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**Citation:** Nam, K.-M. "Learning through the International Joint Venture: Lessons from the Experience of China's Automotive Sector." *Industrial and Corporate Change* 20, no. 3 (June 1, 2011): 855–907.

**As Published:** <http://dx.doi.org/10.1093/icc/dtr015>

**Publisher:** Oxford University Press

**Persistent URL:** <http://hdl.handle.net/1721.1/86412>

**Version:** Author's final manuscript: final author's manuscript post peer review, without publisher's formatting or copy editing

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# Learning through the International Joint Venture: Lessons from the Experience of China's Automotive Sector

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## Abstract

This study explores why international joint ventures (IJVs) based in the global South may meet with only partial success in nurturing local technological capability. The experience of China's passenger-vehicle sector demonstrates that in the existence of a substantial technological-capability gap between alliance partners, the IJV arrangement is likely to create a "passive" learning mode, and learners using this IJV arrangement may be able to strengthen their production capability but leaving their project-execution and innovation capabilities largely undeveloped.

Keywords: China, automotive industry, joint venture, FDI

Please cite this article as follows.

Nam, K.-M. 2011. Learning through the International Joint Venture: Lessons from the Experience of China's Automotive Sector. *Industrial and Corporate Change* 20(3): 855-907.

You can access the final version of this article at the following link.

<http://icc.oxfordjournals.org/content/20/3/855.short>

## Learning through the International Joint Venture: Lessons from the Experience of China's Automotive Sector

*"In carrying out in-house technology development projects, we have not benefited much from our collaboration with foreign automakers. We have done almost all for ourselves."*

— A senior engineer, Dongfeng Group<sup>1</sup>

*"We did everything we promised to do."*

— Philip Murtaugh, former CEO of GM China<sup>2</sup>

### 1. Introduction

Foreign direct investment (FDI) is distinguished from other types of global financial transactions in that knowledge is embedded in it (Hymer, 1960). Multinational corporations (MNCs), the main agent of FDI, bring their knowledge and know-how, as well as tangible capital, to host economies in the process of managing their overseas operations and assets. The international joint venture (IJV) is one particular form of FDI arrangement, where an MNC jointly controls overseas operations in partnership with other MNCs or local firms. MNCs prefer IJV partnerships with local firms to other FDI arrangements, particularly when they enter emerging markets where substantial risk and uncertainty exist. FDI hosts may also favor the IJV arrangement because, with the IJV arrangement, FDI hosts can influence MNCs to strengthen commitment to local economic development—if local participation in the arrangement is assumed—while building linkages to global production or distribution networks. More importantly, IJVs may allow local firms to access knowledge embedded in the hosted investment better than other alternative FDI arrangements do because the former by nature presuppose certain degrees of cooperation and

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<sup>1</sup> Excerpted from Interview #21.

<sup>2</sup> Quoted in Gallagher (2006), p. 63.

collaboration between the equity holders.

The IJV arrangement has been at the center of China's "exchange-market-for-technology" strategy for its passenger vehicle sector development (SDPC, 1994). Since 1983, the Chinese central government has granted foreign automakers access to its domestic market, as long as they operate China-based joint ventures (JVs) in collaboration with Chinese firms. A JV's non-Chinese parties combined cannot claim more than a 50% stake for each of their Sino-foreign JVs, and each JV project is reviewed every two to three decades, depending on its initial contract. In the early period of foreign entry into the Chinese market, foreign passenger vehicle imports were subject to strict import quota or tariffs, although these protectionist measures were either repealed or loosened substantially after China's accession to the World Trade Organization (WTO) (Harwit, 2001). This controlled inward globalization approach ultimately aims to build a sound local automotive sector and to incubate technologically competitive local automakers within a short period of time (Chu, 2008). China's government expected that the IJV arrangement, in combination with its leverage power from China's huge market potentials, would effectively induce MNCs to be good teachers for their local JV partners.

However, skepticism is growing concerning the JV-based catch-up model. Without doubt, the Sino-foreign JV arrangement worked well for import substitution (IS); as of 2009, China had developed the world's second largest passenger car market, and over 95% of the market's demand was fulfilled by domestic-produced volume. Even a quarter century since the adoption of the IJV model, however, was not long enough to incubate a technologically competitive local auto producer: as of 2009, foreign-licensed models still captured over two-thirds of China's domestic

passenger car market.<sup>3</sup> The link between the IJV model and technological catch-up seems even weaker, given that the domestic market share, captured by Chinese independent brand models, was in large part due to the rise of minor local independent automakers, such as Chery and Geely, which have neither operated auto assembly IJVs nor been main beneficiaries of China's automotive industry policy (Lu and Feng, 2005). In this sense, it seems difficult to say that the IJV model has met the expected technological catch-up schedule.

My research question in this study is why IJV-based local technological capability building in China's automotive sector has been so slow and yielded little, despite some favorable conditions, such as the Chinese government's active support for the catch-up model's success and China's seemingly strong bargaining power against foreign actors (thanks to its huge domestic market). Is the poor outcome because of the inherent nature of the IJV-based catch-up model itself or is it due to an inappropriate implementation of the model or some other reasons? My main hypothesis is that the IJV arrangement in itself provides local firms with only "passive" and "incomplete" learning opportunities because foreign firms, which have superior technological capabilities, can effectively control various aspects of the main access channel to their strategic assets (knowledge and skills, in particular) and they take the actual initiative in governing their JVs' key technical affairs. In this respect, I follow in the footsteps of Hymer (1960).

## **2. Theoretical Framework and Method**

My conceptual lens for this study is built on two propositions. One is that the core competency of

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<sup>3</sup> In 2009, 5.7 million (roughly 69%) out of 8.3 million units of passenger vehicles sold in China—excluding two million units of minibuses, often classified as commercial vehicles—were foreign-branded sedans and recreation vehicles produced by Sino-foreign assembly JVs (Fourin, 2010).

a high market-performer derives from its competitive capabilities for production, project execution, and innovation (Amsden and Hikino, 1994); the other is that the outcome of technological capability-building process of a firm lacking its own technological assets depends on the firm's ability to take advantage of its production capability to nurture project-execution and innovation capabilities (Lall, 1992).

As previously mentioned, I hypothesize that in the existence of substantial technological gap between partner firms, the contribution of the IJV arrangement to such technological capability-building process is, by and large, confined to the local firm (i.e., the learner)'s improved production capability. In my theoretical framework, the rationale for the hypothesis includes: (i) what the foreign firm transfers to the local firm through the IJV arrangement is mostly the *outcome* of technological capability, rather than technological capability itself; (ii) the IJV arrangement tends to encourage the local firm to master the transferred knowledge and skills (thus, to improve production capability) while discouraging the firm from searching for their alternative or new uses; (iii) the IJV arrangement leaves little maneuvering space for the local firm, and the local firm does not have actual power to change this condition; (iv) the IJV lacks innovation capability, and the foreign firm takes a dominant part in the IJV-related investment projects; and (v) thus the local firm can hardly find a way to take advantage of its improved production capability to nurture project-execution and innovation capabilities, depending solely on the IJV arrangement. Figure 1 illustrates my conceptual lens, explained above.

I test the main hypothesis with a detailed case study of Shanghai-Volkswagen (SVW) and Shanghai-General Motors (SGM), the two IJVs affiliated with the Shanghai Automotive Industry Corporation (SAIC). The case study aims to demonstrate that (i) in the existence of a substantial technological-capability gap between alliance partners, the IJV arrangement is likely

to create a “passive” learning mode where teachers, not learners, determine what, when, and how to learn; and (ii) accordingly, the IJV’s contribution may be substantial in building local production capability, where IJV partner firms share common interests, but the contribution may be marginal in nurturing local project-execution and innovation capabilities, due to the conflict of interest between the IJV partner firms. If the SAIC case validates my hypothesis, then it would support my view that regardless of its implementation, the IJV-based *inward* globalization model is doomed to at best *partial* success in upgrading local technological capability, due to the passive nature of the learning mode itself inherent in the model.

I chose SVW and SGM as case study subjects because they are among the best practices of the Sino-foreign JV arrangement. Both IJVs not only have captured a large portion of the local passenger car market<sup>4</sup> on the basis of active technology transfer and localization activities, but also have developed better, though incomplete, in-house vehicle development capabilities<sup>5</sup> than their other rival Sino-foreign JVs. For this reason, the case of SVW and SGM, as two exemplary IJV practices in China’s automotive sector, can help us distinguish what key issues may underlie the IJV arrangement as a technological learning device.

For primary data collection, I conducted 25 in-depth interviews in winter 2007 and summer 2008. Each interview lasted one to two hours, was based on semi-structured but open-ended questionnaires. Interviewees included current and former employees (primarily, managers

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<sup>4</sup> As of 2009, SVW and SGM were the top two passenger vehicle makers in China, in terms of annual sales. Both IJVs sold 728,238 units and 708,356 units, respectively, during the whole year (Fourin, 2009).

<sup>5</sup> As of 2009, GM is the only foreign automaker that operated a sizable independent local technical center, called the Pan Asia Technical Automotive Center (PATAC), in partnership with a local firm. Also, SVW and SGM have invested more in their in-house R&D than most other Sino-foreign JVs (for details, see Chapter 2 of Nam (2010)).

and engineers) of China's five major automotive groups<sup>6</sup> and their IJVs<sup>7</sup>; China's central and local government officials; and other potential information holders, including journalists, consultants, and researchers in the Chinese automotive field. In addition, I made two manufacturing plant visits (SGM's Shanghai plant and Dongfeng-Honda's Guangzhou plant) for plant-level data collection purposes. I complemented the primary data, collected through interviews and plant visits, with various secondary sources, including the China Automotive Industry Yearbook and the Fourin China Automotive Intelligence.

### **3. Literature Review**

Three sets of existing studies provide critical insights into this research topic, as to inward FDI and technological catch-up. I review here the development literature on technological capabilities, the economic literature on FDI and local economic development, and the business literature on the JV as a strategic alliance institution.

#### **3.1. Knowledge, Learning, and Technological Capabilities**

Knowledge is a critical production factor, but access to specific knowledge is challenging and costly. Valuable knowledge in general exists in a tacit form, and this very characteristic of knowledge raises difficulty in transacting it in the market place (Polanyi, 1966). Asymmetric information between the consumers and suppliers of specific knowledge may also inhibit the

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<sup>6</sup> The five automotive groups include SAIC, the First Automotive Works (FAW), the Dongfeng Motor Corporation (DFM), the Guangzhou Automotive Group (GAG), and the Beijing Automotive Industry Corporation (BAIC).

<sup>7</sup> The IJVs include SVW, SGM, PATAC, Dongfeng-Honda, FAW-VW, Guangzhou-Honda, Guangzhou-Toyota, and Beijing-Hyundai.



formation of an efficient market system for knowledge. Rent-seeking behavior is another obstacle in having access to needed knowledge at the appropriate time (Amsden, 2001). Creating knowledge, however, is not necessarily an easier alternative to buying it, given the cumulative nature of knowledge (Kline and Rosenberg, 1986). In general, making knowledge is more costly and difficult than buying it, unless the producer already has a solid knowledge base and internal innovation capability.

Technology, by nature, is knowledge; it is “the organization of knowledge for practical purposes” (Mesthene, 1969: 492). Accordingly, technology shares basic characteristics with knowledge; it is also hard to access and create. At a micro level, technology defines the nature of a firm’s product and production function. The technology currently available to a firm directly affects the firm’s immediate market performance. Each firm’s competitive advantage depends substantially on its ability to employ available technologies in a more efficient way and to create improved technologies on the foundation of existing ones. Such an ability at the firm level can be termed a firm’s “technological capability.” Technology is an outcome of technological development activities, and their efficiency and effectiveness are determined by a firm’s technological capability.

A competitive firm in general has three kinds of technological capabilities: (i) production, (ii) project execution, and (iii) innovation capabilities (Amsden and Hikino, 1994; Kim, 1999). Production capability refers to a firm’s ability to monitor, maintain, optimize, and improve existing manufacturing operations in order to meet higher efficiency and quality standards. Project-execution capability, which is also called investment capability (Westphal *et al.*, 1985), includes a wide range of skills and know-how, with which a firm can successfully establish a new operation or expand the existing ones. Innovation capability is a firm’s capacity to create new

knowledge (or improve existing knowledge) or to apply it to practical or commercial uses through ingenious combinations of preexisting (whether internal or external) knowledge, skills, and other resources. Although market leaders usually use their competence in innovation as sources of improving other aspects of their technological capabilities (e.g., investment and production), latecomers often reverse the sequence due to their insufficient innovation capability; that is, many latecomers use production capability, developed from the acquired technology, as fundamental sources of their improved investment and innovation capabilities (Dahlman *et al.*, 1987).

As latecomers initiate their technological capability-building process on the basis of external knowledge, their technological development depends substantially on their learning ability (Amsden, 1989). A firm's learning performance is a function of the firm-level absorptive capacity, which Cohen and Levinthal (1990: 128) define as "a firm's ability to recognize the value of external knowledge, assimilate it, and apply it to commercial ends." On the one hand, the absorptive capacity depends on the pre-existing internal knowledge base as knowledge is cumulative and mutually complementary. A better understanding of the nature and value of external knowledge can be established when a firm already has enough knowledge relevant to it. On the other hand, intense internalization efforts nurture higher absorptive capacity (Kim, 1995). The complete transfer of valuable knowledge is challenging due to its lack of explicitness; external knowledge is thus effectively internalized through various efforts to explore and absorb more of its tacit dimension, such as in-house R&D activities and learning-by-doing practices. A simple adoption of external technology would not lead to a fruitful learning, unless it is accompanied by intense assimilation and recreation practices. In this sense, learning is more than mastering acquired knowledge and skills.

Building and improving technological capabilities is not an option but a “must” for a firm’s sustainable growth (Lall, 1992). Without strong technological foundations, the low-cost advantage, which latecomers from the developing world often possess thanks to location-specific factor prices, may be fragile, as it is sensitive to various external conditions that the latecomers themselves cannot control. More stable sources of a firm’s growth can be created when the location-specific advantage is transformed into a firm-specific one (Dunning, 1977). Technological capability is at the heart of this transformation process, and the developing world has had serious concerns about how to nurture local technological capabilities (Wesphal *et al.*, 1985; Dahlman *et al.*, 1987; Amsden, 1989; Wade, 1990; Kim, 1997).

### **3.2. FDI and Its Impacts on Host Economies**

Is FDI’s net-impact on host economies positive or negative? A substantial body of literature has explored this question, but conclusive answers are not yet established. From a host economy’s perspective, FDI is a double-edged sword as potential positive and negative dynamics coexist in it (Aitken and Harrison, 1999). On the one hand, FDI may induce positive spillovers in host economies. The local presence of foreign firms can help domestic firms improve their productivity and market performance through official transfers of advanced technology and know-how or through the unintended spillover mechanism. FDI-driven output growth can also lead to an improvement in intermediate sectors’ competitiveness in terms of scale and output quality. On the other hand, FDI may have crowd-out impacts on host economies. MNCs’ market entrance may weaken indigenous development dynamics by encroaching on domestic firms’ market share. Shrunk market share can push local firms into operation at a sub-optimal scale, which, in turn, is likely to weaken their market positions further and discourage new investments

by local players. As the net of the two opposing forces—the spillover and crowd-out effects—can differ by location, sector, and time, FDI's impact on host economies is hard to generalize (Javorcik and Spatareanu, 2005).

The spillover effect can happen either in horizontal or vertical directions. Horizontal spillovers occur between MNCs and their local competitors. Besides official technology transfer arrangement, local firms may be able to improve their productivity or product quality by imitating MNCs' production technologies or marketing skills through market research (Blomström and Kokko, 1998), whose process can be accelerated by labor mobility between indigenous local players and foreign-invested firms (Blalock and Gertler, 2005). In some cases, more intense market competition, triggered by MNCs' market entry, can encourage local firms to be more productive and innovative (Blomström and Kokko, 1998). This type of spillover, however, may be quite limited in reality, because MNCs tend to minimize the possibility of horizontal spillover by tightening controls over their intellectual properties (Javorcik, 2004) or by monopolizing local talents through high wages (Lipsey, 2004).

