

Analysis and application of modern supply chain system in China

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Abstract

Purpose – The purpose of this paper is make a significant contribution to the supply chain knowledge system through research on modern supply chain system in China, providing guidance for theoretical research such as methodology of dynamic resource allocation and application of innovative small- and middle-sized service system in the supply chain.

Design/methodology/approach – The paper uses structural analysis of Chinese competitive advantage, and it applies comparative analysis of supply chain models in China, the USA and Japan through the factor disintegration of trading environment.

Findings – China's supply chain model has virtual scale and virtual capabilities. The relationship with suppliers is more dynamic. The requirements for resolving uncertainty are higher. Business transfer is more frequent.

Research limitations/implications – Researchers are encouraged to propose the specific supply chain models in China further with the game theory, auction theory, etc.

Practical implications – It provides advice for government policy making and gives Chinese enterprises guidance to improve operation management.

Originality/value – This paper specifically analyzes characteristics of China supply chain and gives enlightenment for supply chain innovation.

Keywords Agglomeration effect, Scale effect, Industrialization service system, Supply chain in China, Virtual capability

Paper type Viewpoint

1. Introduction

China is important in the global trading system. China's manufacturing and electronics exports have become more similar to the exports of advanced European countries, Brazil and India. In final consumption and capital goods, China has become central to the intermediate goods trade (International Monetary Fund, 2011).

China is well-integrated into the Asian supply chain, along with Japan, Taiwan Province of China and Korea. The Asian supply chain extends across several countries, with goods-in-process crossing borders several times. This means that China can widely transmit real shocks, whether those shocks originate domestically or elsewhere. This also means obvious benefits to consumers in the form of low prices and productivity-enhancing competition on a global scale (International Monetary Fund, 2014). China's ascent has yielded important growth effects in many parts of the world. The development of China depends on the export-oriented growth model, and this model is changing increasingly. China's export-oriented growth model (which comprises of supportive investment, financial and trade policies) has resulted in a large expansion of Chinese trade and rapid upgrade

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in the value-added chain. It has significant implications for the global supply chain. For instance, during the financial crisis, China attenuated the effects of global shocks down the supply chain. Its increased domestic demand during the crisis also led to higher imports of commodities and capital goods (International Monetary Fund, 2016).

In the past few decades, China has created an unprecedented economic growth miracle. Such long-term, high-speed economic growth is inseparable from the price advantage of Chinese products. As we all know, price is an important factor that affects the relationship between supply and demand. When other factors (such as consumer preference, product quality, appearance, design, etc.) are roughly the same, price becomes the decisive factor affecting the relationship between supply and demand, and is also a decisive factor affecting market demand. Under this circumstance, Chinese products usually exhibit characteristics of high quality and low prices, which gives Chinese products a strong competitive advantage in the world market. Large-scale exports of goods with high quality and low prices have led to a trade surplus in the international market. This long-term trade surplus has become a key factor in the rapid growth of our economy.

The competitive advantage of Chinese products not only creates an economic miracle, but also yields a series of important consequences. In the first 30 years of the reform and opening up of China's economy, a large number of foreign manufacturing industries moved into China, thus making China an international factory. China's manufacturing industry has become an indispensable part of the development of the global economy. Also, in the global economic environment, China has unique supply chain advantages especially in manufacturing industry. Shen identified the manufactured goods groups with China's revealed comparative advantages are produced in labor-intensive, resource-consuming and technology-mature industries (Shen and Gu, 2007). Yao found that large developing countries derive their comparative advantages from the coupling between heterogeneous human capital and a diverse industrial structure, physical capital investment and technological level (Xiao and Zhiyong, 2011). Diversity of Chinese human resource and industrial structure helps China obtain the comparative advantage.

Since prices of Chinese products in most countries are lower than the prices of products from developed countries, products manufactured in China would attract more consumers and/or enterprises, and result in China gaining a larger share of the global market. China's manufacturing industry encompasses everything from the low-tech furniture manufacturing industry to the high-tech network equipment manufacturing industry. In almost all aspects, Chinese products have significant price advantages over foreign-made products.

As a result, Chinese prices have led to China's long-term trade surplus with the USA. But China's demand for US products has only grown in terms of bulk agricultural products and raw materials. From a traditional perspective, the USA should have an absolute advantage over China in the manufacturing of high value-added products (especially of high-tech products.) However, trade data shows that even in US-dominated industries, China still has a trade surplus with the USA. The expansion of China's manufacturing industry as a result of foreign investments has strengthened and accelerated China's status as a manufacturing power.

Taken into account the comparative advantage in China below from the perspective of scale effect and agglomeration effect, the characteristics of production factor has been summarized. Then, using the comparative analysis, we would find the uniqueness of the supply chain in China. The specific application of the results found in the comparison is then discussed to make the proposition clearly clarified.

2. Structural analysis

In the manufacturing industry, Chinese products have significant price advantages over American products, and this price advantage is reflected in almost all types of products, whether high added value or low added value. The two structural factors of China's low prices are as follows.

2.1 Scale effect

Scale effect refers to the concept of economies of scale in microeconomics, which primarily means cost advantages that enterprises obtain due to their scale of operation (Chandler, 1977). Mizobuchi decomposed growth in labor productivity into three contributing factors: technical progress; capital input growth and returns to scale effect (Mizobuchi, 2014). The scale effect is the main reason that Chinese products have a price advantage. The scale effect can be explained in two ways: The first is the scale effect of human resources, and the second is the scale effect of land resources. The scale effect of human resources refers to China's large population.

