P < 0.05$). To facilitate interpretations, we plotted the results in Figure 1. As shown in Figure 1, for IJVs with an export market focus (when export market focus equals one standard deviation above mean), R&D intensity has a positive relationship with IJV performance; for IJVs with a local market focus (when export market focus equals zero), this relationship becomes negative. Based upon the approach suggested by Aiken

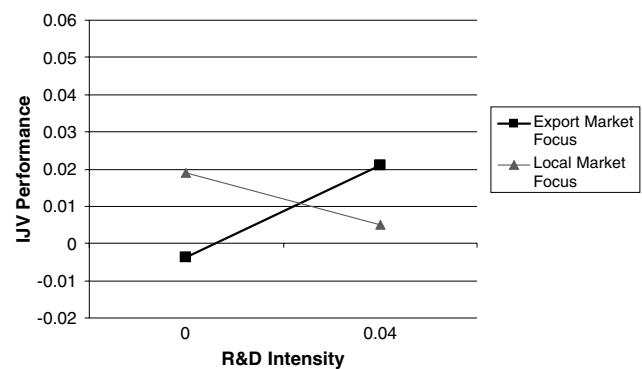


Figure 1 R&D intensity and IJV performance: the moderating role of market focus.

and West (1991: 18–19), the simple slopes (i.e., the simple standardized regression coefficients of IJV performance on R&D intensity) associated with the two lines in Figure 1 were calculated. For IJVs with an export market focus, the simple slope is 0.22, which is significantly different from zero at the

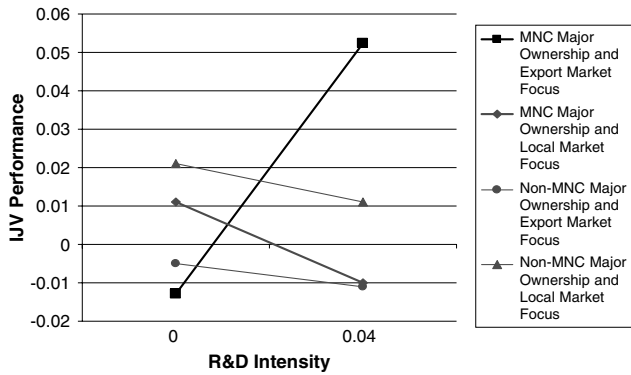


Figure 2 R&D intensity: the moderating effect of ownership and market focus.

level of $P < 0.05$. In contrast, for IJVs with a local market focus, the simple slope is -0.04 , which is not significantly different from zero. Thus Hypothesis 1 receives support from the results.

The results in Model 3 show that the coefficient for the interaction term of R&D intensity and MNC majority ownership is positive but not statistically significant ($\beta = 0.08$, n.s.). Thus Hypothesis 2, suggesting that R&D intensity will have a positive relationship with performance in IJVs with MNC majority ownership, is not supported.

The results in Model 4 show that the coefficient for the interaction term of R&D intensity, export market focus, and MNC majority ownership is positive and statistically significant ($\beta = 0.13$, $P < 0.05$). To facilitate interpretations, we plotted the results in Figure 2 (MNC majority ownership took values of 0 and 1). As shown in Figure 2, R&D intensity has a strong and positive relationship with performance in IJVs with a combined export market focus and MNC majority ownership, but not in other market focus–ownership structure configurations. Following a similar procedure, simple slopes associated with the four lines in Figure 2 were calculated. Specifically, in the configuration of MNC majority ownership and export market focus, the simple slope is 0.63 , which is significantly different from zero at the level of $P < 0.001$. In contrast, in the configuration of MNC majority ownership and local market focus, the simple slope is -0.06 , which is not significantly different from zero. In the configuration of non-MNC majority ownership (including both MNC minority ownership and split ownership) and export market focus, the simple slope is -0.02 , which is not significantly different from zero. Additionally, in the configuration of

non-MNC majority ownership and local market focus, the simple slope is -0.03 , which is not significantly different from zero. These results provide support for Hypothesis 3.

Discussion and conclusion

Researchers have increasingly recognized the importance of the R&D activities of MNCs' overseas subsidiaries. However, few empirical studies have systematically examined the relationship between R&D intensity and the performance of MNC overseas subsidiaries and how this relationship is affected by strategic contexts. Drawing on Teece's (1986) appropriability logic, we examined IJVs' R&D investment in an emerging market context and argued that IJVs face both local-market-related and local-partner-related appropriability hazards in their R&D activities. We proposed that the IJVs' market focus and ownership structure affect the level of these appropriability hazards and therefore moderate the relationship between R&D intensity and IJV performance. Our results provide general support for these arguments.