Spillovers can also happen vertically. MNCs may be willing to provide local parts suppliers with opportunities for technical assistance or professional training, if they are closely related through forward/backward linkages. Also, high quality-standards for local procurement, set by MNCs, can indirectly contribute to local firms' technological development (Lall, 1978; Moran, 2001). Moreover, MNC-generated local demands can help local firms achieve higher economies of scale (Moran, 2005). Vertical spillovers face fewer obstacles than horizontal spillovers, because the former are often mutually beneficial to both MNCs and local firms: better local parts lead to higher quality final goods. Thus, vertical spillovers are more frequently found in reality than horizontal ones (Javorcik and Spatareanu, 2005).

A set of empirical studies test FDI's net-impact on host economies, but the test results somewhat diverge (Table 1). While many studies found statistically significant positive links between the presence of FDI and the productivity of host economies, others found negative correlations between them or failed to find any significant relationships. Inconsistent outcomes in the table may reflect some methodological issues. One example is measurement errors and the uncertainty involved in data or in some key parameters (e.g., output and productivity measures) of the testing models (Lipseý and Sjöholm, 2005). Another example is ambiguity in the direction of causality. When a statistically significant, positive relationship exists between FDI stock and sector-specific local productivity, it is often hard to tell whether more foreign firms enter the sector where local productivity is already high enough, or the local productivity is high due to the strong presence of foreign firms (Rodrik, 1999).

The different results, however, may simply suggest that FDI's net-impact cannot be generalized as it is a function of certain country-specific or industry/firm-unique conditions. In general, FDI inflows create larger positive externalities when host economies share similar socio-economic conditions with MNCs' home base (Lipseý and Sjöholm, 2005). If local firms and MNCs have too large a gap in terms of productivity or technology, local competitors are likely to be crowded out of the market even before taking advantage of FDI-generated spillovers, and MNCs may be discouraged from generating positive spillovers as it is too costly. This view partly explains why a large fraction of FDI falls into the North-North FDI category.<sup>8</sup>

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<sup>8</sup> According to the author's calculation based on World Bank (2006) and the World Development Indicator Database, over three quarters of the total cross-border direct investment flows were among advanced economies, as of 2002. See Chapter 2 of Nam (2010) for further details.

### 3.3. The Joint Venture for Strategic Alliance

The JV is an institutional means by which multiple business entities form a strategic alliance to create synergy (Kale *et al.*, 2000). A strategic alliance can take either a non-equity coalition form or an equity-sharing collaboration form. In general, the latter type of alliance creates sturdier inter-organizational ties as the sharing of financial interests reduces the possibility of opportunistic behaviors and raises the level of each party's commitment to the partnership (Scherer, 1980). For this reason, the JV, a typical form of equity-sharing alliance, is often considered as one of the most effective institutional means to form a solid inter-firm partnership (Mowery *et al.*, 1996).

The primary purpose of the JV-based alliance is often more than financial interests (Oliver, 1990). Many firms use the JV arrangement for mutual learning purposes, in addition to incentives for risk and uncertainty management, high scale economies, and low-cost market entry (Inkpen and Beamish, 1997). The JV allows its stakeholders to exchange their mutually complementary assets and to internalize external knowledge and skills (Hamel *et al.*, 1989; Mody, 1993). The JV-mediated technology transfer is often more effective than other transfer arrangements based on market transactions because it can be more inclusive of tacit dimensions of knowledge, with intense intra-JV collaboration and interactions (Mohr and Spekman, 1994).

The JV-mediated knowledge sharing does not always hold a successful learning promise, however. The outcome instead depends on various factors including the degree of expected synergy between alliance partners. When each JV partner owns a comparably strong and complementary core competency—in terms of primary business fields, in-house capabilities and skills, or proprietary assets—JV partners are more willing to share their internal and exclusive resources with each other (Mowery *et al.*, 1996). This tendency is more so for a manufacturing JV,

because it often involves horizontal technology transactions and is motivated to pool differential abilities or knowledge among competitors (Kogut, 1989). A strategic alliance that lacks a balance in core competencies is fragile, as motivation to compete may overshadow incentive to cooperate within the partnership (Park and Ungson, 2001). If the primary motivation for the alliance is mutual learning, inter-dependency, reciprocity, and balanced bargaining positions among alliance partners are particularly important for its fulfillment (Oliver, 1990; Lane and Lubatkin, 1998). Also, the outcome depends on the degree of similarity in culture, organization, and knowledge base between JV partner firms (Barkema *et al.*, 1996; Inkpen, 2000). The JV is likely to generate more positive outcomes when its stakeholders are very similar in terms of these characteristics.

### **3.4. Implications for This Study**

The following implications can be drawn from the review of the three sets of literature outlined above.

First, a latecomer should nurture, as emphasized in the development-study literature, at least three kinds of technological capabilities (production, project-execution, and innovation capabilities) to become a global player, and needs to utilize its production capability as sources for upgrading project-execution and innovation capabilities. In particular, the dynamic and interactive mechanism, through which production capability leads the project-execution and innovation capability-building process (or the other way around), is critical in cultivating and upgrading overall technological capability.

Second, a substantial body of the FDI literature presents empirical evidence of the positive correlation between the strong presence of FDI and the high market-performance of firms and industries in FDI-hosting economies, but the direction of causality behind the

relationship is uncertain. Even when the efficiency of a host economy is assumed to be a function of FDI flows or stock, it is still not clear whether the FDI-driven efficiency increase in the host economy is from the spillover effect (i.e., improvement in local firms' efficiency due to the presence of FDI) or from the crowd-out effect (i.e., replacement of local firms by foreign-invested firms). Accordingly, the FDI-based learning model involves great uncertainty as to its success, because the sign (i.e., whether FDI's net-contribution is positive or negative) and extent (i.e., where FDI can contribute and where else it cannot) of FDI's net-contribution to the host's technological capability-building process has not yet been examined thoroughly or depends on various local conditions.

Finally, the management literature demonstrates that the JV arrangement is most likely to work well for mutual learning purposes, when each JV partner has comparably valuable and complementary technological assets and capability. It is ambiguous, however, whether the JV can still serve the same purpose if such a condition is not met. Accordingly, it is highly uncertain how much a firm lacking knowledge-based core competencies can benefit from a JV partnership with technological leaders in terms of its technological capability-building process.

#### **4. Case Study: Sino-foreign Automotive Assembly JVs**

Using the case study of SVW and SGM, this section discusses the strength and weakness of the IJV arrangement as an institutional vehicle to build local technological capabilities. The following analysis focuses on why even a successful local IJV operator has experienced some bottlenecks in upgrading its technological capabilities beyond a certain degree.

##### **4.1. China's Passenger Car Sector in Brief**



China has adopted an eclectic approach for its automotive sector development, which is somewhere between Korea's independent model and Latin America's FDI-based model.<sup>9</sup> The

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<sup>9</sup> Korea and Latin American countries differed in terms of the degree of reliance on FDI in their automotive sector development. On the one hand, the Korean government minimized influence of multinational automakers on its domestic market by imposing strict control over foreign ownership of Korea-based assembly operations (Green, 1992). Restricted foreign ownership—in addition to Korea's small domestic market, government-controlled market entry, and other public policies demanding MNCs' strong commitment to the local industrialization drive—was a primary factor that discouraged MNCs from investing in Korea's auto sector. Nonetheless, the Korean government has maintained its position of encouraging technological “self-reliance” and moving away from foreign dominance in the local passenger vehicle sector. Selected MNCs were allowed to acquire the majority share of local assembly operations only after Korea introduced the more liberal policy options required as a condition of the International Monetary Fund's bailout package in the late 1990s (Shin and Chang, 2003). At that time, however, the Korean government was little concerned about potential foreign dominance in the sector because Hyundai Motor—Korea's leading automaker holding a dominant share in the local market—had already grown into a global player with competitive in-house technological capabilities by then.

On the other hand, Latin American countries with sizable auto production bases, such as Brazil and Mexico, employed FDI as catalysts for their auto sector modernization and development (Shapiro, 1991; Morano-Brid, 1996). These countries tended to focus on import substitution and export promotion, with little emphasis on the ownership matter. In most parts of Latin America, MNCs could control overall aspects of their local assembly operations or subsidiaries without being subject to foreign equity ownership regulations, as long as they agreed to meet required localization schedules and other performance standards. As a result, local assembly operations, in which multinational automakers have full or majority stakes, have dominated local passenger vehicle markets in Latin America. In terms of FDI-hosting arrangements, India's experience in auto sector modernization overlaps with the Latin American model: the Indian government, since its 1991 liberalization policy, has allowed MNCs to control full or majority shares in local auto assembly operations in exchange for their high degree of commitment to localization and export activities (Okada, 2000).

Chinese government has granted foreign automakers access to its domestic market but only through one particular form of FDI arrangement—IJVs in partnership with Chinese automakers, where the upper threshold of the total foreign equity share in each IJV is strictly controlled at 50%. This IJV arrangement, strategically chosen for the main purpose of gaining access to advanced skills and knowledge (SDPC, 1994), was expected to fulfill China's ultimate aim at incubating technologically competitive local automakers (NDRC, 2004).

This controlled inward globalization model was effective in the stage of import substitution (IS). Since the arrival of the American Motors Corporation—the first foreign automaker that established a Sino-foreign automotive JV—in 1983, China took only a quarter of a century to create the world's second largest domestic passenger-car market and to build the world's third largest output capacity. Since 1997, almost the entire local passenger-vehicle demand has been fulfilled by domestic-produced volume, and local passenger-car makers have carried out a substantially high portion of their value-added activity within China. The increasing export volume of domestic-produced passenger cars demonstrates that China's passenger car sector has also developed the capability to meet globally competitive productivity and quality standards.<sup>10</sup> As illustrated by these facts, the Chinese automotive sector achieved an impressive IS outcome within a short period of time.

As noted earlier, however, it is questionable whether the FDI-based model has provided Chinese automakers with an effective vehicle for technological catch-up beyond the IS stage. In its 2004 automotive industry policy, China's central government acknowledged that its exchange-

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<sup>10</sup> In 2009, 122,874 units of passenger vehicles produced in China were exported to other countries. Among them, 55,206 units (45%) went to advanced economies such as North America, Western Europe, and Japan. *Source:* Computed from Fourin (2010).

market-for-technology strategy ultimately failed to meet its aims, given that Sino-foreign JVs functioned as no more than local assembly bases for MNCs, and that the local firms operating the IJVs still lacked in-house technology-development capability (Chen and Zhang, 2004; Lu and Feng, 2005; Gallagher, 2006). The situation is not much different now; most Chinese automakers still depend on foreign firms for technology, and foreign-licensed passenger vehicles capture roughly two-thirds of the domestic market (Fourin, 2010).

Then, why is it the case that the same IJV-based catch-up model may be less effective in the post-IS upgrading stage than in the earlier IS stage? A primary reason may be that the IJV arrangement by nature is effective in nurturing local production capability, which is most crucial in the IS stage, but less effective in promoting local capabilities for other dimensions of the overall technological capability such as capabilities for project execution and innovation, which are also essential in the post-IS upgrading stage. The following case study of SVW and SGM will shed light on the validity of this hypothesis.

## **4.2. Sino-foreign JVs and Horizontal Knowledge Flows**

In Section 4.2., I examine how SVW and SGM have helped SAIC nurture each of the three segments of technological capability: production, project execution, and innovation.

### **4.2.1. Nature of the Sino-foreign JV Arrangement**

Each Sino-foreign JV is a semi-permanent project that is subject to renewal every two to three decades, with the approval of the Chinese central government. In the renewal process, terms and conditions for each JV are supposed to be renegotiated by the JV equity holders. Foreign parties combined cannot claim more than half the total equity of each JV. Literally, each equity holder

has the right to participate in the management of JVs in proportion to its share in total equity. Foreign automakers have accessed China's domestic market under the IJV arrangement, while not being allowed to operate wholly-owned assembly subsidiaries. Before China's accession to the WTO in late 2001, the domestic passenger-car market was highly protected against foreign imports through various public measures like import quotas and tariffs.

Each Sino-foreign JV exists as a separate business entity; it belongs to neither of the JV partner firms. Sino-foreign JVs have their own assets and resources, none of which are under the direct control of each JV partner firm. Their internal assets, including technologies and production equipment/facilities, should be utilized only for the IJVs' own good without being taken advantage of by other business entities, including IJV equity holders. Each Sino-foreign JV also recruits its own people and operates internal training programs for its hires. Similar to other tangible assets, human resources are the IJV's own asset; job rotations between each JV and its stakeholder firms are strictly prohibited. That is, the JV employees are not allowed to work for other business entities at the same time. The only direct connection between JVs and JV partner firms exists at the top management level. Each Sino-foreign JV's top management board consists of several delegates from each JV stakeholder. The number of board members reserved for each JV stakeholder is determined according to its share in the total JV equity. Except for top management, official resource-sharing channels do not exist between Sino-foreign automotive JVs and their equity holders.

Under this arrangement, technology-related knowledge flows are quasi-delinked between each IJV and its Chinese equity holder (Figure 2). Foreign JV partners transfer their product-specific technologies to their JVs for local production of the chosen vehicle models. In many cases, foreign members of the IJV management board are recruited from their headquarters' (HQ)

development or engineering department in order to handle such technology transfer processes smoothly and to manage technical affairs within the JV skillfully. In contrast, the Chinese side typically sends its management or marketing people to the JV. To achieve technology transfer, frequent interactions are necessary between the JV and its foreign JV partner. The MNC HQ often sends its own engineers to the JV to assist the JV-hired engineers and shop-floor workers technically so that the transferred technology can be adopted for local production. Human resource exchanges in the opposite direction are not rare, either: JV engineers are often sent to the MNC HQ for training purposes. Accordingly, each Sino-foreign JV can secure an official learning channel in improving its production capability.

This knowledge-transfer process, however, does not leave much room for the Chinese JV partner firm. It has little to offer its JV from a technical standpoint, and it is not allowed to take advantage of the JV's improved technological capabilities, thanks to the technology transfer. Perhaps this practice deviates somewhat from the ideal IJV model that the Chinese government imagined when it formulated the IJV-based catch-up strategy, as skills and know-how accumulated within the IJVs have remained quasi-external to local firms.

#### **4.2.2. IJVs and Production Capability**

SVW and SGM conform to the above-described Sino-foreign JV arrangement. Both SVW and SGM are independent business entities, which hire their own personnel and operate and manage their own assets. SAIC has half the total equity share for each JV, and its delegates in each JV's management board are mainly in charge of human resource management, local procurement (except for key capital goods for production), product sales and marketing, and government relations. Volkswagen (VW) and General Motors (GM), whose representatives are primarily

responsible for the IJVs' technical affairs, control the other half of SVW and SGM's equity. As of 2009, all of both IJVs' products were respectively VW- and GM-branded vehicles.

SVW, founded in 1985, began its operation with the assembly of imported, completely knocked-down (CKD) kits for the Santana<sup>11</sup>, a mid-sized sedan based on VW's 1982 technology. Its beginnings were humble. For the first five years of its operation, SVW used the remodeled Shanghai Tractor and Automobile Corporation (STAC) manufacturing facilities, which were SAIC's non-cash contribution to the JV, without having its own assembly plant. The initial STAC factory with a labor-intensive assembly line had an extremely limited annual production capacity of 5,000 vehicles. Over the next several years, VW renovated the plant to expand SVW's CKD assembly capacity to the level of 75,000 units a year, but SVW's productivity in early periods of its operation was as low as 100 vehicles a day (Posth, 2006).

The lack of skilled labor, as well as dated manufacturing facilities, was responsible for the low productivity. When SVW was in its initial operation, most of its shop-floor workers were rural junior high school graduates without much practical vehicle production experience (Long, 1996). VW sent 35 to 65 German engineers to Shanghai under three-year contracts in order to train local production workers (Posth, 2006). SVW offered new hires a three-year on-the-job training program, consisting of both lectures and practical training on modern automobile-production system and their missions in SVW's actual production lines (Long, 1996). Only those who completed the three-year training program were placed on production lines (*ibid.*).