Cheap labor has always been a strong comparative advantage of China over other nations. Bombardini concluded that the whole distribution of human capital is an important determinant of comparative advantage (Bombardini *et al.*, 2012). Romer, Grossman and Aghion generated a positive relationship between per capita income growth and population size (Romer, 1989; Grossman and Helpman, 1991; Aghion and Howitt, 1992). Song found that labor endowment is positively associated with comparative advantage in the primary and secondary sectors while human capital has significant effect in manufacturing and services. Industries in developed countries are mostly technology-intensive and the products they produce are mostly high value-added. Costs of employee benefits are also high in developed nations, and so labor costs there are much higher than in China. When China began to implement its reform and opening up policy, 40 years ago, the market mechanism was not perfect, and the industrial structure needed further adjustment. However, with the advantage of low labor costs, China still attracted a large amount of foreign investment, introduced advanced technologies, and produced goods with at competitive prices. In the process, Chinese businesses gradually shifted from labor-intensive to technology-intensive industries, which, in turn, promoted China's economic growth. With the development of China's economy and trade, the proportion of low-tech products in its export volume has gradually declined, while its medium and high-tech products have achieved rapid development. At the same time, the comparative advantage of China's labor costs is still maintained to a certain extent. Therefore, in high-end manufacturing, China still has the means by which to obtain a price advantage. Viet found that China obtains its advantage in the respect of stability of price in production factor (Viet *et al.*, 2017).

Scale effect of land is also an important comparative advantage. Song concluded that land plays an important role in manufacturing (Song *et al.*, 2017). China has a large land area (ranking only after Russia and Canada), and this promotes China's price advantage in some way. With the continuation of China's rural land reform, the land contractual management circulation system has improved, and more land potential has been realized. With the advancement of science and technology, more intensive and efficient management methods have also been achieved. The opening of local cities, promoting of investment, constructing of industrial parks and industrial high-tech zones, as well as the strong support of the government's finance, have created a high-quality development environment for the manufacturing industry, and have also resulted in profits brought about by China's land and human resource factors. In addition, a group of Chinese companies have stepped out and contracted land in some countries to form China's virtual land capacity and incorporated them into the Chinese land supply system.

2.2 Agglomeration effect

Agglomeration effect refers to benefits arising from the spatial agglomeration of economic activities. Benefits arising from the spatial agglomeration of physical capital, companies, consumers and workers include low transport costs, a great local market, a large supply of labor and the accumulation of knowledge and human capital (Fujita and Thisse, 2013).

Industrial agglomeration is another important factor in China's manufacturing price advantage. Mukhlis showed that population exhibited significant effect on agglomeration of manufacturing industry. Agglomeration of the manufacturing industry and population had a significant effect on economic growth (Mukhlis *et al.*, 2017). Otsuka found that both the agglomeration economies and the improvement of market access have a positive influence on the productive efficiency of Japanese manufacturing and non-manufacturing industries (Otsuka *et al.*, 2010). Industrial agglomeration, which includes specialized agglomeration, diversified agglomeration and industrial synergy, is considered to be a factor with a relatively important effect on total factor productivity. It often exhibits non-linear effects and even produces exponential growth effects. Industrial agglomeration interacts with synergies, spillovers and self-enhancing effects to form external economies.

In China, industrial agglomeration has formed a complete system. This system includes the agglomeration of the manufacturing industry, service industry and the circulation industry, all three of which cooperate with each other to form a collaborative advantage.

The agglomeration of the manufacturing industry is an important trend for the development of the manufacturing industry and can promote the rapid formation of manufacturing centers. To date, China has formed a manufacturing center represented by the Yangtze River Delta and the major urban agglomerations of the Pearl River Delta. The industrial agglomeration achieves industrial restructuring and economic growth through the full flow of regional resources and optimal allocation of productive factors. Numerous economic development zones have sprung up, resulting in the clustering of enterprises in the same value chains in those regions, forming regional manufacturing brand advantages, encouraging inter-industry technology transfer and information network construction, and promoting the industrial structure optimization and upgrading.

The gathering of service industry is business process outsourcing in service outsourcing, which can provide services such as supply chain planning, operation planning, process management, logistics management, information management, financing support, operating costs reduction and labor efficiency improvement by coordinating customer needs. The core of supply chain services is to provide customers with services such as supply chain planning, production technology support, logistics management, information technology support, financial support and business management. At present, many companies focus efforts on their strengths, and outsource their additional business to third parties. These companies' commercial platforms and service outsourcing networks could have a broad radiation and aggregation effect, providing a resource docking platform for all participants in the supply chain, including raw material suppliers, logistics suppliers, product distributors, capital suppliers and manufacturing companies.

The agglomeration of the circulation industry is mainly reflected in the fact that circulation enterprises can optimize relationships with consumers and producers, and bring about a detailed and division of labor and deep cooperation. At this stage, China has built an efficient, professional and socialized product circulation system, of which the logistics industry covering all cities and counties across the country is an outstanding representative. The concentration of the circulation industry has enabled the competitive advantages of different production companies to be realized. Under the influence of the agglomeration effect, each enterprise exerts its own advantages (be it in logistics, procurement, distribution, manufacturing or assembly), and effectively promotes the division of labor and cooperation in the supply chain.