Our findings show that R&D intensity has a positive relationship with IJV performance when the IJVs have an export market focus, but not when the IJVs have a local market focus. These findings contribute to our knowledge of the role of market focus in MNC overseas subsidiaries' R&D activities. While previous research has examined the effects of market focus on MNC overseas subsidiaries' R&D intensity (e.g., Odagiri and Yasuda, 1996; Belderbos, 2003), our research suggests that market focus affects the extent to which MNC overseas subsidiaries can benefit from their R&D activities. Specifically, our results suggest that while IJVs with a local market focus may invest more in R&D activities (as evidenced by the negative and significant correlation between R&D intensity and export market focus), they are less able to benefit from their R&D investments than are IJVs with an export market focus. The latter IJVs reap more benefits from their R&D investments because their innovation activities are less likely to be leaked to local firms in an emerging market, and because their R&D activities enable them to meet the higher standards that often exist in international markets.

Our results indicate that the role of ownership structure in the relationship between R&D intensity and IJV performance is more complicated than expected. Importantly, we did not find support for the proposition that R&D intensity will be positively related to performance in IJVs with MNC

majority ownership. It appears that, after MNCs enter into an IJV, holding a majority ownership *alone* cannot effectively mitigate local-partner-related appropriability hazards. This is probably because, in the Chinese context, property rights protection is weak and difficult to enforce. Therefore, even though the MNC majority ownership in an IJV grants the MNC a majority ownership of the IJV's resources, it would be difficult to enforce any provisions/safeguards in the IJV contract. Instead, even with a minority ownership, local partners of IJVs still have access to the IJVs' R&D activities and technological breakthroughs, which provides the potential for them to misappropriate the IJV's innovations. Particularly because the Chinese government strongly encourages local firms to develop technologies, IJVs become an important tool for local firms to gain access to advanced technologies and innovations. Even if local firms have a minority ownership, they have strong incentives to appropriate from the IJVs' innovations. Further, compared with local firms in other emerging markets, Chinese firms have stronger learning capabilities to acquire the technological knowledge (Hitt *et al.*, 2005). As a result, these firms have a relatively greater capability to appropriate value from the R&D activities undertaken in the IJVs in which they participate.

In contrast, further analyses suggest that the configuration of export market focus and MNC majority ownership produces a strong positive relationship between R&D intensity and IJV performance, and that this positive relationship does not exist in other market focus–ownership structure configurations. This outcome suggests that, when combined with an export market focus, MNC majority ownership can effectively mitigate the appropriability hazards of IJVs' R&D activities. The export market focus provides the MNC partner with an opportunity to integrate the IJV's operations into its worldwide business networks, thereby allowing it more control over the innovations produced in the IJV. And the majority ownership provides the MNC partner with legitimate authority to take these actions and exercise the necessary control. In other words, the combination of MNC majority ownership and export market focus provides an important means of controlling the threat of innovation leakage and protecting MNC technological assets in IJVs undertaken in China's emerging market. Further, in this configuration, because the MNC partners are more willing to provide support for the IJVs' R&D activities, and the

IJVs focus on relatively familiar and sophisticated international markets, these IJVs can have better returns from their R&D investments.

Finally, in this study we did not find a direct positive relationship between R&D intensity and IJV performance. This is consistent with Oxley and Sampson's (2004: 723) suggestion that 'there may be circumstances where even the most "protective" alliance form (for example, the equity joint venture) does not reduce leakage concerns sufficiently to ensure the level of knowledge-sharing required to achieve alliance objectives.' Indeed, the plot in Figure 2 shows that the positive relationship between R&D intensity and IJV performance occurs in the configuration of export market focus and MNC majority ownership but not in other configurations of market focus and ownership structure. Thus the relationship between R&D investment and firm performance must be examined within the context in which it occurs.

Research contributions

The findings of this study make significant contributions to our knowledge of MNCs' overseas R&D activities. This is one of the few studies that have examined how the linkage between R&D intensity and IJV performance varies across different strategic contexts. Most previous studies have focused on the antecedents of MNC overseas subsidiaries' R&D activities (e.g., Mansfield and Romeo, 1980; Zejan, 1990; Belderbos, 2003). These studies have largely predicted what these subsidiaries *will do* (regardless of whether their behaviors lead to positive results or not). More interesting and important to MNC managers and policymakers, however, is what these subsidiaries *should do* in order to benefit from their R&D investments. Yet empirical evidence regarding the effect of R&D intensity on subsidiary performance is limited. Our study advances this line of research by showing that the linkage between R&D intensity and IJV performance varies across IJVs with different market focuses, and also varies across IJVs with different configurations of market focus and ownership structure. Indeed, our findings show that the highest IJV performance occurs in the configuration of a higher level of export market focus, MNC majority ownership, and a higher level of R&D intensity. These findings contribute to our knowledge on how the combinations of MNCs' various strategic choices (in terms of market focus, ownership structure, and R&D investment) can lead to success.