After its first modern plant began operations in April 1990, SVW's overall productivity improved substantially. In contrast to the renovated STAC factory, SVW's Shanghai No. 1 plant

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<sup>11</sup> The original Santana CKD kit consisted of 5,200 parts and components (Posth, 2006).

was built on modern technologies, not only for vehicle and engine assembly but also for other core production processes including pressing, stamping, welding, and painting. SVW's annual production volume increased over seven times, from 15,688 units in 1989 to 115,316 units in 1994, when the Santana assembly line was completely transferred to the new plant with an annual production capacity of 100,000 vehicles and 180,000 engines (Figure 3). This growth was accompanied by SVW's active efforts at localization. By the end of 1994, SVW achieved a local-content ratio of 86% for the Santana model (for further details, see Section 4.3. below). With the higher local-content ratio, SVW's output capacity was less constrained by the internal foreign exchange reserves that could be mobilized to import CKD kits from Germany.

Rapid output growth was driven not only by increased capital efficiency (the introduction of modern manufacturing equipment and facilities) but also by improved labor productivity at the plant level (as a result of VW-initiated on-the-job training). In order to demonstrate an improvement in SVW's production capability, I use the trend of annual output volume per worker between 1990 and 1994 as a substitute for the plant-level learning curve of the same period, which I cannot draw due to a lack of data. Analysts may claim that the accumulation of labor's production skills and know-how was the main driver of the increase in the per capita output volume during the period because SVW produced only one vehicle model (Santana) and there was no further production capacity expansion until the end of 1994 (Figure 4; see also Figure 3). In other words, capital- and technology-related variables can be controlled during the period. SVW's annual output volume per worker increased dramatically from 6.1 units in 1990 through 12.8 units in 1992 to 17.0 units in 1994 (Figure 5). A large fraction of this increased efficiency resulted from the improved labor productivity, driven by knowledge transfer (through on-the-job training and technical assistance) and the mastery of the transferred know-how and skills through

actual production practices.

Despite the plant-level productivity increase, SAIC wanted more than what VW brought to SVW. One thing that SAIC demanded from VW was more advanced technologies than were currently being used, and their frequent updates. By 2000, SVW finished constructing the foundation of its current production bases: four manufacturing plants in Shanghai and Nanjing, with a total annual production capacity of over half a million vehicles (see Figure 3). Nonetheless, SVW produced only one vehicle model until it added Santana 2000, a minor-upgraded version of the original Santana, to its product lineup in 1995; SVW produced only these two models until 1999, when its regional rival, SGM, began its initial vehicle production (see Figure 4).

The original Santana was a four-door mid-size sedan (the second-generation Passat), which was sold in advanced markets between 1981 and 1989 (Edmonds, Inc., 2010). From SAIC's perspective, the dated Santana model needed to be replaced by newer vehicle models adopting more advanced technologies (Gallagher, 2006). VW, however, did not share this strong need because Santana was still selling well—in 1998, for example, SVW captured 46% of China's domestic market with Santana's two sister models—primarily due to SVW's oligopolistic market position.

Another issue obvious to SAIC was SVW's lacking in-house technology-development capability. When the Chinese government and SAIC signed the IJV project with VW, they expected that SVW would follow a sequential evolutionary path from a CKD kit assembler through an original equipment manufacturer (OEM) to an original design/brand producer equipped with independent in-house vehicle development capacity. But even a decade after its initial operation, SVW was no more than one of VW's multiple global auto-assembly bases lacking R&D capability. From VW's perspective, SAIC's desire to bring more in-house technical



functions to SVW was not feasible in every sense. In the first place—even besides additional capital investment in development and testing equipment—SVW would have to hire a sizable number of German engineers for new vehicle development purposes, each of whom would demand over 100 times higher wages than an average local SVW worker received in the late 1980s (Posth, 2006). Although the exact number for SVW is not available, the estimate by the American Motors Corporation (AMC), the foreign equity holder of the Beijing-Jeep company, sheds light on how much SVW's comparable local R&D efforts would cost: in the mid-1980s AMC estimated that it would cost an additional US\$200 million for local R&D and engineering activities alone, if it initiated a new vehicle development project in China, besides an additional capital cost of US\$800 million for the modernization of manufacturing machinery and facilities and testing equipment (Mann, 1997). Equipping SVW with vehicle-development capabilities was not easily justifiable from a cost-effective perspective either, given that VW already had a number of vehicle models that could be immediately introduced to China's market.

Such a conflict of interests pushed SAIC to consider a new JV project with GM in 1998. From SAIC's standpoint, the primary purpose of the deal was to create larger maneuvering space within the IJVs by inducing competition between VW and GM (Gallagher, 2006). As a latecomer to China's market, GM was active in its JV partnership with SAIC, the local market leader. GM promised to bring its up-to-date technologies to its JV and establish a sizable technical center in China. As promised, GM introduced contemporary Buick lineups to China through SGM, and established a sizable China-based technical center, the Pan Asia Technical Automotive Center (PATAC), in a separate JV partnership with SAIC. GM's active market-entry strategy effectively incentivized VW's strengthened local commitment. VW's response came rapidly; shortly after GM's arrival in Shanghai, SVW extended its product lineup, and introduced more advanced

technologies, although the dated Santana model was still produced until 2008 (see Figure 4).

At present, SGM has four manufacturing plants in three locations: two in Shanghai, and one each in Yantai and Shenyang. The two Shanghai plants, which in combination have an annual production capacity of 320,000 vehicles and 200,000 engines, are the central production base for SGM (Figure 6). The Yantai and Shenyang plants were renovated from acquired production facilities, due to SGM's urgent need to expand production capacity before the completion of its second Shanghai plant. In contrast to SVW, SGM began its operations with modern manufacturing facilities, skipping the CKD assembly stage.<sup>12</sup> In accordance with the then-local-content regulation of 40% for the initial year of production, SGM's first Buick sedan sourced around half its final output value locally; SGM's Sail model, launched in 2001, even achieved a 70% local-content ratio in the year of its market debut. SGM owed this outcome substantially to SVW's early localization efforts; the latecomer, with the mediation of SAIC, could share the first-mover's primary local supply partners (Tao, 2005).

As a second mover, SGM also benefited from the solid pool of semi-skilled labor in Shanghai. By the late 1990s, Shanghai already became the center of China's passenger vehicle manufacturing sector, thanks to SVW's enormous market success. The SVW-provided training program and first-hand manufacturing experience enriched Shanghai's local pool of semi-skilled labor with good knowledge of and experience in modern automotive manufacturing. When SGM began operations, a significant number of its production workers were ex-SVW employees, which in fact caused a substantial conflict between VW and SGM's two stakeholders—SAIC and

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<sup>12</sup> In China, imported parts and components are not considered CKD kits, if they are for a vehicle model, whose local-content ratio is over 40%.

GM (Tao, 2005). Of course, SGM had its own job training and technical assistance programs for its hires, but it clearly began the market race from a high starting point, on the foundation of pre-existing local infrastructure developed by the first mover.

Although sufficient information to draw SGM's plant level learning curve is not available, a rough guess of SGM's improved production capability can be made with the available output and employment data. As illustrated in Figure 6, SGM had only one manufacturing plant (Jinqiao North) in Shanghai until its Jinqiao South plant began operations in May 2005. Given that SGM's Jinqiao North plant had a production lineup of only one to three vehicle models between 1999 and 2004 (Figure 7), I attribute part of the changes in annual output volume per worker during the same period to changes in labor productivity, caused by internal training program and subsequent learning-by-doing practices. Except for the first year of the period, when SGM's employment increased by roughly 50% from 2,075 in 1999 to 3,011 in 2000, annual output volume per worker in SGM's Jinqiao North plant continuously increased by substantial margins, from 11.4 in 1999 through 31.2 in 2002 to 36.0 in 2004 (Figure 8). This fact in part shows that SGM engineers and production workers have accumulated skills and know-how necessary to utilize existing manufacturing facilities and equipment efficiently, and to optimize existing production technology.

In sum, the SVW and SGM case demonstrates that the two IJVs have developed in-house production capability on the basis of technologies and relevant technical support provided by VW and GM. The primary incentive for the technology transfer was to raise the plant-level productivity and product quality by helping the IJV workers take advantage of existing manufacturing facilities and equipment. With the foreign partner firms' technology transfer, both

SVW and SGM currently produce export-quality products at competitive cost<sup>13</sup>, and this gives rise to a critical improvement in local production capability.

#### **4.2.3. IJVs and Project-execution Capability**

There is evidence that SAIC has also accumulated certain degrees of project-execution capability from its JV partnerships with VW and GM. Until 2009, there were five major expansions in SVW's and SGM's production capacity (excluding the case of acquisition-based capacity increases) and SAIC actively participated in each project (Table 2; see also Figures 3 and 6). The division of labor between SAIC and its foreign JV partners was clear in each expansion project. On the one hand, foreign JV partner firms were responsible for the overall assembly design and machinery procurement for each manufacturing plant. VW and GM provided their JVs with the assembly-line drawings and related technical assistance, and were in primary charge of procuring manufacturing equipment for the new plants. On the other hand, SAIC took charge of the construction management and engineering. The pre-investment feasibility assessment and the actual plant construction work for each project were carried out by the Shanghai Institute of Mechanical and Electrical Engineering (SIMEE), one of SAIC Group's wholly owned subsidiaries.<sup>14</sup>

This pattern of intra-JV division of labor seems natural in light of each party's comparative advantage. As SVW and SGM produce VW and GM's products, respectively, the former's manufacturing facilities necessarily need to reflect the latter's production technologies. The

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<sup>13</sup> In 2006, SGM exported 3,350 units (SAIC, 2006), for example, and part of the SVW-produced volume has been exported to the Asia, Australia, and North America market since 2004 (Interview #4).

<sup>14</sup> Interview #4.

knowledge gap between the foreign and Chinese JV partners regarding the technologies restricted SAIC's involvement in some core tasks in each investment project such as designing assembly lines and procuring appropriate capital-goods providers. However, SAIC played a leading role in the actual construction phase. With half a century of manufacturing experience<sup>15</sup>, SAIC was capable of managing and mobilizing internal and other local resources effectively so as to complete the projects on time and within budget.

From the plant-expansion projects, SAIC could improve part of its project-execution capability to a certain degree. SAIC had accumulated project-execution skills internally by involving SIMEE in SVW and SGM's major investment projects. An improvement in SAIC's project-execution capability is partly evidenced by the time SIMEE spent in completing each expansion project: obviously, the more SIMEE worked for SAIC's JVs, the sooner it completed its mission. When SIMEE undertook the construction and manufacturing preparation work for SVW's No. 1 plant, it took over five years to build the manufacturing facility to an annual production capacity of 100,000 vehicles and 180,000 engines (See Table 2). However, it spent only three years and two months completing its construction work for a bigger manufacturing plant with an annual production capacity of 200,000 vehicles and 270,000 engines (SVW No. 2 plant). The most recent SVW plant began operations in two years and five months from the onset of the project. Similarly, SGM's two main plants were completed in two years and three months (Jinqiao North) and in one year and nine months (Jinqiao South), respectively.

However, the project-execution capability that SAIC was able to improve from its IJV experience was *partial* at best given that SAIC did not have a chance to accumulate its skills and

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<sup>15</sup> The precursor of the current SAIC Group was founded in 1958.

experience for basic and detailed project engineering tasks. SAIC's role has been marginal in such segments of the JV-related investment projects because they should reflect the JV-adopted foreign technologies. This SAIC case presents a striking contrast to the Hyundai Cement Company (HCC) case, which Amsden (1989: 266-267) describes as an example of an ideal path of accumulating project-execution skills. When HCC, a subsidiary of the Hyundai Group, completed building its initial plant in 1964, five out of six key tasks (except for the actual construction)—basic engineering, detailed engineering, procurement, supervision, and start-up—were done by U.S.-based Allis Chalmers. But the Hyundai Group tried to be involved in as many aspects of HCC's initial plant erections as possible, with a separate consulting contract with Fuller Company of the U.S. As a result, when HCC expanded its initial plant in 1968, the Hyundai Group was fully in charge of procurement and supervision, as well as construction. In HCC's second plant expansion in 1974, the Korean firm's involvement was even broader: the Hyundai Group was exclusively or jointly responsible for five out of the six stages, excluding basic engineering. Unfortunately, this kind of learning process is not found in SAIC's plant expansion projects: the division of labor was still clear between SAIC (construction portion of the projects) and its multinational JV partner firms (technical portion of the projects) regardless of accumulated plant expansion experience. This is primarily because SAIC's IJVs are set up to use foreign technologies, not SAIC's: foreign JV partner firms always know about their own technologies better than SAIC, and thus it is no wonder that plant expansion projects, which should reflect foreign production technologies, have been led by the foreign firms while allowing SAIC minor roles in the technical portion of the projects.

#### **4.2.4. IJVs and Innovation Capability**

Like other Sino-foreign JVs, the two SAIC-affiliated IJVs have adopted VW and GM's technology under the official license contracts. Foreign automakers have ruled out JV-initiated new vehicle development, primarily due to its low financial feasibility. From an objective standpoint, the current OEM production model may be ideal for Sino-foreign assembly JVs, as it is cost-effective and time-saving. Accordingly, foreign automakers' other investment strategies have been formulated given this OEM production model. At present, basic R&D functions, necessary to develop new vehicles internally, are quasi-nil in most Sino-foreign JVs. Foreign automakers' non-manufacturing investment in their JVs has been limited to engineering support for the local adaptation of the imported technologies, such as slight modifications of vehicles' interiors to suit local tastes.<sup>16</sup> SVW is no exception to this trend.

SGM's case, however, somewhat deviates from the above explanation. Until now GM has invested in China-based engineering capability more actively than any other foreign automakers. PATAC is the showcase of GM's efforts at more comprehensive knowledge transfer. Since its founding in 1997, PATAC has been involved primarily in local adaptation of GM's passenger vehicle models (e.g., interior/exterior modifications) and vehicle safety testing. Literally, PATAC and SGM are two separate business entities, but they have developed strong business ties. Initially, around three-quarters of PATAC's business was done for SGM, and the share further increased to over 90% after SGM's development center was consolidated with PATAC's in 2003.<sup>17</sup> Recently, GM has expanded PATAC's scale and functional coverage substantially. The initial US\$50 million JV now owns total capital assets worth US\$300 million,

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<sup>16</sup> Interviews #1, 3, 5, 6, 12, 16, 21, 23, 24, and 25.

<sup>17</sup> Interviews #2 and 3.

and its employment level increased four-fold from 400 in 2002 to 1,600 in 2009 (Y. Li, 2009). With its rapid external growth, PATAC has redefined its primary missions: as of 2009 PATAC engineers were also carrying out part of the concept car and platform development projects for SGM's future passenger vehicle lineups. In 2008, GM officially announced that it would equip PATAC with independent in-house vehicle development capabilities by 2010 (*ibid.*)<sup>18</sup>, although this plan is being met with skepticism because the U.S. government has prohibited the public loan made to rescue GM from bankruptcy from being spent on the firm's global business expansion (Bradsher, 2009a).

In the case of SGM, there is evidence that its foreign equity holder will substantially expand China-based vehicle development and engineering activities beyond modest technology adaptation works. SAIC's experience with SGM and PATAC might have been an asset, to a certain extent, when it launched its first self-branded passenger vehicle in 2005. But this point should not be exaggerated given that PATAC—SGM's engineering arm—still has only limited technological capacity by global standards. Also, SGM's case is an exception rather than a typical example. Other foreign firms have made far less investment in local technology development activities than GM (Nam, 2010). In the first place, foreign firms have not carried out critical basic R&D activities or new product development projects in China, and accordingly, there is little evidence that the Sino-foreign JV practice has significantly upgraded local JV partner firms' innovation capabilities. This finding coincides with Gallagher (2006)'s main conclusion from her study of three Sino-American automobile JV projects that U.S. FDI brought modern vehicle models into production in China, but without visible contributions to local innovation capabilities.

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<sup>18</sup> Also confirmed with Interview #2.



Of course, SAIC itself may not be free from the blame for its weak innovation capability. At least until China's central government began to emphasize independent technology development in its 2004 automotive policy, it is hard to tell that SAIC tried hard to take advantage of its IJV experience to develop its in-house technological capabilities. For example, starting in 1964, for 27 years, SAIC produced only one vehicle model SH760—a reverse-engineered version of the 1956 Mercedes 220S model—without significant technological upgrades, and in 1991 when SVW's business was on the right track, SAIC simply abandoned this model, instead of upgrading, to focus on its IJV business (Posth, 2006). Obviously for a long period SAIC itself was not strongly motivated for in-house technology development.