3. Comparative analysis

3.1 Supply chain model in China

Supply chain management (SCM) is the management of materials, money, and information across the entire supply chain, from suppliers to component producers, final assemblers,

distributors (warehouses and retailers) and, ultimately, to the consumers. Proper selection, evaluation and management of supplier relationships can help to reduce conflict, opportunistic behavior, and transaction and inventory costs, while also enhancing quality, delivery, flexibility, customer service and innovative capabilities. All of this would go a long way toward helping Chinese firms gain a competitive advantage in the marketplace and improve financial performance (Liu and McKinnon, 2016).

Pyke (Pyke *et al.*, 2000) pointed out that when discussing the SCM in China, it is necessary to identify the nature of the Chinese firm. In China, there are state-owned enterprises, collective-owned enterprises and privately-owned enterprises. Pyke discovered that the differences among these three ownership types are generally insignificant. He also learned that these firms were more advanced than expected with respect to explicit manufacturing strategies, but were not as advanced as many Western firms in SCM. For example, Tan (1995) reported significant communication between firms and their customers and suppliers – but the nature of the communication was often limited to the downstream side. They note that firms that communicate with customers tend to do so with suppliers as well (Vollmann *et al.*, 2005).

The four operations objectives of manufacturing strategy are cost, quality, delivery and flexibility. Flexibility is defined on three dimensions – new product introduction, product mix and volume flexibility.

Low product cost is almost taken for granted in China. While cost is emphasized and improvements are difficult to achieve, the current emphasis is on delivery and quality. Quality became the dominant concern in the 1980s. Then, in the late 1980s and early 1990s, flexibility and delivery – or time-based competition – came to the fore.

A firm's relationships with suppliers and customers are significantly correlated with the firm performance index. It is common to ask customers about new products; consulting suppliers about new product development is a sophisticated form of SCM. Communication with supply chain partners is a supply chain initiative that could be valuable for Chinese firms. Chinese firms have either already realized the benefits, or are presently at a stage in which they can benefit from closer relationships with their supply chain partners. Further results confirm that downstream relationships are closer than upstream relationships. In general, a close relationship with suppliers is correlated with communication between the firm and its suppliers, and with consultation about production schedules (Pyke *et al.*, 2000).

Lee (2000) outlines a series of four stages of supply chain integration. Stage 1 is sharing information (e.g. about demand or production schedules); stage 2 is exchanging decision rights (such as allowing a vendor to make inventory stocking decisions); stage 3 is exchanging work (such as allowing a distributor to perform some final assembly and configuration); and stage 4 is an explicit scheme for sharing risks and benefits. Chinese firms share information more than they share work, and they share work more than they do decision rights. "Sharing work" might imply outsourcing, which is pursued by many firms. If there is little new product development, or if new products do not depend on a particular supplier's components, there is little need for discussion on that topic. If delivery times are important, communication about production schedules and delivery performance might be extremely valuable. Managers should form supply chain relationships that fit the complexity and uncertainty inherent in the situation. Choy *et al.* discussed application of an intelligent supplier relationship management system for new product development, including customer relationship management, supplier rating systems, and product coding systems. They found that outsourcing cycle time and delivery delays were greatly reduced when this system was used (Sayed *et al.*, 2017).

China's supply chain is composed of enterprise clusters, in which many individuals are concentrated into an enterprise cluster in one region. Completion can only rely on the supply of the entire cluster.

In the Chinese supply chain model, each SME is an individual in the cluster. Each industry is clustered in one area to form a supplier group. They supply products according to their respective positions in the supply chain. The industry's upstream supplier base supplies products to the mid-stream's supplier base, and the mid-stream's corporate group supplies products to the downstream business group (Figure 1).

3.2 Supply chain model in the US

In the USA, there is a wide acceptance that integrating operations with suppliers and customers in the supply chain is important. The balance between SCM and customer satisfaction is crucial for companies to gain a competitive advantage (Chow *et al.*, 2008).

Previously, there were two forms of integration that manufacturers regularly employed. The first involved coordinating and integrating the flow of deliveries between suppliers, manufacturers and customers. Many of these kinds of supply chain integration cannot satisfy the requirements of the just-in-time system. The second involved implementing product postponement and mass customization in the supply chain. However, recent SCM and relationship marketing research have attempted to increase understanding of the conditions for win-win partnerships. They have looked at customer-supplier relationships in which close long-term cooperation increased the value produced by the demand chain and decreased the cost of the chain. Several researchers have come to the conclusion that companies should divide their customer-supplier relationships into classes along the continuum from "arms-length" relationships to true partnerships. True strategic partnerships can definitely create new value, but they are costly to develop, nurture and maintain. Also, they are full of risks, given the specialized investments they require. The number of real partnerships a company can build and maintain is limited. Therefore, partnership types of relationship cannot be expected to be built with a large number of customers or suppliers, and focusing resources on building the right relationships requires careful planning and decision making (Kuei and Madu, 2001).