In particular, our findings contribute to an emerging research stream on MNCs' R&D activities in emerging markets. It has been noted that performing R&D activities in emerging markets is challenging for MNCs because institutional support such as intellectual property rights protection is lacking (e.g., Zhao, 2006). Meanwhile, it has been observed that MNCs are increasingly conducting their R&D in emerging markets such as China and India (Kuemmerle, 1999; Li *et al.*, 2005). In a recent study, Zhao (2006) argued that MNCs possessing alternative mechanisms for protecting their intellectual properties will find it attractive to conduct R&D in emerging markets. She found that MNCs can substitute internal organization (e.g., closely knit internal technology structures) for external intellectual property protection in emerging markets with poor institutional environments. Our study adds to this line of research by showing that, in addition to internal organization, MNCs can benefit from their R&D investment in emerging markets through carefully selecting the market focus and ownership structure in tandem. Thus this research broadens our understanding of MNCs' R&D activities in emerging markets with weak intellectual property rights protection.

We have extended Teece's (1986) appropriability logic into the context of IJVs' R&D activities in an emerging market context, and propose that there are two types of appropriability hazard: local-market-related and local-partner-related. We advance the literature by developing a coherent theoretical model to explain how these two types of appropriability hazard occur, and how they affect the linkage between R&D intensity and IJV performance across different strategic contexts. While IJVs in emerging markets represent only one special type of MNC overseas subsidiaries, it provides a unique opportunity to examine the appropriability concerns of MNCs' international R&D activities. Our theoretical model, however, is not specific to IJVs, and it can shed some light on the performance consequences of MNCs' overseas R&D activities in other contexts. For example, for MNCs' wholly owned subsidiaries in emerging markets, local-market-related appropriability hazards may be more relevant than local-partner-related appropriability hazards. Additionally, in a host country in which property rights protection is more advanced and enforced, local-market-related appropriability hazards may not be as important for MNCs' subsidiaries (either wholly owned or joint ventures). Thus these situations are representative of

the theoretical argument developed and tested in our study. In this sense, our set of theoretical arguments has the potential to serve as an overarching model for investigating the performance consequences of MNCs' overseas R&D activities.

Our findings also contribute to our understanding of knowledge-sharing and protection in strategic alliances. Prior research in transaction cost economics examined how firms choose governance structures that promote knowledge-sharing and protection in strategic alliances (Pisano, 1989; Sampson, 2004). Thus much of the empirical research to date has the logic of transaction cost economics to examine governance choices. Only a few recent studies (e.g., Sampson, 2004) have examined the performance implications of governance choices. Our study contributes to this emerging research stream by showing that the performance implications of governance choices are further dependent on other strategic factors. For example, our results show that MNC majority ownership alone does not affect the link between R&D intensity and IJV performance; however, when combined with an export market focus it has significant effects on the relationship. Thus our study highlights the potential limitation of the exclusive focus on governance choices in strategic alliances in much of the previous research.

Limitations and directions for future research

This study's findings suggest directions for future research. First, as noted earlier, although our focus on IJVs' R&D intensity in China's emerging market is a strength, given the lack of research in this context, we had no comparison country or comparison entry modes (e.g., wholly owned subsidiaries). Hence our study provides only within-country and within-IJV variance. We believe that our logic has a broader applicability, and should shed some light on IJV R&D activities in other emerging markets. Relative to developed countries, in most emerging markets laws protecting intellectual property rights are either weak or ineffectual (Zhao, 2006). Thus MNCs have to deal with local-market-related and local-partner-related appropriability hazards when they attempt to conduct R&D activities within their IJVs in emerging markets. However, property rights protection and law enforcement may differ across emerging markets. Additionally, firms in some emerging markets (e.g., China and Russia) may have higher learning capabilities than their counterparts in other emerging markets (Hitt *et al.*, 2005). Therefore the levels of local-market-related

and local-partner-related appropriability hazards may vary across emerging markets. Future research should replicate this study with other samples such as IJVs (and wholly owned subsidiaries) in other emerging markets to examine the generalizability of the findings.

Second, we acknowledge that the level of causal analysis adopted in our appropriability/spillover argument is a rather proximate one. This is typical in spillover research because of the extreme data requirements. Blomström and Kokko (1998: 9) noted that, to examine spillover effects,

...the study would require detailed micro data, both quantitative and qualitative. The study would have to cover several years, to take into account the fact that spillovers are not instantaneous. It should also include a large number of firms and industries, so that inter-industry spillovers could be observed, and so that it would be possible to draw statistically significant conclusions. ... *However, to the best of our knowledge, no comprehensive analyses of this character have ever been made – one reason, of course, is the extreme data requirements.* (emphasis added)

Consistent with prior research on the appropriability of innovation and organizational resources (e.g., Duliba *et al.*, 2001; Li and Zhang, 2007), in this study we used the performance implication of innovation to examine the appropriability of IJV innovation. Future research may further test our arguments by using dependent variables that can better capture technology appropriation/spillover, such as patent citations and productivity changes after the entrance of an MNC in the local market.