However, when the SAIC management considered the revival of its independent vehicle development projects in the early 2000s, it could not take advantage of knowledge and skills accumulated within the IJVs and neither VW nor GM responded positively to its request for help. A SAIC manager commented that:

When we decided to relaunch our own brand sedans in the early 2000s, we found out that there was little we could benefit from our IJV experience. As SVW and SGM are not SAIC subsidiaries under our control, we could not share IJV-trained human resources or IJV-possessed foreign technologies for our own vehicle development projects. Neither VW nor GM was willing to license their up-to-date platform technologies to us.<sup>19</sup>

Then, he continued:

In this situation, we made lots of efforts to attract the best people in China's auto sector to strengthen our in-house vehicle-development capabilities. We scouted top engineers from SVW, SGM, and PATAC with competitive incentive packages, and even from our local rivals, such as FAW and Dongfeng. But we still needed base technologies to start from. We had to seek alternative technology sources—a series of

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<sup>19</sup> Excerpted from Interview #19.

SAIC's foreign asset acquisitions were done for this purpose.<sup>20</sup>

The episode described above provides some clue that SAIC at least tried to utilize learning outcomes accumulated within its IJVs for its independent technology development. But it is highly ambiguous whether SAIC actually benefited from such efforts in developing its own brand vehicles. In fact, the first two of SAIC's own brand models, Roewe 550 and 750, were based primarily on platform technologies acquired from Rover with the technical support of Ricardo 2010, a then-British automotive consultancy hiring over 300 ex-Rover engineers.

The last point that I would like to highlight is the sequence of events that occurred between PATAC's functional expansion and SAIC's improved in-house vehicle development capability. When GM decided to strengthen its joint R&D activities with SAIC through PATAC in 2008, SAIC already possessed substantial in-house vehicle development capability based on technologies and human resources acquired from Rover, as evidenced by the market launch of Roewe 750—the first of SAIC's own brand models—in 2007.<sup>21</sup> In other words, in terms of the direction of causality, it is more likely that GM came closer to SAIC because SAIC had better innovation capability, rather than that SAIC developed better innovation capability because GM came closer to SAIC. In addition, a strategic concern about growing emerging markets may have affected GM's sympathetic view of China-based R&D. From GM's perspective, expanding PATAC's R&D capacity may be a more time- and cost-effective option to strengthen its market position in China and other emerging markets than using Detroit's resources, given that GM has been incompetent in making profits by producing compact vehicles, crucial in emerging markets

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<sup>20</sup> Excerpted from Interview #19.

<sup>21</sup> For outward FDI's contribution to SAIC's in-house technology development, see Chapter 2 of Nam (2010).

(Muller, 2010). GM has shown a great interest in using PATAC as an outpost to take advantage of SAIC's capability to make profits by producing compact vehicles (*ibid.*).<sup>22</sup> GM ultimately aims to employ PATAC as its regional R&D hub, which would mitigate GM HQ's R&D burden on the Asian market.<sup>23</sup> Kevin Wale, President of the GM China Group, confirmed the expanding role of PATAC in GM's global strategy by commenting that:

PATAC's capability in design and development of cars has grown substantially over the last few years. We have seen there are similar requirements in other parts of the world for products that PATAC is involved with. ... PATAC is continuing to take a stronger and stronger role in our world presence because it's naturally maturing and also because of the absolute size of the China market.<sup>24</sup>

Another signal showing that GM has begun to look at SAIC as a critical strategic partner is GM's recent decision to establish a new 50-50 automotive assembly JV in India, in alliance with SAIC (Bradsher, 2009b).

In sum, even the best practice of the Sino-foreign JV arrangement does not weaken the argument that foreign automakers' investment in local R&D is a function of the pre-existing local innovation capability, rather than the other way around. Until now, the dominant Sino-foreign JV business model—a quasi-OEM production system where the IJVs manufacture foreign-licensed vehicle models in accordance with the drawings and specifications provided by leading global automakers—has failed to make critical contributions to local innovation-capability building. The

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<sup>22</sup> SGM-Wuling, which is an IJV project between SAIC and GM separate from SGM, is a good example. SGM-Wuling's primary product is the Sunshine utility vehicle, whose price ranges between US\$4,500 and US\$9,000 and which sold 597,000 units in 2009. SGM-Wuling reported a pretax profit of RMB2 billion (roughly US\$300 million) in 2009.

<sup>23</sup> Interview #2.

<sup>24</sup> Quoted in F. Li (2009).

IJV model by nature does not need local engineering capability beyond a minor local adaptation of imported technologies, and Sino-foreign JVs, by and large, have remained assembly-specialized operations, lacking the abilities and means to nurture local innovation capability.

#### **4.2.5. Knowledge Flows from IJVs to Wholly SAIC-controlled Subsidiaries**

As argued in the previous sections, Sino-foreign JVs have substantially improved their in-house technological capabilities through technology transfer from foreign JV partner firms and following-up learning-by-doing practices, although the improvement is less obvious in project-execution and innovation capabilities than in production capability. Then, the next question is how local JV partner firms can benefit themselves from the Sino-foreign JVs' improved technological capabilities in the absence of official knowledge flow channels between Sino-foreign JVs and local JV partner firms. As explained in Section 4.2.1., Sino-foreign JV's in-house technological capabilities are their own assets, which cannot be utilized for local firms' self-benefits without the consent of their foreign JV partner firms. The official channel through which the IJVs' in-house technological capabilities can be transferred to local JV partner firms' wholly owned subsidiaries does not exist under the current Sino-foreign JV arrangement.

SAIC released such constraints on horizontal knowledge flows primarily through the acquisition of ex-JV employees. Since 2006, SAIC has operated a wholly owned vehicle development division, called SAIC Motor. The flagship SAIC subsidiary, taking initiatives in the group's self-brand vehicle development, is staffed by SAIC's best R&D and engineering personnel, and has already carried out several independent vehicle development projects (e.g.,

Roewe 750) successfully.<sup>25</sup> A substantial number of SAIC Motor's key engineers have working experience with SVW, SGM, and PATAC. In many cases, they were scouted by SAIC with more attractive financial packages than they received at the SAIC-affiliated IJVs.

A SAIC Motor engineer whom I interviewed is an example of such practices. The ex-PATAC hire voluntarily left his former company to work for SAIC Motor. He was very satisfied with his current job because not only is he paid more by his current employer but he is also involved in more creative and productive activities.<sup>26</sup> This hiring practice is not limited to skilled engineers. A SAIC manager confirmed that a considerable number of ex-SVW and SGM shop floor production workers were working for SAIC Motor, as well.<sup>27</sup> With such hiring practices, SAIC has spread its JV-based learning internally to its wholly controlled subsidiaries.

In addition, SAIC has internally accumulated improvements in project-execution capability, through a series of production-capacity expansion projects for its IJVs. SIMEE's improved project-execution capability was a precious asset when the SAIC Group independently undertook the assembly line and engine manufacturing plant construction project for SAIC Motor, with the substantial assistance of Ricardo 2010—a then-British automotive consultancy, which later became SAIC's subsidiary.

I note, however, that inter-firm variations exist in terms of the degree of benefit from IJV-based learning. For example, the First Automotive Works (FAW) and the Dongfeng Motor Corporation (DFM), which are strong rivals of SAIC in the local market, have been less successful than SAIC in using IJV-trained human resources, in part due to their rigid wage

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<sup>25</sup> Interview #5.

<sup>26</sup> Interviews #5 and 20.

<sup>27</sup> Interview #19.

system.<sup>28</sup> China's socialist traditions still remain relatively entrenched in these two centrally controlled state-owned enterprises (SOEs)<sup>29</sup>. Their compensation system, based on jobs and seniority, allows far lower thresholds for wage differentials than SAIC's does.<sup>30</sup> Their rigid wage system has substantially limited both FAW and DFM's ability to attract local talent, while SAIC, a locally controlled SOE<sup>31</sup> located in Shanghai, which has a more open and capitalist atmosphere than most other Chinese cities, seems to be relatively free from the socialist legacy.

#### **4.3. Sino-foreign JVs and Vertical Knowledge Flows**

Automobile manufacturing is a composite art that deals with over 20,000 parts (Womack *et al.*, 1991). Accordingly, local assembly and supply capabilities are inter-dependent; quality vehicles are built on quality parts and components. Recently, their inter-dependency has been higher than in the past. Parts suppliers' technological capability is viewed as an increasingly crucial constituent of vehicle assemblers' technological competency, as their R&D and engineering collaboration has been extended to very early stages of new vehicle development (Fujimoto, 2007; Jurgens, 2001). Taking up this point, in this section, I examine how Sino-foreign assembly JVs have contributed to the technological development of China's local supply sector.

##### **4.3.1. The Early Construction Stage of the Local Automotive Supply Base**

When early Sino-foreign assembly JVs entered into actual vehicle production, extremely weak

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<sup>28</sup> Interview #23.

<sup>29</sup> Both FAW and DFM are under the direct control of China's central government.

<sup>30</sup> Interview #23.

<sup>31</sup> The SAIC Group is an SOE under the direct control of the Shanghai municipal government.

local-supply capability was a serious obstacle (Posth, 2006). Most local parts suppliers lacked the production capabilities to meet MNC-set quality standards; thus, early assembly IJVs in China began their local production through the assembly of imported CKD kits. The Chinese central government granted the IJVs their initial operations based on the CKD kit assembly, but required them to maintain certain time schedules for localization. Public measures like import tariffs, local-content regulation, and foreign exchange control were used to incentivize the IJVs' localization activities. Also, failure to abide by such guidelines from Beijing meant the withdrawal of various preferential policies (e.g., subsidized credits) for the IJVs. A primary reason for China's strong localization drive is that imported CKD kits exhausted the then-limited national foreign exchange reserves and the simple assembly of the foreign-made kits was far from desirable in building the local automotive sector (SDPC, 1994).

With local currency's limited convertibility to hard currency, foreign JV partners also saw an imminent need to boost local sourcing (Harwit, 1995; Mann, 1997; Posth, 2006). Although they could earn large profits by selling CKD kits to their JVs, this CKD business model was not sustainable due to the limited foreign exchange reserves. Under the then-Chinese foreign-exchange regime, Sino-foreign JVs could raise hard currency necessary to import CKD kits only by exporting their final products. Export, however, was not immediately possible, as domestically-assembled vehicles were too expensive given the quality by global standards, due to the small production scale, low labor productivity, and lack of production skills. Accordingly, all of the IJV-produced vehicles were supposed to be sold locally. Sino-foreign JVs needed to raise their output volume to drive cost down and accumulate local production skills, but their production scale was constrained by the amount of foreign exchange reserves that could be used to import CKD kits. This is the dilemma in the CKD business model: the local ability to export

depends on the local ability to import CKD kits, but, conversely, this local ability is constrained by the amount of foreign exchange reserves determined by the ability to export. Expanding local sourcing was considered as the most realistic solution to this dilemma.

However, substantial inter-firm variations existed in localization outcomes, partly due to dissimilar local capacity to deal with the coordination problem, which was obvious in the early stages of China's automotive sector development (Harwit, 1995; Thun, 2006). When SVW—the most successful localizer among early Sino-foreign JVs (Figure 9)—initiated its localization efforts, VW's technical staff could not find a single local parts supplier near Shanghai that met the global company's minimum quality standards (Posth, 2006). VW was willing to help local parts suppliers improve their product quality, but it was evident that VW's technical assistance would be in vain unless the supply firms upgraded their dated production equipment and facilities. VW thus requested that they make additional investment in manufacturing facilities, as a prerequisite to accessing its technical assistance. Local supply firms were, however, reluctant to take the financial risk attached to their capital investment unless they were guaranteed solid supply contracts with SVW (Huang and Thun, 2002). Unfortunately, such contracts were not immediately possible given SVW's limited operation scale and local supply firms' weak capability during its early operation periods.<sup>32</sup>

The Shanghai municipal government played a critical role in breaking through the standstill. It established the Localization Office under the direct supervision of the Mayor's Office in order to monitor and support the localization drive of the Shanghai automotive industry. Funds for localization activities, controlled by the Localization Office, were raised through a

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<sup>32</sup> In late 1985, SVW assembled about 30 cars per day (Huang and Thun, 2002).



localization tax, which was set at around 16% of a Santana's retail price (Huang and Thun, 2002). Local-supply firms could substantially reduce investment-involved financial risks through their access to loans subsidized by the localization fund. As coordination failure became less obvious, VW became more engaged in SVW's localization project (Long, 1996; Posth, 2006). When local-supply firms upgraded their production facilities, SVW hired retired engineers from the German Senior Expert Service as short-term consultants. Those engineers were in primary charge of training SVW assembly workers and engineers, and providing local-parts suppliers with technical supports on the operation of new production equipment and facilities (Posth, 2006). As a result, the number of SVW's local-parts suppliers that could meet VW's quality standards (under most circumstances) increased from 31 in 1990 to 230 in 1997 (Thun, 2006).

The Sino-foreign JV arrangement, as exemplified by the SVW case, generated industry-wide vertical knowledge spillovers, when it was implemented in combination with an effective public support and incentive system. SVW was the main window through which local-parts suppliers could access VW's advanced production technology and know-how. In particular, VW's technical assistance, which aimed at a more complete transfer of production knowledge and skills, helped local parts suppliers utilize their modern production equipment in order to raise their product quality. Supply contracts with SVW let them further accumulate learning through their self-application practices (Huang and Thun, 2002).

Most other early assembly IJVs in China were not as active in localization as SVW was. For example, over 70% of Beijing-Jeep's local content in 1997 was actually sourced from the outside of its main assembly base in Beijing (mostly from Shanghai)<sup>33</sup>, suggesting that the IJV

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<sup>33</sup> Even in 2002, Beijing-Jeep sourced over half the total vehicle value of its Cherokee lineup from Shanghai (Thun,

simply took advantage of existing supply infrastructure rather than making efforts to build its own. This is a striking contrast to the fact that 90% of SVW's local content was procured within Shanghai (Huang and Thun, 2002). This fact, however, does not mean that the IJV arrangement itself is not effective for the purpose of localization; instead, it is more a matter of implementation. The SVW case shows that the best practice of the IJV arrangement can ensure a successful localization outcome.

#### **4.3.2. Localization in More Liberalized Environment**

Public IS tactics, such as local-content regulation, import tariffs, and foreign-exchange control, gave substantial incentives to the localization drive in China's automotive sector, as argued in the previous section. Such protectionist measures, however, were mainly incapacitated with China's accession to the WTO. In accordance with the conditions of its WTO membership, for example, China repealed its local-content regulation in 2001, and reduced tariff rates for imported vehicle and automotive parts by 2006 to roughly one-third of the year 2001 levels (Harwit, 2001).

Accordingly, foreign automakers gained more options for formulating their sourcing strategies.

The changed economic environment, however, has not significantly interrupted the localization drive in China's auto sector. Foreign automakers have still taken a pro-localization position in the post-WTO period. The primary reason seems to be the heated competition and increasing cost-reduction pressure in the Chinese market. China's local demand for passenger cars has grown at phenomenal rates for the last several years. The annual domestic sales of passenger cars in China were barely over half a million units in 1997 (around 3.3% of the then-

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2006).

US market size), but grew nearly 20 times, to over 10 million units by 2009, roughly the same size as the US market for the same year (Figure 10).<sup>34</sup> Such impressive market growth has attracted more automakers to China, as evidenced by the number of China-based passenger car makers, which increased from 11 in 1998 to 64 in 2009.<sup>35</sup> Under the changed market condition (from a supplier market to a consumer market), local automakers have given up their high-price policy. Between 2004 and 2007, for example, Sino-foreign JVs, affiliated with the Chinese Big Three automotive groups, reduced the retail prices for their flagship vehicle models between 12% and 26% (Table 3).

Table 4 illustrates the fact that increased market competition is a primary factor that has lifted the cost-reduction pressure. SVW, for example, constantly reduced the retail price of its best-selling model Santana from RMB114,000 in 1998 to RMB79,800 in 2007. During this period, the reduced tariff rate itself was not chiefly responsible for the price-cut, because SVW already achieved a domestic-content ratio of 93% for Santana by 1998 and thus should not have been affected much by the changed tariff rates. Instead, the changed market conditions, such as the transition away from the oligopolistic market—which is evidenced by SVW’s declining market share (from 46% in 1998 to 9% in 2007) despite its continued market-leading status and weakened market protection against foreign imports—should be seen as a main driver that caused

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<sup>34</sup> As of 2009, the United States and China were the only countries that had annual domestic passenger car markets of over 10 million units.