Some researchers agree that information sharing, internal integration, and external integration with suppliers are what influence supply chain performance. Huo pointed out that internal integration improves external integration and that internal and external integration directly and indirectly enhance company performance (Huo, 2012). Guo found that under confidentiality, the retailers infer the shared information from the wholesale price. It gives rise to a signaling effect that makes the manufacturer's demand more price elastic, resulting in a lower equilibrium wholesale price and a higher supply chain profit (Zhiling *et al.*, 2007).

In respect to information sharing, US companies tend to use various means to ensure information. The sharing process is smooth, and involves a lot of sharing of production plans and systems. As for internal integration, US companies emphasize operational integration of physical process flows between a company and its suppliers and customers. As for their external integration with suppliers, US companies show that long-term

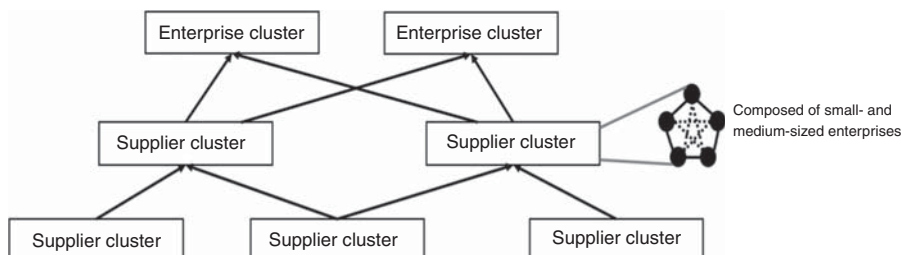


Figure 1.
Supply chain
model in China

partnerships with suppliers and customers are critical to achieving competitive advantages in the long run (Lambert, 2008). Cooperative relationships, or win-win relationships, are vital to moving companies that share the same focus forward.

In other research, there are three variables that assess a supply chain's quality; these are supply chain practices, supply chain concerns, and supply chain competence. US middle-line managers view supply chain competence as the primary factor in achieving better corporate performances (Tan, 2002).

In the US model, contracts are the basis of supply chain relationships. Suppliers form long-term strategic alliances. They share interests, information and resources. However, they also have competitive interest-sharing relationships. The focus of the US model is to establish a strategic partnership and manage outsourcing. Managing outsourcing requires the consideration of many factors, most important of which is the reliability of supply. Reliability is a prerequisite for the survival of the supply chain. Reaction rate is also an important factor. Fast and precise responses can greatly increase the effectiveness of the supply chain. At the same time, costs should be considered when managing outsourcing as well. High costs are a major factor in the adoption of outsourcing services. In addition, process and organizational factors can also affect the actual performance of management outsourcing (Figure 2).

3.3 Supply chain model in Japan

SCM has become a central aspect of corporate strategic planning in many Japanese firms in recent years. Those Japanese firms have a strong belief that “companies will no longer compete against companies, but rather supply chains will compete against supply chains.” They focus on improving their core competence, and developing global outsourcing and strategic alliances. There is an increasing focus in organizations on their ability to control what happens in the value chain outside their own boundaries, that is, the SCM competence. It has become critical for companies’ strategic competence and competitiveness in business. Examples to support this abound in popular business periodicals, such as in the success of Honda and Toyota (Park *et al.*, 2012). Matsuo discussed the Toyota Production System and concluded that a direct control mechanism is necessary for key parts and materials across the entire supply chain in Japan (Matsuo, 2015). Japanese executives attach importance to a supplier’s current manufacturing and design ability. Their strategic executive values include strategic fit, top management compatibility, functions of buyers and/or suppliers, and suppliers’ speed in development. Other factors emphasized include economic performance, financial outlook, financial stability and suppliers’ customer base (Vokurka *et al.*, 2002). In general, Japan has gained the competitive advantage in the manufacturing industry. It evolved from low labor costs-through scale-based strategy, focused factory and flexible manufacturing to a time-based competitive advantage (Lincoln *et al.*, 1998). In Japan, trust is

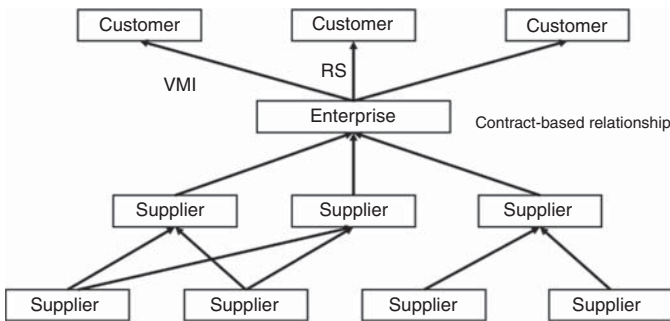


Figure 2.
Supply chain
model in the USA

widely diffused into the supply chain system, and keeps relations strong. Trust exists when a firm believes its partner is reliable and benevolent, and is composed of two essential elements. The first is trust in a partner's reliability, believing that the partner will stand by its word, fulfill promised role obligations, and be sincere. The other is trust in a partner's benevolence, believing that the partner will not act in a way that could harm the firm. Companies are interested in sharing information so that they can know more about the need of the customer at the end of the supply chain. A successful strategic alliance and integrated relationship with customers should be based on trust. In Japan, trust is regarded as the invisible glue which holds the partnerships of a supply chain all together (Bednar *et al.*, 2010). Cingano showed that High-trust regions and countries exhibit larger value-added and export shares in delegation-intensive industries relative to other industries (Cingano and Pinotti, 2016).