Also, since the data we used were cross-sectional, an argument might be made for reversed causality in which the more profitable IJVs have the slack resources with which to invest in R&D. However, the prior empirical literature with lagged data has suggested causal effects of R&D on firm performance rather than the reverse (Franko, 1989: 459). The relationship we studied herein is consistent with prior work. Further, the moderating effects studied herein make simple reverse causality arguments less tenable (Simons and Peterson, 2000). In additional analyses, we tested whether the interaction of an IJV's performance with its market focus and its ownership structure, and the three-way interaction, are related to R&D intensity. We found no statistically significant results. These additional analyses help to reduce the potential concern that IJV performance might lead to R&D intensity. Nevertheless, a longitudinally designed cross-validation of the findings, and more sources of

data, would enable further evaluation of causality in the hypothesized relationships.

Third, in this study we focused on how market focus and ownership structure affect the relationship between R&D intensity and performance in IJVs. Other factors might affect this relationship as well. For example, the appropriability regime of technologies may differ across industries (Gulati and Singh, 1998), and thus technologies may be more difficult to protect in some industries than in others. Hence future research could examine how this relationship is affected by industry conditions. In addition, the control mode (other than equity control) and communication systems might affect the interdependence between overseas subsidiaries' R&D activities and the MNC parent (Nobel and Birkinshaw, 1998). Further research could explore how the control mode and communication systems affect the relationship between R&D intensity and performance in overseas subsidiaries. Further, in this study, we have focused on local-market-related and local-partner-related appropriability hazards of MNCs' innovation in emerging markets. It is possible that, under certain circumstances, MNCs' interactions with local firms and local partners in emerging markets may increase their understanding of the local market and thus make their R&D investments more efficient. Future research needs to examine conditions under which these benefits may exceed the potential costs of appropriation/spillover.

Finally, the question of how R&D investment may influence the IJVs' long-term stability is a potentially important one. Considering that IJVs represent a 'race to learn' by partners, a partner that can learn more and learn faster from the IJV's R&D activities becomes less dependent upon the other partner (Hamel, 1991). After acquiring the desired knowledge, the firm may leave the partnership or acquire the IJV. Exploring this issue further would contribute to our understanding of the evolution of IJVs.

In conclusion, the present study indicates that MNCs' overseas subsidiaries may not necessarily be able to benefit from their R&D investments. Focusing on IJVs in China's emerging market, our findings highlight that MNCs have to carefully consider the appropriability hazards of their overseas subsidiaries' R&D activities. Only if the appropriability hazards can be effectively mitigated can the subsidiaries benefit from their R&D investments. Although preliminary, this is one of the first studies to systematically examine the

performance implications of R&D intensity in IJVs within the context of an emerging market. As such, this research has potentially important implications for the theory and management of MNC overseas R&D activities, and should serve as a catalyst to future research.

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Notes

¹We adjusted industry variance for IJV performance by subtracting industry median ROA from IJV ROA. Other studies may use alternative ways to adjust industry variance – for example, dividing IJV ROA by industry median ROA.

²Since almost half of the IJVs in the sample have zero R&D intensity, one may be concerned that our results

might be biased. In supplementary analyses, we re-estimated our model using Heckman's two-stage model, which can account for the self-selection effect (Heckman, 1979; Shaver, 1998). In the first stage, probit regression was used to estimate the probability that an IJV has R&D intensity greater than zero. The model is as follows. $R\&D\ Intensity\ Dummy$ (coded 1 if R&D intensity is greater than zero and 0 otherwise) $=\alpha + (\beta_1 \times split\ ownership) + (\beta_2 \times IJV\ age) + (\beta_3 \times IJV\ size) + (\beta_4 \times Location\ 1) + (\beta_5 \times Location\ 2) + (\beta_6 \times Origin\ 1) + (\beta_7 \times Origin\ 2)$. Based upon the results of the first-stage model, we predicted and saved the value for the inverse Mill's ratio (λ_i). The inverse of Mill's ratio is the monotonically decreasing function of the probability that an IJV has R&D intensity greater than zero (Heckman, 1979). The inverse of Mill's ratio was then included as a regressor in the second-stage models to estimate an IJV's performance (Heckman, 1979; Shaver, 1998). This two-stage procedure generates consistent and asymptotically efficient estimates (Heckman, 1979). Results of these analyses (available from authors upon requests) are consistent with those reported here.

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