<sup>35</sup> Since 2004, China’s central government has controlled market entry to the domestic passenger vehicle sector by requiring newcomers to have a total investment of RMB two billion and an R&D investment of RMB half a billion as preconditions. Accordingly, the total number of domestic passenger vehicle producers has remained stable for the last several years.

automakers' changed pricing policy. In fact, until leading global automakers rushed into the Chinese market in the late 1990s, neither local auto assemblers nor parts suppliers had incentives to reduce their production costs, as the oligopolistic market condition in China's passenger-car sector allowed them to enjoy excess profits without doing so (Farhoomand and Tao, 2005). The new market environment, however, does not ensure Sino-foreign JVs excess profits any more, and they must lower the cost to win the competition-driven price war.

With the increased market competition, China's post-WTO actions have not interrupted its localization drive. Despite the lowered market protection against imported parts and components, China-based automakers are still incentivized to expand local sourcing for production-cost reduction. According to a 2004 survey by the Korea Institute for Industrial Economics and Trade, parts and components produced in China were 39% cheaper than those produced in Japan in terms of retail price and 28% less in terms of production cost, although the former did not reach the latter's product quality (Table 5). Similarly, parts and components produced in China were substantially cheaper than those produced in Korea, which present a benchmark price-quality substitution level for parts and components, although their price/cost index margins were narrower than their quality index gaps. This fact suggests that Sino-foreign IJVs can reduce production costs significantly by increasing domestic content, although they may need to compromise product quality somewhat. According to a GM-China engineer, parts and components sourced within China are not only reasonable in price but also good enough in quality to ensure Chinese consumers SGM's quality-products; parts and components sourced from outside of China are, in general, over-engineered by Chinese standards and would drive up

production cost without adding clear benefit.<sup>36</sup>

In addition, even the post-WTO tariff rates are effective enough to support China's import substitution drive in the automotive parts sector. The basic framework of China's post-WTO tariff policy for the automotive sector is that (i) different rates apply to integrated vehicles (25%) and parts and components (10%), and (ii) even vehicles assembled in China are considered integrated-vehicle imports and thus are subject to the tariff rate of 25%, if their local content is 40% or less.<sup>37</sup> Under the heated market competition, the tariff rate difference of 15% has in part encouraged IJVs to expand their local sourcing, as evidenced by the fact that, as of 2008, most top-selling passenger models produced by major Sino-foreign JVs showed fairly high local-content ratios, with little inter-firm variation (Figure 11). As of 2008, each firm's steady-selling, flagship models, such as Santana, Jetta, and Citroën ZX comprised nearly 100% of the parts and components produced within China, and most of the vehicle models, which showed a 40-month or longer period of market presence, achieved local-content ratios of 60% or higher.

#### **4.3.3. Upgrading Stages: The Inside of the Local-Content Ratio**

I urge caution in translating high local-content ratios directly into local suppliers' improved technological capabilities. In the first place, firm-level local-content figures are believed to be

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<sup>36</sup> Interview #2.

<sup>37</sup> In April 2006, the United States, the European Union, and Canada, seeing this policy as a serious obstacle to their automotive parts export to China, brought this issue to the WTO for a dispute settlement. On February 11, 2009, the WTO concluded that the policy went against the conditions for China's WTO accession, and on February 27, the Chinese government accepted the WTO's ruling with a grace period of 7 months and 20 days for the policy's repeal (WTO, 2009).

biased upward because automotive parts and components, which are initially imported by a domestic party and then traded to other local firms, are often counted as local content for the latter.<sup>38</sup> More critical than the bias issue, however, is the fact that a high local-content ratio does not ensure China's local suppliers an increasing role in local production networks. Note that China does not regulate foreign equity ownership in its automotive-parts sector; thus, foreign automotive-parts suppliers are allowed to establish their wholly controlled subsidiaries in China and to acquire controls over local assets without upper thresholds (Tsuji and Wu, 2005). In the absence of equity-related regulations, leading global parts suppliers have established Chinese branches under their full control, in proximity to their major customers. In the post-WTO period, it was not rare, either, for foreign automakers, when they established new IJV operations in China, to enter the Chinese market together with their primary home-base-supply partners. As a result, local automotive production clusters, which emulate MNCs' home-based production networks, have been formed around major Sino-foreign passenger vehicle assembly JVs.<sup>39</sup>

In many cases, Chinese local parts producers participate in MNCs' localized automotive production networks as low-tier supply partners.<sup>40</sup> This outcome is in part related to the paradigm shift in the modern automotive manufacturing business itself (from Fordism to Toyotism), in addition to Chinese supply firms' insufficient technological capabilities. Before the Japanese lean production system was introduced to Western automakers, a provided-drawing system for detail-controlled parts was the industry's standard sourcing method (Clark and

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<sup>38</sup> Interviews #16 and 23.

<sup>39</sup> This tendency is more obvious in the case of Asian automakers. Refer to Fujiwara (2006), Kishimoto (2006), and Jung and Lee (2007) for Japanese and Korean automotive supply networks in China.

<sup>40</sup> Interviews #2, 9, 16, 17, and 23.

Fujimoto, 1991). The provided-drawing method refers to the sourcing pattern where assemblers design automotive parts and components and provide their drawings and specifications to parts makers for their actual production. Even in the early 1990s, when global leading automakers were increasingly incorporating the lean production system into their Fordist mass-production model, the provided-drawing sourcing model was still prevalent in the West (Fujimoto, 1999). In this sourcing model, parts suppliers do not necessarily need to equip their own in-house R&D capabilities; their primary competitive advantage instead is in their production capability, which enables the production of quality parts and components at competitively low costs, in accordance with the assembler-provided designs for each part. In this model, the assembler-supplier relationship is more price-driven, and often lasts a short period of time.

At present, however, the approved- (or consigned-) drawing method is more prevalent (Fujimoto, 2007). In this sourcing method, supply firms design and develop parts and components for themselves, in accordance with assemblers' integrated-vehicle designs. Once assemblers approve the designs and specifications, suppliers manufacture parts and components to deliver them to assemblers. As this method becomes the industry's standard sourcing model, there has been a critical change in the assembler-supplier relationship: assemblers and their primary parts suppliers work together from the very early stages of new vehicle development (i.e., design-in) and form more interdependent and longer alliances than before (Fujimoto, 1999). Accordingly, their collaboration process has generated crucial knowledge-sharing networks for technology development.<sup>41</sup>

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<sup>41</sup> For example, the number of patents that Toyota and Honda obtained jointly with their primary-parts suppliers increased substantially from 900 and 290 in 2000 to 1,480 and 480 in 2004, respectively (Konno, 2006).

It is technologically challenging to be top-tier supply partners of global leading automakers. In order to deliver quality black-box parts and components to assemblers, parts producers need highly competitive R&D and engineering capabilities. In addition to competitive manufacturing capability, they should be able to design key parts for themselves in accordance with integrated vehicle designs, and to integrate part-specific technologies for more complicated subassembly or module components. When parts suppliers are classified into component manufacturer, subassembly manufacturer, and module-system manufacturer, only module-system manufacturers and a small number of subassembly manufacturers are qualified as leading automakers' primary suppliers (Veloso *et al.*, 2000).

The technological barrier is even higher for newcomers. The knowledge-sharing networks between assemblers and parts suppliers discriminate against outsiders, as the networks are formed through long-term transactions on the basis of social, cultural, and geographical proximity. Outsiders can join the networks, but only after proving that they have better engineering and manufacturing capabilities than insiders do, as assemblers often set higher technological standards for newcomers than for those already having joint engineering experience with them (Veloso and Kumar, 2002). Also, it is not rare for assemblers to ask newcomers for a significant commitment to their development capabilities without guaranteeing any supply contracts (*ibid.*). Thus, it is hard and costly for outsiders to replace pre-existing primary suppliers. From the assemblers' perspectives, there is no strong incentive to change existing members of their knowledge-sharing community, in the face of substantial transactions and adaptation costs, unless newcomers can offer benefits that can more than offset these costs.

With a "China-rush" of leading global supply firms, the Chinese local automotive production system has embraced more multinational actors. Sino-foreign assembly JVs are at the



center of the local automotive production system in most of the Chinese major automotive clusters—notably, Shanghai, Changchun, Wuhan, Guangzhou, and Beijing (Figure 12). Foreign automakers usually exercise their equity share in the IJVs through their wholly owned subsidiary holding companies in China.<sup>42</sup> Although China-based holding companies are the direct parties that are involved in the management of the assembly JVs, they themselves do not have strong influence in determining key JV matters. Instead, most foreign-side key decisions, including what to produce in China and from whom to source key parts and components, are made in the MNCs' HQ, and are conveyed directly to their Chinese operations.<sup>43</sup> Some foreign automakers operate separate JVs for power train components (mainly engines and transmissions) with their local assembly JV partners, and they are managed the same way that the assembly JVs are.

In this production system, key knowledge and information on vehicle development does not flow within China. As Sino-foreign assembly JVs manufacture foreign-licensed vehicle models, for which development and engineering processes were already completed in MNCs' home bases, key vertical knowledge-sharing channels exist in the MNC home bases, not in China. Even the Chinese subsidiaries of global leading supply firms simply manufacture their products according to the designs provided by their HQs, lacking significant local R&D functionalities.<sup>44</sup> Interactions between assemblers and supply firms are also more intensive in the MNC home bases than in China. In fact, key decisions and orders between assemblers and their primary

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<sup>42</sup> For example, GM controls its equity in SGM through GM-China, and VW controls its equity in SVW and FAW-VW through VW-China.

<sup>43</sup> Interviews #2 and 12.

<sup>44</sup> Interviews #7, 16, and 23.

suppliers are often fine-tuned in their homes, and then conveyed to their Chinese subsidiaries.<sup>45</sup>

The assembler-supplier interactions that exist in China mostly involve sourcing itself, not collaboration for development and engineering.<sup>46</sup> In sum, a dearth of assembly IJVs' local technology development initiative has reduced the need for engineering and R&D supports from local supply firms.

The parts and components delivered by local indigenous supply firms are clearly distinguished from those provided by foreign-controlled supply firms. On the one hand, most parts sourced from Chinese indigenous suppliers are detail-controlled ones, for which foreign assembly JV partner firms or upper-tier foreign suppliers provide drawings and specifications.<sup>47</sup> This procurement pattern is sensible in light of local indigenous firms' relatively strong production capability but weak in-house development and integration capabilities. On the other hand, foreign-controlled supply firms are primarily in charge of the high value-added portion of the local supply chain (Lee *et al.*, 2004; Shu, 2009a). They have large market shares in technological sophisticated parts and components, such as engine-management systems, central control units, small motors and anti-lock braking systems, many of which fall into the black-box parts category (CATARC, 2008). In an extreme case, like electronic-stability-control equipment, all local demand is met by the products of foreign-controlled parts suppliers (Wang, 2009b).

There are some inter-firm variations in local sourcing patterns. Local production networks, initiated by VW and GM-affiliated JVs, embrace more local-parts-supply firms than others (Table 6). This circumstance is, in part, related to their sourcing strategies. In China,

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<sup>45</sup> Interviews #7, 16, and 23.

<sup>46</sup> Interviews #1, 2, 4, 12, 13, and 21.

<sup>47</sup> Interviews #5, 16, 21, and 23.

Western automakers, in general, have had more price-driven (based on more open bidding systems) sourcing policies than their Asian rivals have (Jung and Lee, 2007). When Chinese local suppliers have capabilities to manufacture detail-controlled parts at competitive costs, Sino-Western JVs have kept sourcing partnerships with them. For example, in 2004, 42% to 54% of the total number of the three Sino-Western JVs' (SVW, SGM, and FAW-VW) local sourcing partners were Chinese, and in 2007, 60% of SGM's local content was from Chinese suppliers.<sup>48</sup> In contrast, Sino-Japanese and Sino-Korean JVs showed far less dependence on Chinese suppliers. As of 2007, for example, FAW-Toyota and Beijing-Hyundai sourced less than 30% of their output values from Chinese suppliers, while over half of their output's local content was from Chinese subsidiaries of Japanese and Korean supply firms, respectively. This sourcing pattern may have been affected by the Asian automakers' geographical proximity to China or may reflect strong supplier-assembler ties embedded in the home-based production system itself.

The three Sino-Western JVs' considerable dependence on local Chinese suppliers is a consequence not only of the Western automakers' more open-sourcing system but also of SVW's early localization efforts, as discussed previously. SGM and FAW-VW share a significant number of SVW's Shanghai-based suppliers—through the mediation of SAIC (SGM's Chinese equity holder) and VW China (FAW-VW's foreign equity holder), respectively<sup>49</sup>—as evidenced by FAW-VW's relatively far physical distance from primary suppliers, compared with SVW and SGM's (Table 7).<sup>50</sup> This fact reflects the strong presence of quality parts suppliers in Shanghai,

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<sup>48</sup> FAW-VW shares a significant number of SVW's Shanghai-based suppliers.

<sup>49</sup> For example, around 20% of SVW's primary suppliers also had supply contracts with FAW-VW (Wang, 2009a).

<sup>50</sup> A significantly large number of SVW and SGM's Shanghai-based sourcing partners are actually SAIC's subsidiaries. As of 2008, around 40% of their passenger car output value was sourced from SAIC-affiliated parts

and suggests that the Shanghai-based supply firms have owed their improved production capabilities to their business with VW and GM's JVs in China. Vertical knowledge flows in Shanghai, however, are not exceptions to the pattern illustrated in Figure 12; key vertical knowledge-sharing channels exist not in Shanghai but in Wolfsburg or in Detroit. Most of the Shanghai-based local parts suppliers also lack in-house development and integration capabilities.<sup>51</sup>

By and large, the IJV-initiated local production system has limited its influence on local supply firms to their production-capability building process; little influence is found in local efforts to upgrade project-execution and innovation capabilities. In fact, assembly IJVs in China have endowed their local supply partner firms with their weak in-house innovation capability by leaving little room for potential R&D or engineering collaboration. Under the current OEM production model adopted by Sino-foreign assembly JVs, however, effectively local indigenous supply firms may take advantage of their partnership with the assembly IJVs, and most of them are likely to remain as the captive suppliers of detail-controlled parts.

#### **4.4. Synthesis of the Section**

Under the Sino-foreign JV arrangement, Chinese local automotive assembly firms have accessed advanced technologies, transferred by leading global automakers, and local-parts suppliers have also benefited substantially from the technology-transfer process. There is no question that the constituents of the Chinese automotive industry have developed better technological capabilities with the sector's IJV practices than in the past.

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suppliers (Ping, 2009).

<sup>51</sup> Interviews #2 and 5.

The SVW and SGM case suggests, however, that the IJV arrangement is not capable of nurturing every aspect of local technological capability. The IJV model's contribution has been most notable in incubating local production capability. MNCs have been active in transferring product-specific technologies and relevant production know-how to their Chinese operations. With their technology transfer, Sino-foreign assembly JVs are producing foreign automakers' up-to-date vehicle lineups in their modern manufacturing production facilities. As part of this technology-transfer process, foreign automakers have provided local engineers and shop-floor workers ample opportunities for official job training and technical assistance in order to optimize the operation of the introduced process technologies. In addition, the IJVs' growing efforts at local sourcing, incentivized both by public regulations (e.g., local-content regulation, import quota/tariffs, foreign-exchange control) and market factors (e.g., market growth and inter-firm competition), have paved the way for the growth of local supply capacity. Interactions with global automakers helped (and pushed) local suppliers to upgrade their manufacturing capability, so that their products could qualify as components of the JV-produced vehicles.

The IJV model may also induce a significant, but partial, improvement in local firms' project-execution capability. The more IJV-driven organic growth experiences SAIC accumulated, the better project-execution capability it could develop, as evidenced by the fact that SVW and SGM's more recent plant-expansion projects were completed within a shorter period of time than earlier expansions. However, the core technical portion of the plant-expansion project was done mainly by VW and GM without SAIC's significant participation. For example, VW and GM provided the assembly design to SIMEE for its actual construction, and procured necessary

capital goods, mostly imports, under their primary control.<sup>52</sup> This practice is a convention under the Sino-foreign JV arrangement, specialized for the production of foreign-licensed vehicle models: the whole production line design and the required production facilities and equipment for the JVs should reflect foreign automakers' technologies, which the foreign automakers themselves know best. Concerning this point, it would matter little whether or not SAIC accumulated more experience in plant expansion. Regardless of SAIC's capability improvement, asymmetric information about the JV-adopted technologies would keep reserving the core technical portion of the investment project not for SAIC but for its foreign JV partner firms.