In the Japanese model, commitment is the basis for the survival of the supply chain. Under this model, enterprises are cross-shareholding interests and form a corporate group. The enterprise group is mainly composed of two parts, one part consists of large enterprises accounting for only 1 percent, and the other are small enterprises accounting for 99 percent. In the Japanese model, financing methods mainly rely on the links between integrated trading companies, and large companies and commercial banks. The integrated trading company is a monopoly comprehensive trading company unique to Japan. Its distinctive features are that it is large-scale, strong and has diversified operations and wide coverage. In addition to engaging in trade, it also operates real estate, transportation, insurance, leasing, resource and energy development, and intelligence. It also set up branch offices and subsidiaries overseas, actively organizes investment, and contracts large projects. From a vertical perspective, suppliers can be divided into Tier 1 suppliers, Tier 2 suppliers, etc. Within the supplier system, the Tier 1 supplier is a direct supplier (also called a supplier). He/she may also purchase raw materials or semi-finished products from other places, sell them after processing or assembly, and supply them to Tier 2 suppliers. Tier 2 suppliers would supply them to Tier 3 suppliers, and so on, thus forming a vertical supply system with division of labor. Therefore, the Japanese model has formed a complete industrial closed loop between suppliers and is self-fulfilled (Figure 3).

3.4 Comparison and analysis

Through the descriptions above, it is not difficult to find that the supply chain models in China, the USA and Japan revealed different characteristics (Table I).

These differences in characteristic among the three supply chain models result from the countries' different trading environments. Trading environments include both legal and ethical factors. In the US model, the market is mature and effective, and the legal system is complete, comprehensive and based on legal contracts, thus forming a trading environment with higher legal factors. In the Japanese model, the market also exhibits mature and effective characteristics, but unlike the USA, the Japanese model is based on commitment, so it relies mainly on a strong moral system, thus forming a trading environment dominated by moral factors. In the Chinese model, the market is competitive, and the trading environment is influenced by both legal and ethical factors. Nevertheless, China's current legal system is not perfect enough, and moral constraints are not mandatory (Figure 4).

In terms of relationship management in supply chain, there are also differences between China, the USA and Japan. There are two outstanding characteristics in the USA. First, corporate culture is based on building the common vision, emphasizing employee cultural identity, and the common interests of employees and enterprises. Second, US companies pay attention to the cultivation of knowledgeable employees in corporate management. Therefore, employees have greater autonomy to be creative.

In the supply chain relationship management of Japan, the identification of corporate culture is its first characteristic, and the family management system is its second characteristic.

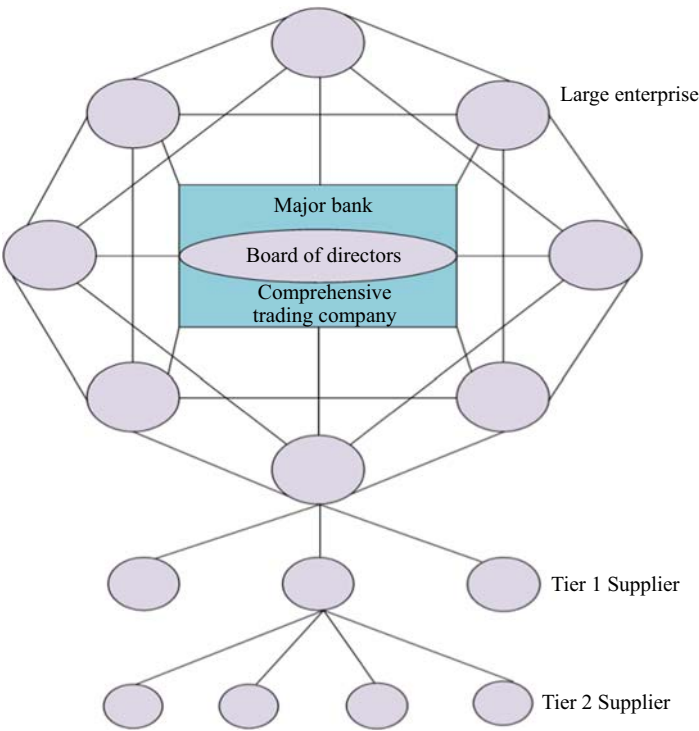


Figure 3.
Supply chain
model in Japan

Table I.
Comparison of
three models

	Trading environment	Management mode	Supply chain
China	Contract or commitment	1. Strict employee management 2. Small power of employee	1. Agglomerated cluster 2. Mostly SMEs
USA	Contract	1. Common interest of enterprise and employee 2. Autonomy of employee	1. Strategic partnership 2. Management outsourcing
Japan	Commitment	1. Enterprise culture acknowledgment 2. Family-run management	1. Large enterprise domination 2. Closed-loop industry

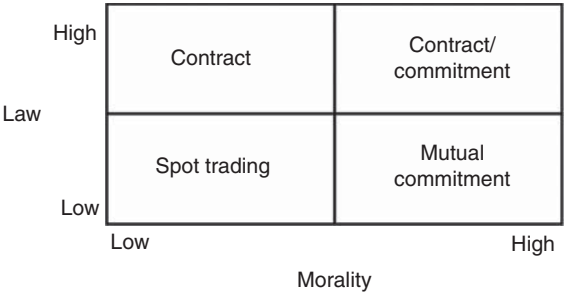


Figure 4.
Factor table of
trading environment

The family-style management system has many advantages, such as simple management level and unified management on command. It is both effective and has a low management cost.

China's enterprises strictly manage the behavior of employees. Under this kind of management, individual employees do not have greater power or influence or sufficient uniqueness. Managers often ignore employees' human side and instead aim to meet absolute standards.

The particularity of China's supply chain lies in environmental differences, model differences and management differences when compared to other countries.

The government is an important environmental factor. In China, land is not privately owned. By contrast, land ownership in the USA is capitalistic, and occupation of private land is higher than that of the federal government land. Japan's land ownership is mainly private. All land can also be owned by individuals or legal persons. Decentralized small-scale operations are also a major environmental difference. In China, small- and medium-sized suppliers in the supply chain are mainly self-employed, and the supply chain is too long to become a special feature of China's supply chain model.

Differences in supply chains have led to corresponding differences in their management. In terms of strategic management, considering that each industry is a completely competitive market, the strategic management status of individual enterprises declines, and the strategic position of the group rises. The rapid response of managers is also important. In terms of marketing management, a management degradation from 4P (i.e. product, price, channel and promotion) to 2P (i.e. price and product management) is observed. Cooperation with a specific company is less important and the interaction with practitioners in the entire industry is more important. The status of strategic partnerships declines and the importance of interpersonal networks rises. In general, Chinese supply chain model has the following characteristics. First, relationship between suppliers is more dynamic. There is no monopoly in the market. The relationship between enterprises and suppliers in each link is more flexible and is not restricted by large suppliers. Second, it is required to solve more uncertainty due to the unique size and agglomeration of China's supply chain. Therefore, the ability to control and resolve uncertainty is particularly important. Third, business transfer is more frequent. In each industry, the production capacities and prices of all individual enterprises are highly similar and business transfers are relatively convenient, which leads to more frequent transfers.

Todo found that ties with distant suppliers improve productivity more than ties with neighboring suppliers and suggested that access to diversified ties is important for improving productivity and innovation capability through knowledge diffusion (Todo *et al.*, 2016). Therefore, forming virtual scale and virtual capabilities in China's supply chain could help China keep winning the competitive advantage. SMEs in the industry can restructure their production capacity. Concentration of the industry provides conditions for specialization, which is conducive to improving the overall efficiency and economic benefits of the supply chain. IT and other support services can be provided by third parties so as to achieve cost savings, professionalism and resource sharing.

4. Application discussion

4.1 Present situation of high-tech zones

In China, the term "high-tech zone" refers to a "National-Level High-Tech Industry Development Zone." Companies located in these zones not only benefit from better infrastructure and access to talent, but can also receive special incentives such as lower tax rates (Slater, 2018). The first China high-tech zone was established in Beijing in 1988 and is called Zhongguan Science Park.

High-tech zones typically reflect the scale and agglomeration effect of Chinese manufacturing and service industry. They have made great contributions to Chinese technological and

economic development in the past 30 years. China has been in the process of transformation and upgrading of economic structure with the help of high-tech zones. In 2017, GDP of all the high-tech zones is 9.52 trillion yuan, accounting for 11.5 percent of China's GDP. There are 52,000 high-tech enterprises in high-tech zones, accounting for 38.2 percent of those nationwide (Torch High Technology Industry Development Center of the Ministry of Science and Technology, 2018). Meanwhile, high-tech zones have provided strong support to business incubation of small- and middle-size enterprises (SMEs).

4.2 Present situation of innovative SMEs

Innovative SMEs have a clear life cycle. According to statistics, the average SME life in China is about four years, 15 percent of those are over ten years. The average SME life in China is much shorter than those in European and American countries. Although the existing industrialized services have laid an important foundation for the rapid development of innovative SMEs in high-tech zones, “survival” and “development” problems of innovative SMEs in China still exist. There are some existing problems in the industrialized service system of innovative SMEs in the high-tech zone. Entrepreneurial incubation system is inadequate, resources support is insufficient and the industrialization development of SMEs in different stages lack strong support.

4.3 Building virtual supply chain capabilities in high-tech zones

Appropriate innovative industrialization service system for SMEs is important in building virtual supply chain capabilities in high-tech zones. The system provides public service support for innovative SMEs and is dominated by local governments. All types of enterprises and institutions such as financial institutions and professional service enterprises run through the growth and development of innovative SMEs (Figure 5).

A perfect park management service system should be established to provide high-quality administrative regulations, certification, enterprise management and technical support services for the development of innovative SMEs.

Innovative SME supply chain logistics system should be constructed to lower the channel cost in procurement, production, sales and inventory, which would help innovative SMEs expand market channels and achieve profit growth.