The final point that the SGM case makes clear is that even the best practice of the IJV model is unlikely to ensure a critical degree of local innovation-capability building. GM is the foreign automaker that has made the largest R&D investment in China, but its Chinese assembly operation, SGM, does not possess significant in-house vehicle-development capability, either, like any other Sino-foreign assembly JVs. GM's flagship China-based R&D operation, PATAC, has also defined itself as SGM's localization-supportive engineering arm, specialized primarily in minor technological adaptation tasks. SAIC, of course, has accessed GM's up-to-date technologies in the form of vehicle drawings and relevant assembly-line designs. The Sino-foreign JV arrangement, however, has not allowed SAIC either to modify such technologies without GM's consent or to utilize them for SAIC's discretionary purposes. Innovation is fundamentally a product of a continuous search process for alternative or complementary uses of existing knowledge, in combination with other various kinds of internal and external assets. The outcome of the search process is a function of the intensity of the firm's application processes as

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<sup>52</sup> Interviews #2 and 19. Part of SVW's early plant construction episode is also documented in Posth (2006).

much as it is that of the firm's preexisting innovation capability. Simply mastering the "outcomes" of others' innovation does not lead to a better in-house innovation capability, without further subsequent internalizing through application practices or R&D activities. The SGM case suggests that even successful IJV practices in the developing world may not only fail to induce MNCs to bring in their critical technological capability but also may discourage local firms' self-learning process through intensive application practices.

## **5. Conclusions**

When China's central government decided to pursue the Sino-foreign JV arrangement in the early 1980s, it had two main reasons. One was to substitute locally produced passenger vehicles for foreign imports. The IJV arrangement was initially viewed as the most feasible option to meet rapidly growing local demands for passenger vehicles without exhausting China's then-limited foreign-exchange reserves. The other reason was to incubate technologically competitive local firms within a short period of time. China's government expected that it would be able to achieve this goal by requiring foreign automakers to meet certain degrees of local content and technology standards.

In the case of SAIC-affiliated JVs, I argue that the IJV arrangement, although it might be suitable for meeting the first goal, does not serve the second purpose, primarily due to different technological development requirements for each development stage and the basic nature underlying the IJV-based learning model. Compared with the IS stage, the post-IS upgrading stage demands that local firms have a balanced combination of in-house capabilities for production, project execution, and innovation. Accordingly, the same IJV arrangement may result in different outcomes depending on development stage.

The basic nature of the IJV-based learning channel—incompleteness and passiveness—was not a serious problem in the IS stage, but it was in the post-IS upgrading stages. The IJV-learning model is incomplete, in that knowledge transferred to the IJV, set up to perform only production functions, and is limited to product-specific production technology. In most cases, MNCs have provided their IJVs with the explicit “outcomes” of their technological capabilities, not the technological capabilities themselves. The IJV arrangement has discouraged local firms from making efforts to internalize the transferred knowledge for their own goods, by putting strict restrictions on the potential use of the transferred knowledge; its modification or application for local firms’ own benefit is prohibited. Accordingly, IJV-based learning has been driven mostly by mastery of the transferred knowledge and skills, related primarily to the production dimension. Further internalizing efforts beyond the mastery of the transferred innovation “outcomes” have been missing. Also, there is no official channel through which even partially IJV-based learning outcome can be spread to local firms.

The IJV-based learning mode is also passive, as the IJV arrangement allows local firms little room for maneuvering in choosing objects and methods of their learning. Under the IJV arrangement, local firms could learn only what they were supposed to learn in a given way at a given time. The knowledge gap and the asymmetric information about the IJV-adopted technologies between JV partner firms have granted MNCs a great influence over the key technical aspects of the IJV management, such as technologies to be transferred, the timing and method of transfer, and the procurement of key capital goods. Each shareholder’s equity stake in the IJV has failed to endorse a comparable influence on such technical aspects of the IJV-related affairs.



Technological capabilities consist of a number of detailed sub-segments, including in-house capacity for production management and engineering, project management, basic and detailed project engineering, and basic and applied R&D. All these segments are complementary and mutually reinforcing in building overall technological capabilities. Production-related capabilities can serve as foundations for investment capabilities; skills and know-how, accumulated as results of production and investment activities, can help a firm develop better innovation capabilities. As the SVW and SGM case illustrates, the IJV arrangement has been effective in building local capabilities for production and part of the project execution task (e.g., project management and construction), but has not been effective in developing other segments of the overall technological capability (e.g., procurement, project engineering, and innovation). Accordingly, local firms have developed partial segments of the overall technological capability, and the disparity among the technological capability segments has been further deepened in the absence of a mutually reinforcing cycle. Local firms have no effective means to maneuver the IJV arrangement to modify its nature in favor of their needs in in-house capability building process.

In this sense, it is not meaningful to discuss whether or not the IJV model is useful for local technological capability building, from a collective perspective; instead, it is necessary to understand which aspects of the capability building process in detail the IJV can contribute to and which other aspects it may not be able to contribute to. The Sino-foreign JV case suggests that the IJV arrangement itself may be at best a partial solution to nurturing the development of local firms as solid contenders in the global market, due to the very basic nature of the arrangement-involved learning mode. Perhaps the IJV-based learning model may work better when combined

with other learning channels that can complement its missing dimensions and ensure that local firms have substantial maneuvering space for their proactive learning attempts.

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**Table 1:** Selected Studies on South-received FDI's Productivity Spillovers

<i>Authors</i>	<i>Country</i>	<i>Year</i>	<i>Data</i>	<i>Unit of Analysis</i>	<i>Result</i>
Blomström and Persson (1983)	Mexico	1970	Cross-sectional	Industry	+
Blomström (1986)	Mexico	1970, 1975	Cross-sectional	Industry	+
Haddad and Harrison (1993)	Morocco	1985-89	Panel	Firm/Industry	?
Aitken and Harrison (1999)	Venezuela	1976-89	Panel	Firm	-
Djankov and Hoekman (1999)	Czech Rep.	1993-96	Panel	Firm	-
Schoors and van der Tol (2002)	Hungary	1997-98	Cross-sectional	Firm	+
Smazynska (2002)	Lithuania	1996-2000	Panel	Firm	+
Blalock (2002)	Indonesia	1988-96	Panel	Firm	+
Yeon (2003)	S. Korea	1991-2000	Panel	Firm	+
Javorcik (2004)	Lithuania	1996-2000	Panel	Firm	+
Javorcik and Spatareanu (2005)	Romania, Czech Rep.	1998-2000	Panel	Firm	Romania (+) Czech (-)

Note: “?” indicates mixed outcomes or statistically insignificant results.

**Table 2:** Expansion of SVW and SGM's Major Manufacturing Plants

	<i>SVW Plants (Shanghai)</i>			<i>SGM Plants (Shanghai)</i>	
	<i>No. 1</i>	<i>No. 2</i>	<i>No. 3</i>	<i>Jinqiao North</i>	<i>Jinqiao South</i>
Project scale (annual production capacity in thousand units)	Vehicles: 100 Engines: 180	Vehicles: 200 Engines: 270	Vehicles: 150	Vehicles: 150 Engines: 100 Transmissions: 200	Vehicles: 170
Project begun	February 1985	October 1991	December 1997	January 1997	September 2003
Project completed	April 1990	December 1994	April 2000	April 1999	May 2005
Assembly line design	VW	VW	VW	GM	GM
Procurement of production equipment	VW	VW	VW	GM	GM
Pre-investment feasibility study	SAIC	SAIC	SAIC	SAIC	SAIC
Construction & production preparation	SAIC	SAIC	SAIC	SAIC	SAIC

Source: Firm interviews and SVW and SGM's official websites.

**Table 3:** Retail Prices of Selected Passenger-vehicle Models Sold in China, 2003 and 2007

<i>Class</i>	<i>Producer</i>	<i>Brand</i>	<i>Model</i>	<i>Retail Price (thousands of RMB)</i>		
				<i>2003</i>	<i>2007</i>	<i>% Change</i>
Full-size	SVW	Volkswagen	Passat 1.8 L *	280	233	-16.8
	SGM	Buick	Regal 3.0 L	369	285	-22.8
	SGM	Buick	Regal 2.5 L	263	196	-25.5
	SGM	Buick	Regal 2.0 L	237	176	-25.7
Small/ Medium	FAW-VW	Volkswagen	Bora 1.8 L	204	173	-15.2
	SVW	Volkswagen	Santana 1.8 L	99	90	-9.1
	DF-PSA	Citroën	Elysee	140	106	-24.3
	DF-Nissan	Nissan	Sunny	190	167	-12.1

Note: \* Passat 1.8 L Turbo high-end (luxury) trim.

Source: 2003 data from Farhoomand and Tao (2005); 2007 data from Fourin (2007).

**Table 4:** Cost-reduction Pressure from Increased Market Competition, SVW's Santana

<i>Indicators</i>	<i>1998</i>	<i>2003</i>	<i>2005</i>	<i>2007</i>
Facts on SVW's Santana				
Retail price (thousands of RMB)	114 <sup>†</sup>	99 <sup>††</sup>	90 <sup>††</sup>	80 <sup>††</sup>
Local-content ratio (%)	93 <sup>†</sup>	99 <sup>‡</sup>	99	99 <sup>‡‡</sup>
SVW's market performance				
Market share in China (%) <sup>§</sup>	46	20	8	9
Market share relative to market leader's (market leader's share = 100)	100	100	77	96
Domestic sales rank <sup>§</sup>	1	1	2	3
Tariff rates by local-content ratio (%)				
Integrated vehicle imports	110 <sup>*</sup>	52	34	25 <sup>**</sup>
Local-content ratio < 40%	50 <sup>*</sup>	52	34	25 <sup>**</sup>
40% ≤ Local-content ratio < 60%	30 <sup>*</sup>	21	14	10 <sup>**</sup>
60% ≤ Local-content ratio < 80%	24 <sup>*</sup>	21	14	10 <sup>**</sup>
Local-content ratio ≥ 80%	20 <sup>*</sup>	21	14	10 <sup>**</sup>

Note: (i) The tariff rates for 2003 and 2005 were computed by the author under the assumption that the 2001 tariff rates of 70% for integrated vehicles and 28% for parts and components declined linearly to the 2006 levels of 25% and 10%, respectively; (ii) Santana's local-content ratio for 2005 was surmised from those for 2003 and 2007; (iii) <sup>†</sup> Data for 1997; (iv) <sup>\*\*</sup> The tariff rates required to China as conditionality of WTO accession.

Source: <sup>†</sup> Huang and Thun (2002); <sup>††</sup> Shu (2009b); <sup>‡</sup> Thun (2006); <sup>‡‡</sup> Fourin (2007); <sup>§</sup> Computed from Fourin (2010); <sup>\*</sup> Farhoomand and Tao (2005); <sup>\*\*</sup> Harwit (2001).

**Table 5:** Price and Quality Indices for Automotive Parts and Components Made in China, in Comparison with Those Made in Japan and Korea, as of 2004

<i>Price and Quality Indices</i> (※ <i>Parts and Components Made in Japan = 100</i> )	<i>Automotive Parts and Components</i>	
	<i>Made in China</i>	<i>Made in Korea</i>
Price indices*		
Retail price	61	84
Production cost	72	84
Quality indices**		
Defection rates	82	94
Durability	75	93
Precision and Accuracy	74	91

Note: \* Higher numbers mean higher prices or costs; \*\* Higher numbers mean higher product quality.

Source: Adapted from Cho *et al.* (2007).

**Table 6:** Local Sourcing Partners by Nationality for Selected Sino-foreign Assembly JVs

<i>Sino-foreign Assembly Joint Ventures</i>	<i>Local Sourcing Partners from MNC's Home Base</i>		<i>Chinese Sourcing Partners</i>	
	<i>% of Total Local Sourcing Value</i>	<i>% of Total No. of Local Sourcing Partners**</i>	<i>% of Total Local Sourcing Value</i>	<i>% of Total No. of Local Sourcing Partners**</i>
Shanghai-VW	n/a	13	n/a	54
Shanghai-GM	n/a	17	60*	42
FAW-VW	n/a	13	n/a	53
FAW- Toyota	75***	79	25***	15
DF-Nissan	n/a	43	n/a	34
DF-Yueda-Kia	60+*	29	15*	26
Beijing-Hyundai	50+*	81	20+*	6
Guangzhou-Honda	60+*	55	10*	25

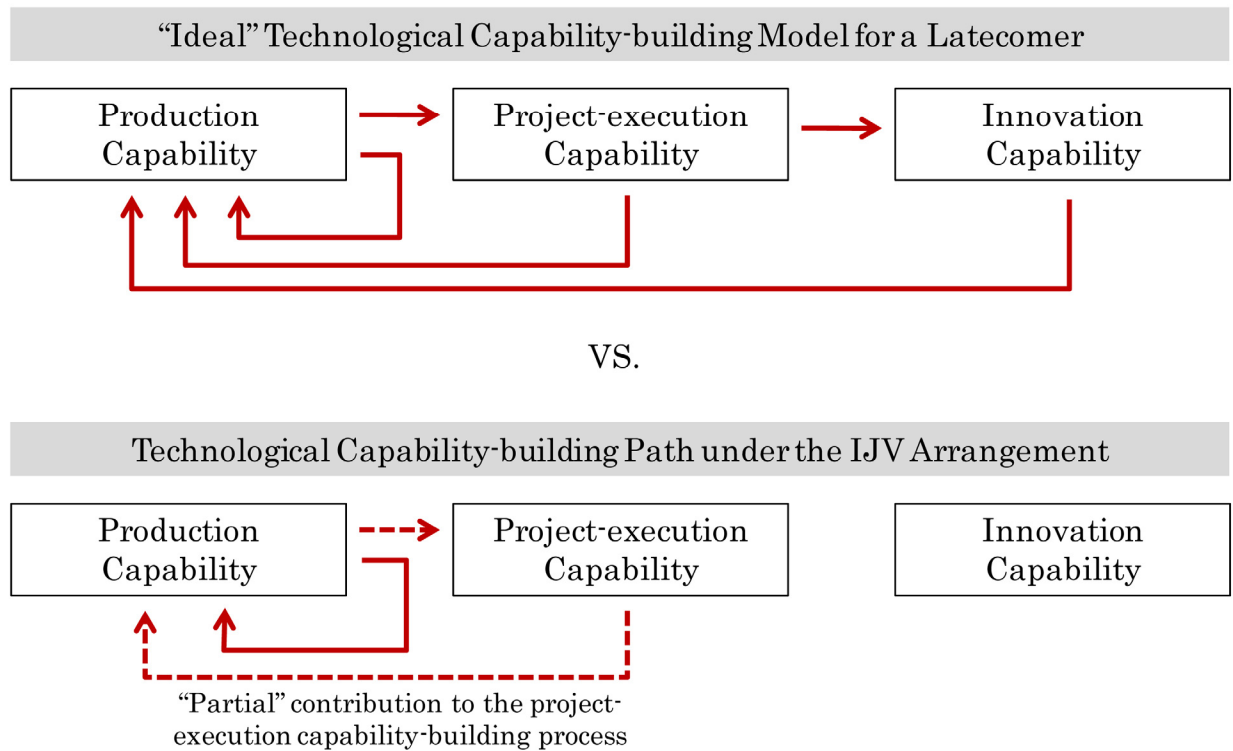
Note: \* as of 2007; \*\* as of 2004; \*\*\* as of 2002.

Source: \* Firm interviews; \*\* Marukawa (2006); \*\*\* Tsuji and Wu (2005).