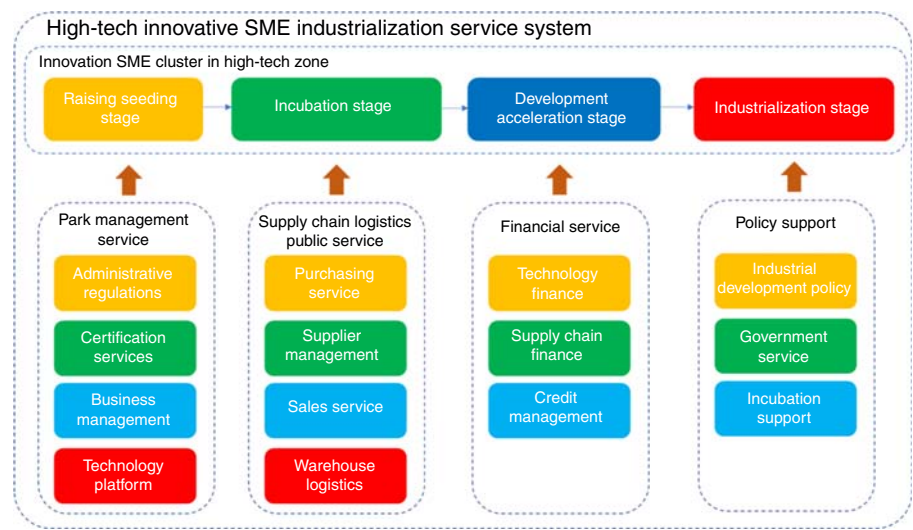


Figure 5.
High-tech innovative
SME industrialization
service system

Financial service system in high-tech zones should be improved, which could provide financial support as well as security for the development of innovative SMEs.

Meanwhile, local governments and administrative authorities of high-tech zones should actively participate in the construction of innovative SME industrialization service system. They should strengthen institutional innovation, and accelerate the transformation of role in innovation to help innovative SMEs develop better and faster.

5. Conclusion

Chinese products have significant price advantages over those in developed countries. There are two structural factors: scale effect and agglomeration effect. Scale effect of human resources results in the comparative advantage of labor costs. Scale effect of land resources results in the construction of industrial parks and industrial high-tech zones, thus helping China build a great land capacity and adequate supply system. Industrial agglomeration in China has formed a complete system including the manufacturing industry, service industry and the circulation industry. Under the influence of the agglomeration effect, each enterprise exerts its own advantages in logistics, procurement, distribution, manufacturing or assembly, and effectively promotes cooperation in supply chain.

After comparison analysis of China, USA and Japan in the respect of trading environment, management mode and supply chain, characteristics of Chinese supply chain are summarized. First, relationship between suppliers is more dynamic. Second, it is required to solve more uncertainty due to the agglomeration of China's supply chain. Third, business transfer is more frequent.

With those characteristics taken into account, forming virtual scale and virtual capabilities in China's supply chain could help China keep winning the competitive advantage. SMEs in the industry can restructure their production capacity. Concentration of the industry provides conditions for specialization, which is conducive to improving the overall efficiency and economic benefits of the supply chain.

The concept of forming virtual scale and virtual capabilities typically applies to building an innovative industrialization service system for SMEs in high-tech zones. The industrialization service system could help innovative SMEs to deal with the "survival" and "development" problems. Park management service, supply chain and logistics service and financial service should be provided with the active support of local governments.

Research on modern supply chain system in China could make a significant contribution to the supply chain knowledge system, providing guidance for theoretical research such as methodology of dynamic resource allocation and application of an innovative SME service system in the supply chain. After the characteristics of the modern supply chain system being analyzed, the operation mechanism design of the dynamic system should be studied in the future to broadly empower supply chain development in China.

References

- Aghion, P. and Howitt, P. (1992), "A model of growth through creative destruction", *Econometrica*, Vol. 60 No. 2, pp. 323-351.
- Bednar, J., Bramson, A., Jones-Rooy, A. and Page, S. (2010), "Emergent cultural signatures and persistent diversity: a model of conformity and consistency", *Rationality and Society*, Vol. 22 No. 4, pp. 407-444.
- Bombardini, M., Gallipoli, G. and Pupato, G. (2012), "Skill dispersion and trade flows", *American Economic Review*, Vol. 102 No. 5, pp. 2327-2348.
- Chandler, A.D. (1977), "The visible hand: the managerial revolution in American business", *Journal of Financial Economics*, Vol. 3 No. 1, pp. 305-360.