**Table 7:** Mean Distance between Assembler and Primary Suppliers, 2004

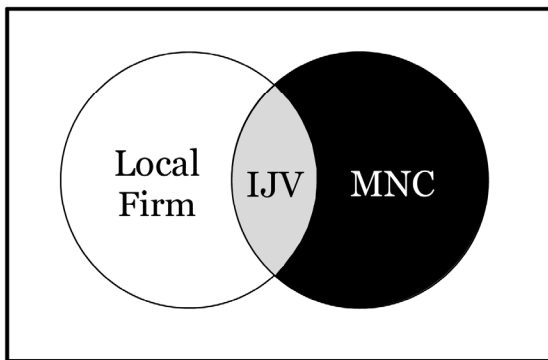
<i>Assembly JVs</i>	<i>Main Production Base in China</i>	<i>Number of Primary Suppliers</i>	<i>Mean Distance from Primary Suppliers</i>
SVW	Shanghai	254	542 km
SGM	Shanghai	145	258 km
FAW-VW	Changchun, Jilin	240	1,736 km

Source: Marukawa (2006).

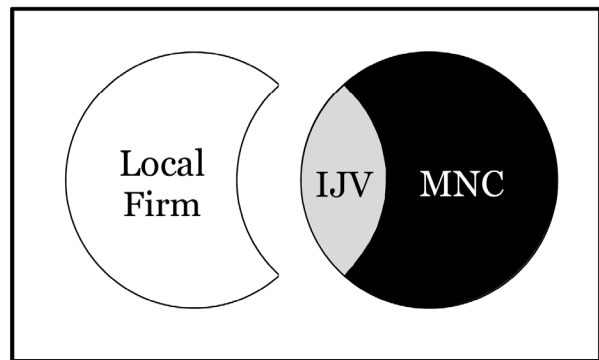


**Figure 1:** Conceptual Lens for This Study



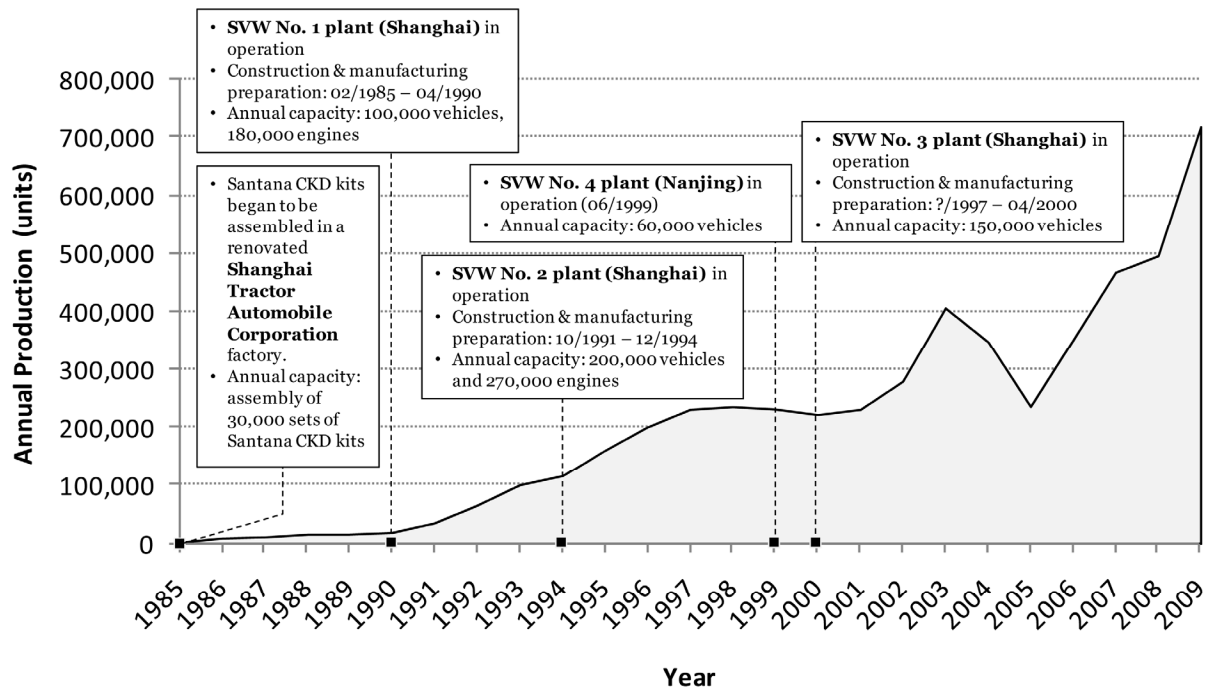


(a) Ideal JV Model



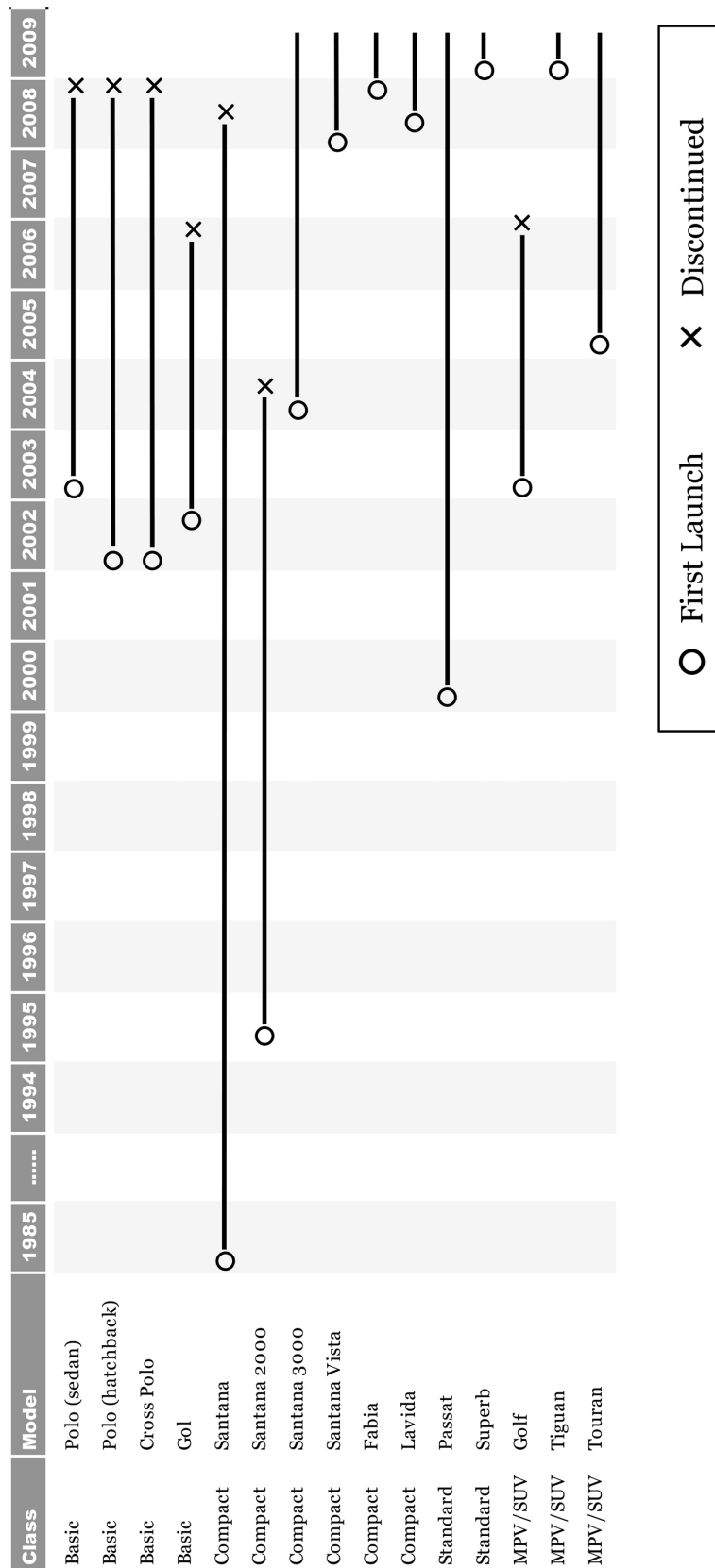
(b) Typical Sino-foreign JVs

**Figure 2:** Comparison of an Ideal International JV Model and a Typical Sino-foreign JV Practice



**Figure 3: SVW's Production-Capacity Expansion, 1985-2009**

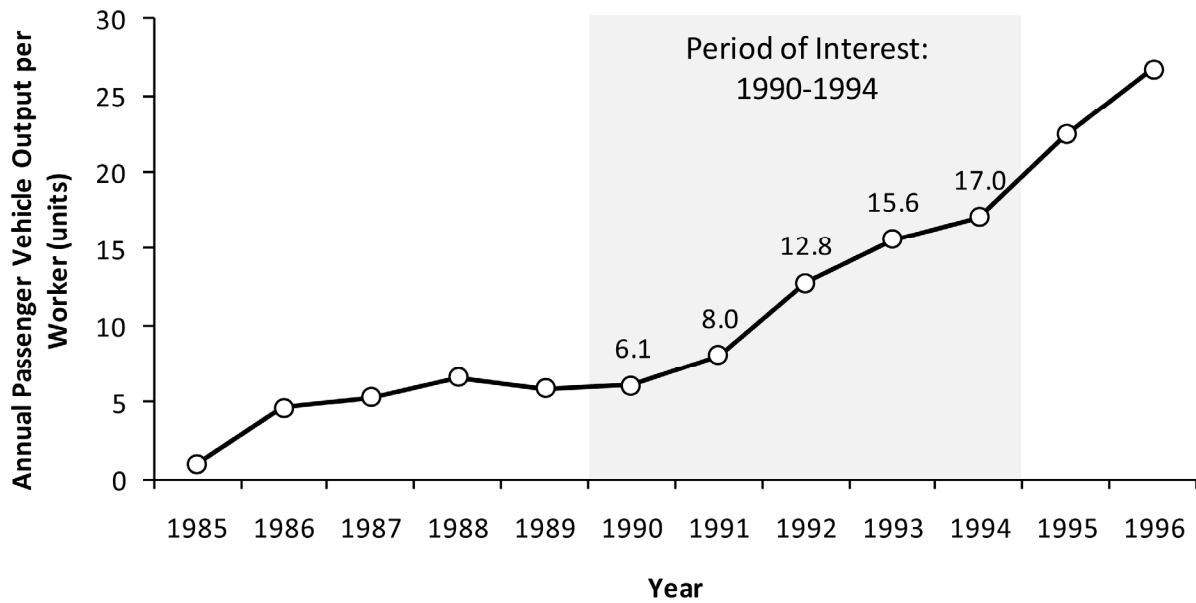
Source: Created by author; Annual production data from Fourin (1998-2010); other information from SVW homepage (<http://www.csvw.com>) and firm interviews.



**Figure 4:** SVW's Passenger Vehicle Lineup, 1985-2009

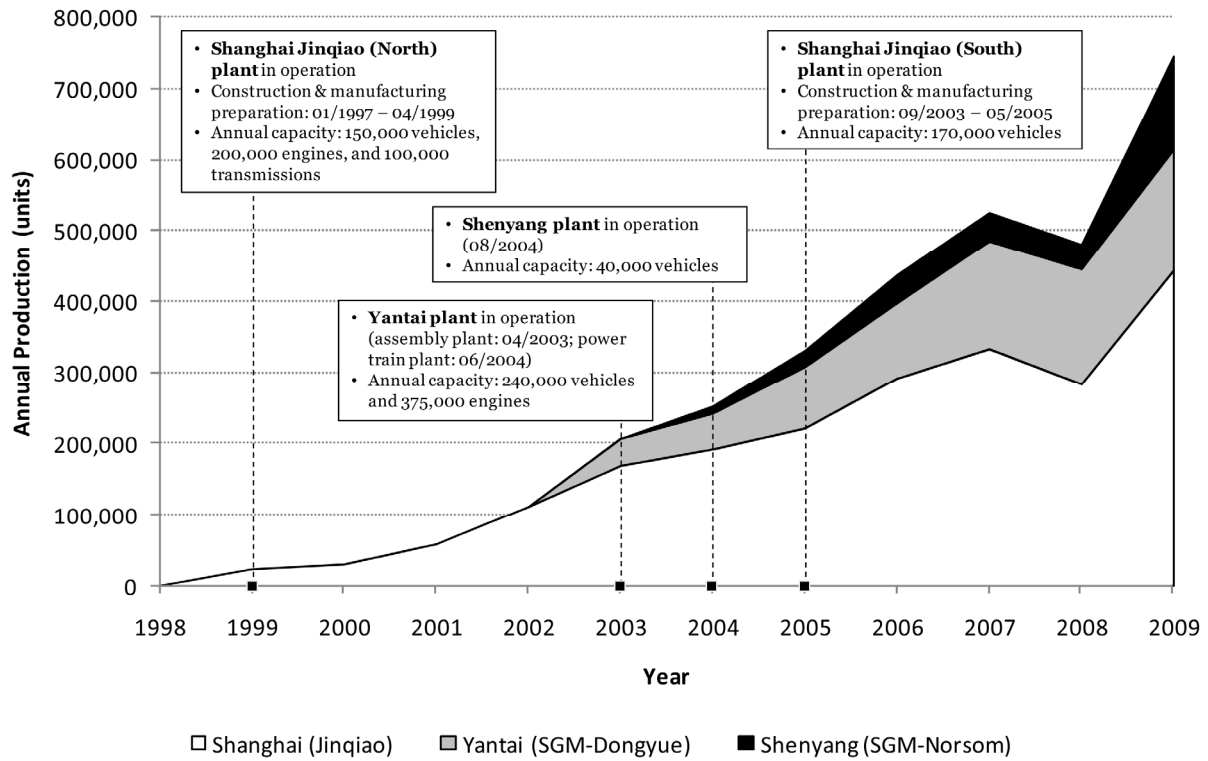
Note: Minor model change schedules are ignored.

Source: Created by author from Fourin (2010) and CATARC (1986-2009).



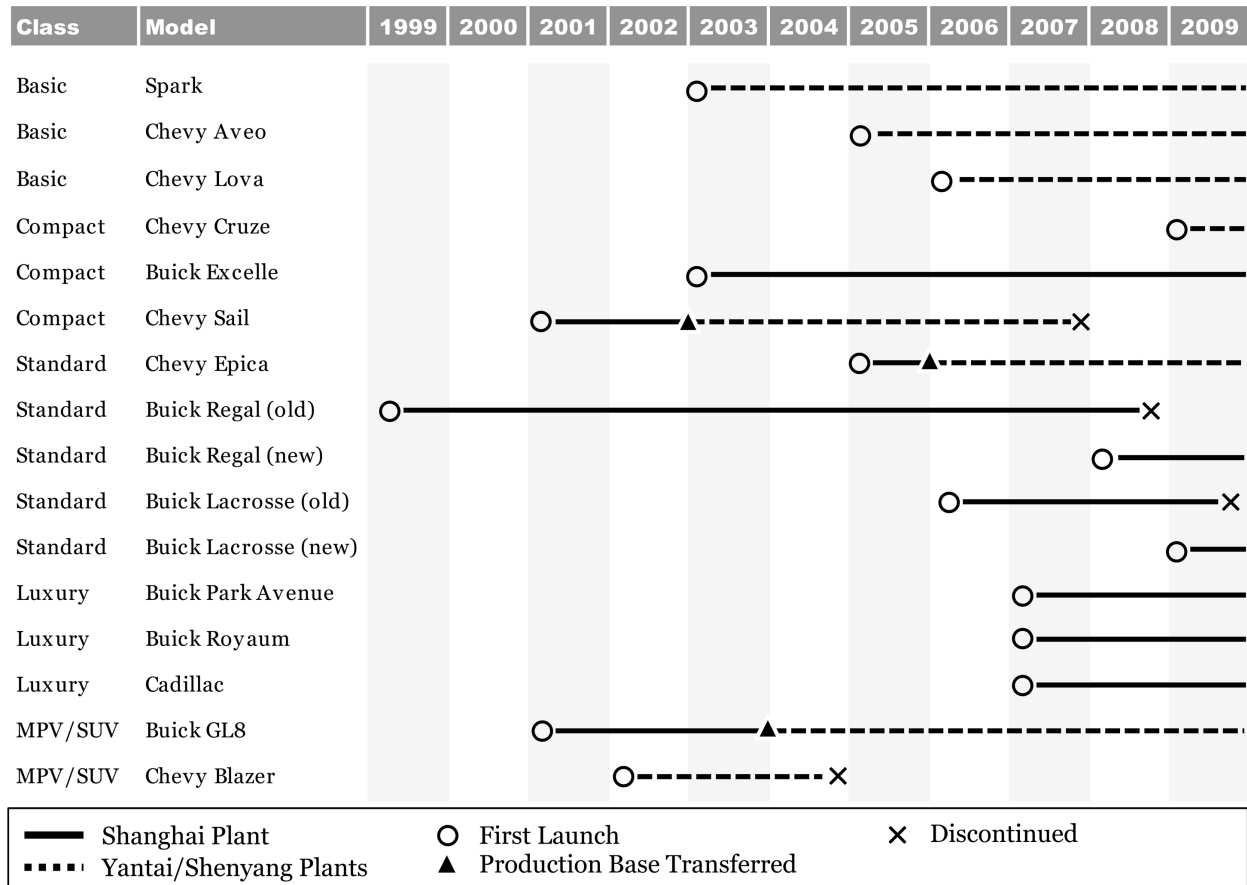
**Figure 5:** SVW's Annual Passenger Vehicle Output Volume per Worker, 1985-1996

Source: Computed from CATARC (1986-1997).