- Chow, W.S., Madu, C.N., Kuei, C.H., Lu, M.H., Lin, C. and Tseng, H. (2008), "Supply chain management in the US and Taiwan: an empirical study", *Omega*, Vol. 36 No. 5, pp. 665-679.
- Cingano, F. and Pinotti, P. (2016), "Trust, firm organization, and the pattern of comparative advantage", *Journal of International Economics*, Vol. 100, pp. 1-13.
- Fujita, M. and Thisse, J.F. (2013), "Economics of agglomeration", *Journal of the Japanese and International Economics*, Vol. 10 No. 4, pp. 339-378.
- Grossman, G.M. and Helpman, E. (1991), "Innovation and growth in the global economy", *MIT Press Books*, Vol. 1 No. 2, pp. 323-324.
- Huo, B. (2012), "The impact of supply chain integration on company performance: an organizational capability perspective", *Supply Chain Management: An International Journal*, Vol. 17 No. 6, pp. 596-610.
- International Monetary Fund (2011), "Staff country report", International Monetary Fund, Washington, DC.
- International Monetary Fund (2014), "Spillover report", Washington, DC.
- International Monetary Fund (2016), "External sector report", Washington, DC.
- Kuei, C.H. and Madu, C.N. (2001), "Identifying critical success factors for supply chain quality management (SCQM)", *Asia Pacific Management Review*, Vol. 6 No. 4, pp. 409-423.
- Lambert, D.M. (2008), "Supply chain management: processes, partnerships, performance", Supply Chain Management Institute, Florida.
- Lee, H.L. (2000), "Creating value through supply chain integration", *Supply Chain Management Review*, Vol. 4 No. 4, pp. 30-36.
- Lincoln, J.R., Ahmadjian, C.L. and Mason, E. (1998), "Organizational learning and purchase-supply relations in Japan: Hitachi, Matsushita, and Toyota compared", *California Management Review*, Vol. 40 No. 3, pp. 241-264.
- Liu, X. and Mckinnon, A.C. (2016), "Theory development in china-based supply chain management research: a literature review", *International Journal of Logistics Management*, Vol. 27 No. 3, pp. 972-1001.
- Matsuo, H. (2015), "Implications of the Tohoku earthquake for Toyota's coordination mechanism: Supply chain disruption of automotive semiconductors", *International Journal of Production Economics*, Vol. 161, pp. 217-227.
- Mizobuchi, H. (2014), "Returns to scale effect in labour productivity growth", *Journal of Productivity Analysis*, Vol. 42 No. 3, pp. 293-304.
- Mukhlis, M., Bernadette, R., Taufiq, T. and Rosmiyati, C. (2017), "Agglomeration of manufacturing industrial, economic growth, and interregional inequality in South Sumatra, Indonesia", *International Journal of Economics and Financial Issues*, Vol. 7 No. 4, pp. 214-224.
- Otsuka, A., Goto, M. and Sueyoshi, T. (2010), "Industrial agglomeration effects in japan: productive efficiency, market access, and public fiscal transfer", *Papers in Regional Science*, Vol. 89 No. 4, pp. 819-840.
- Park, D., Krishnan, H.A., Chinta, R., Assudani, R. and Lee, M. (2012), "Elephant and Samurai: differences between Indian and Japanese supply chain management", *Journal of Managerial Issues*, Vol. 24 No. 2, pp. 207-224.
- Pyke, D., Robb, D. and Farley, J. (2000), "Manufacturing and supply chain management in china: a survey of state-, collective-, and privately-owned enterprises", *European Management Journal*, Vol. 18 No. 6, pp. 577-589.
- Romer, P.M. (1989), "Endogenous technological change", *Journal of Political Economy*, Vol. 98 No. 98, pp. 71-102.
- Sayed, M., Hendry, L.C. and Zorzini Bell, M. (2017), "Institutional complexity and sustainable supply chain management practices", *Supply Chain Management: An International Journal*, Vol. 22 No. 6, pp. 542-563.

- Shen, G. and Gu, A.Y. (2007), "Revealed comparative advantage, intra-industry trade and the US manufacturing trade deficit with China", *China & World Economy*, Vol. 15 No. 6, pp. 87-103.
- Slater, M. (2018), "List of China high-tech zones", available at: www.chinacheckup.com/blogs/articles/china-high-tech-zones (accessed December 10, 2018).
- Song, M., Wang, S. and Singh, S.K. (2017), "Market competition, green technology progress and comparative advantages in china", *Management Decision*, Vol. 56 No. 1, pp. 188-203.
- Tan, K.C. (2002), "Supply chain management: practices, concerns, and performance issues", *Journal of Supply Chain Management*, Vol. 38 No. 4, pp. 42-53.
- Tan, L.H. (1995), "Mergers and acquisitions in china", *Economic Review*, Vol. 80, November, pp. 15-29.
- Todo, Y., Matous, P. and Inoue, H. (2016), "The strength of long ties and the weakness of strong ties: knowledge diffusion through supply chain networks", *Research Policy*, Vol. 45 No. 9, pp. 1890-1906.
- Torch High Technology Industry Development Center of the Ministry of Science and Technology (2018), "National high-tech zone innovation capability evaluation report", Scientific and Technical Documentation Press, Beijing.
- Viet, H.T.T., Shuang, L., Rukhsana, R., Nadeem, I.M. and Abrar, F.M. (2017), "An economic response of export performance and comparative advantage of rice trade between China and Vietnam", *Russian Journal of Agricultural and Socio-Economic Sciences*, Vol. 61 No. 1, pp. 180-187.
- Vokurka, R.J., Zank, G.M. and Lund, C.M. III (2002), "Improving competitiveness through supply chain management: a cumulative improvement approach", *Competitiveness Review: An International Business Journal*, Vol. 12 No. 1, pp. 14-25.
- Vollmann, T.E., Berry, W.L., Whybark, D.C. and Jacobs, F.R. (2005), *Manufacturing Planning and Control for Supply Chain Management*, McGraw-Hill, New York, NY.
- Xiao, O. and Zhiyong, L. (2011), "Human capital comparative advantage in large developing countries", *Chinese Economist*, Vol. 6 No. 1, pp. 22-31.
- Zhiling, G.A., Fang, F.B. and Andrew, B.W.C. (2007), "Supply chain information sharing in a macro prediction market", *Decision Support Systems*, Vol. 42 No. 3, pp. 1944-1958.

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