**Figure 6: SGM's Major Production Capacity Expansion, 1998-2009**

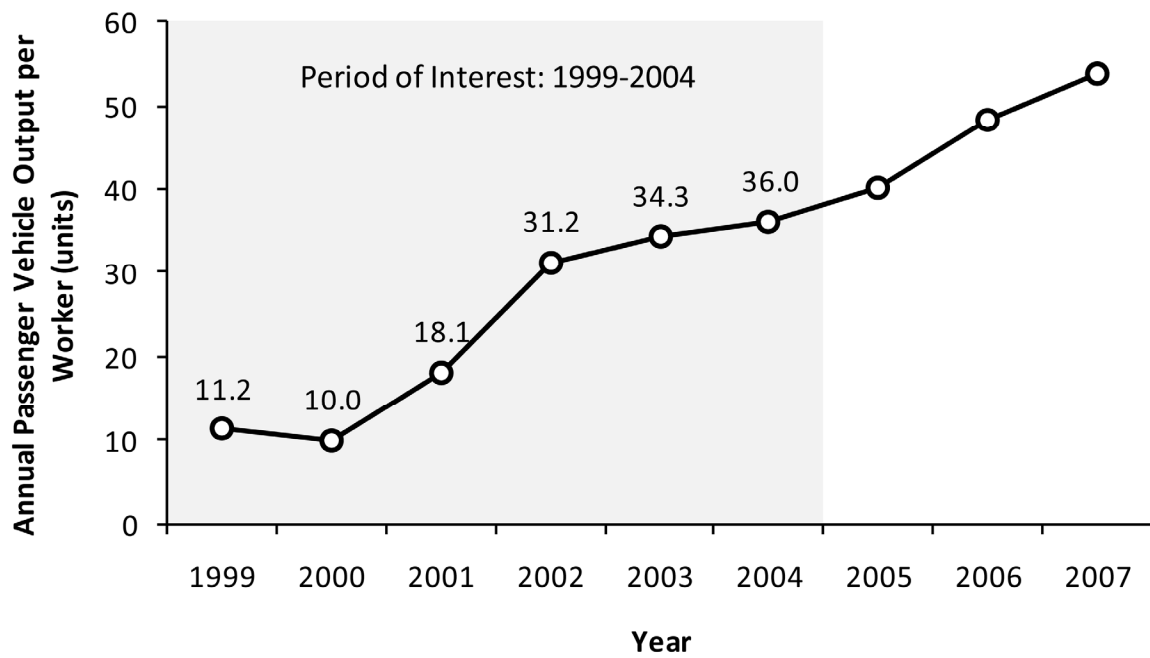
Source: Created by author; Annual production volume data from Fourin (1998-2010); other information from SGM homepage and firm interviews.



**Figure 7:** SGM's Passenger Vehicle Lineup, 1985-2009

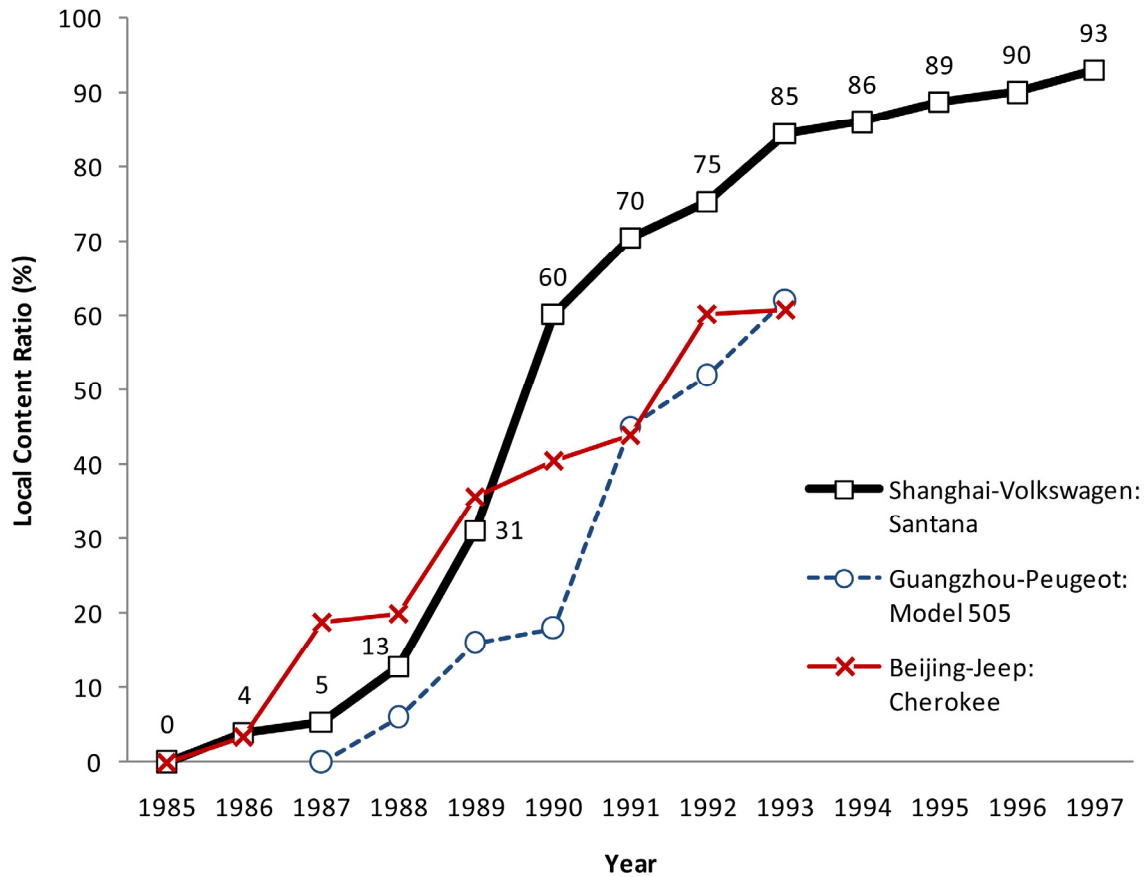
Note: Minor model change schedules are ignored.

Source: Created by author; Data from Fourin (2010) and CATARC (2000-2008).



**Figure 8:** SGM's Annual Passenger Vehicle Output Volume per Worker, 1999-2007

Source: Created by author; Data from Fourin (2010) and CATARC (2000-2008).

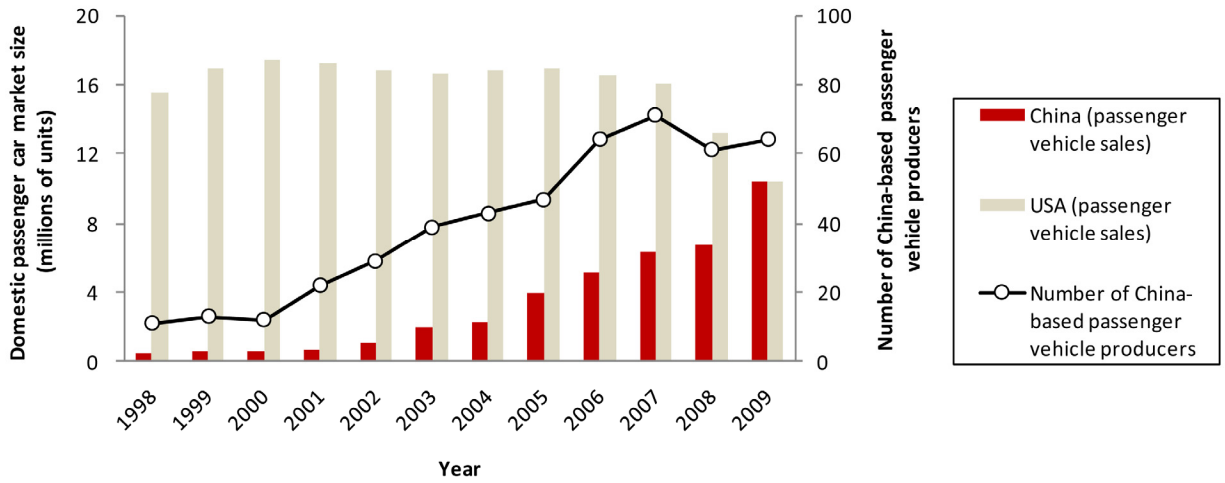


**Figure 9:** Localization Paths of Three Early Sino-foreign JVs, 1985-1997

Note: In 1997, Peugeot liquidated its stake in Guangzhou-Peugeot, and Honda took over the stake to establish a new joint venture with Guangzhou Automotive Group (Guangzhou-Honda).

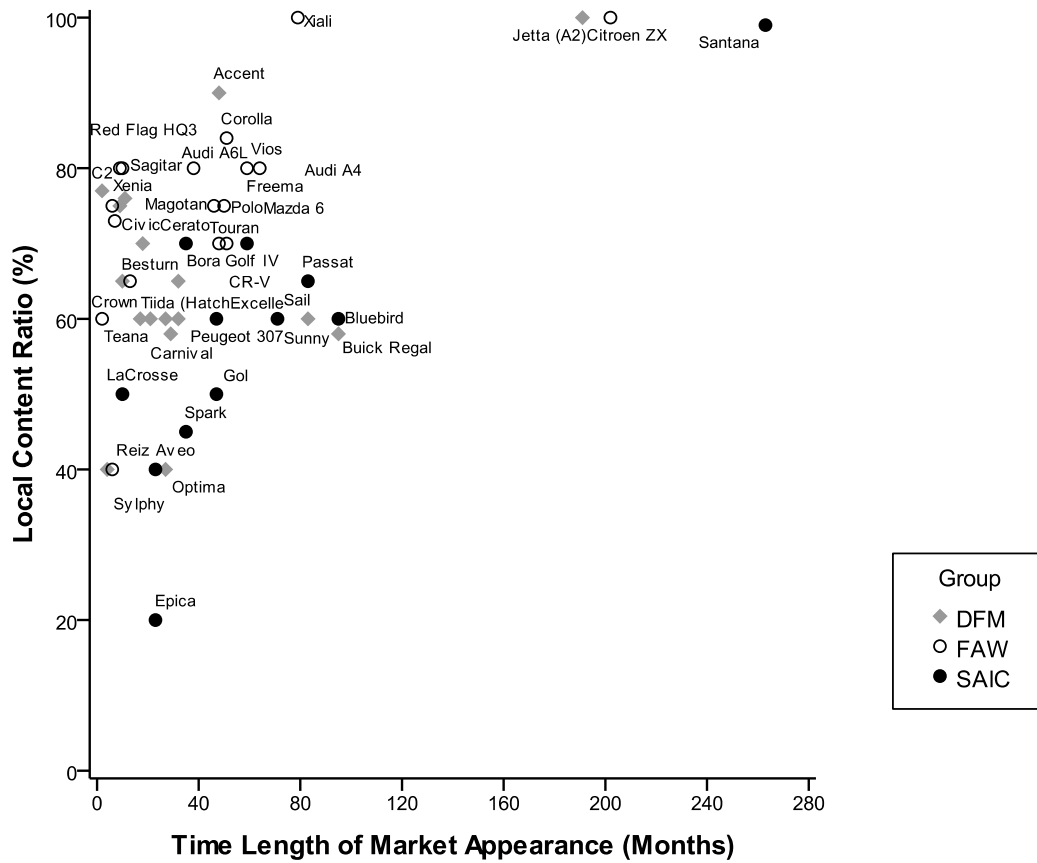
Source: Data from Harwit (1995) and Huang and Thun (2002).





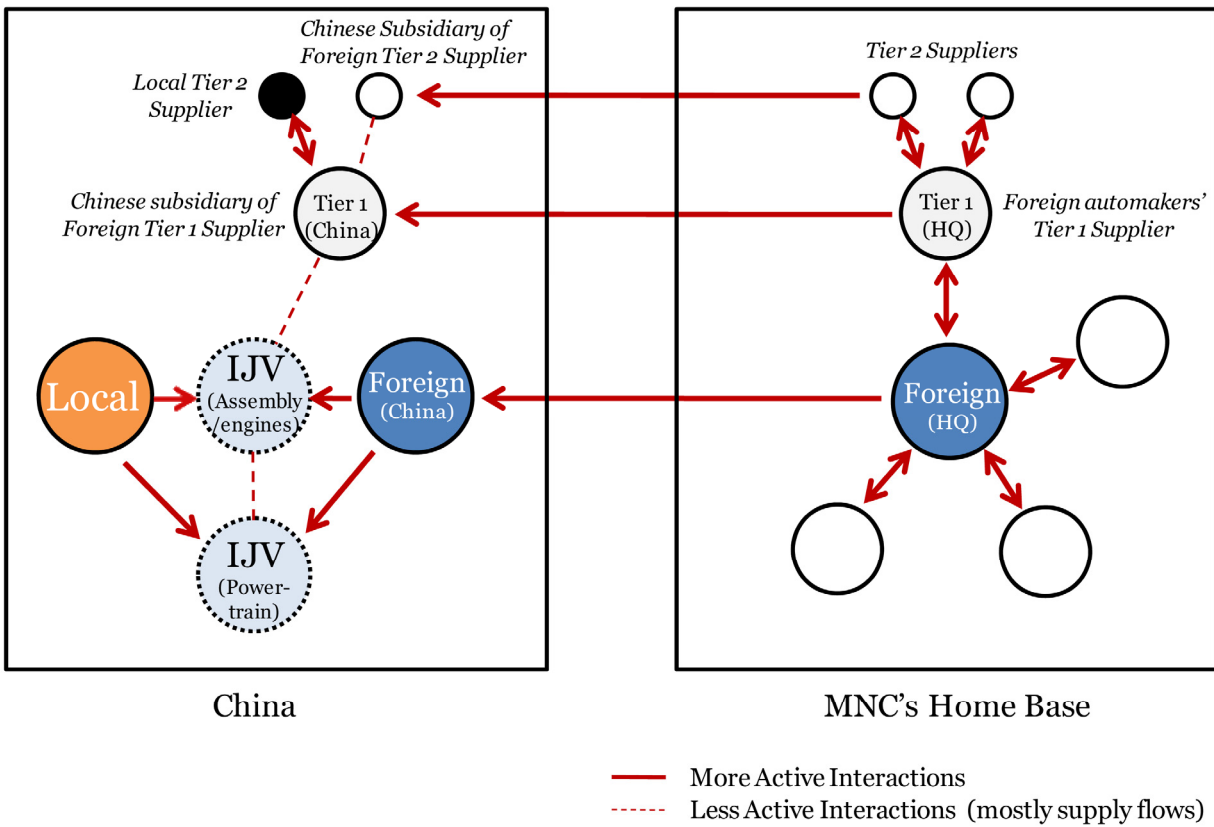
**Figure 10:** Number of China-based Passenger Vehicle Producers and China's Passenger Vehicle Market Size (in comparison with USA's), 1998-2009

Source: China data from Fourin (1998-2010); USA data from Ward's Automotive Group (2010).



**Figure 11: Local-Content Ratio by Firm and Vehicle Model, As of 2008**

Source: Data from Wang (2009), Fourin (2007), and firm interviews.



**Figure 12:** Knowledge Flows within Localized Production Networks

Note: Generalized from the cases of Sino-foreign JVs affiliated to SAIC, FAW, DFM, the Guangzhou Automotive Group, and the Beijing Automotive Industry Group.

Source: Created by author on the basis of firm interviews.