

Research on Global Supply Chain Model of Multinational Corporations Based on Global Production Network Theory-- Apple Corporation as an Example

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Abstract. From the 20th century, with the development of manufacturing Industry, the concept of division of labor and globalization had become more and more important, manufacturing companies have formed a global production network based on the division of labor in the product value chain. As a well-known company, Apple has built a global supply chain based on this theoretical foundation, as a result, brought Apple huge commercial profits and increase its proportion in the market share. This paper analyzes how Apple flexibly uses the global production network to reduce its production costs and increase profits, as well as the problems that may appears by using this theory. The analysis show that Apple has become a leading company in the electronic technology industry by maximizing the use of global resources and high-precision production processes and techniques, giving it a discourse power of choosing manufacturers. At the same time, Chinese manufacturers are basically in the middle or lower level of Apple's supply chain, which can be most easily abandoned and replaced.

Keywords: Production network, Manufacturing, Supply chain, Apple Inc.

1. Introduction

In the book "The Wealth of Nations" (A Study of the Nature and Causes of National Wealth), Adam Smith systematically elaborated on the basic elements of economic growth, which are: division of labor, capital accumulation, and foreign trade. The division of labor and trade are endogenous and mutually reinforcing, while the division of labor depends on the scales of the market. The greater the scales of the market, the deeper the division of labor will tend to be[1].

Since the twentieth century, as the manufacturing process has become more modern, the concept of division of labor has become more important.

Especially in the wave of global economic integration, enterprises from various countries have formed transnational inter-enterprise division of labor cooperation mainly through outsourcing. Due to the more frequent exchanges between countries' economies and other aspects, this global division of labor has gradually stabilized and formed a global production network based on the division of labor in the product value chain.

The reason why globalized industrial division of labor emerges and becomes more and more important is that from the enterprise level: enterprises can fully evaluate and utilize the resources, geography, human resources, environment, and other factors of different countries around the world to build factories according to local conditions, thus greatly reducing the production costs of enterprises, forming economies of scale and increasing company profits; to the countries or regions that have been chosen, the construction of these factories does not only create labor jobs and increases employment, but also promotes the development and upgrading of local industries.

Apple is a global electronics industry which has build up its own successful model for multinational companies. This paper will combine the global production network theory and Apple's

actual operation to let more people understand the reason why the company has become the industry benchmark also the risks faced by Apple's global production strategy in the context of today's times, such as the shutdown of production due to the epidemic, are also issues worthy of consideration by Chinese multinational companies.

With this information, this paper will first present the theoretical strategies used by Apple in selecting manufacturers based on economic formulas, and on this basis, it will present how Apple operates to increase the efficiency of its entire production chain based on the global production network theory. Finally, the essay will present the risks of Apple's global production by combining the production background of Apple.

2. Literature Review

With the deepening of economic integration, Gary Gereffi and others established the concept of Global Commodity Chains (GCCs) and Global Value Chains (GVCs).

Economic geography scholars like Peter Dicken built the theoretical framework of Global Production Networks (GPNs) from the perspective of geographic space and economy on this foundation, combined with the early cross-border business activities of enterprises. This work has garnered a lot of attention from academics in the field of social economics and other fields to study[2]. For instance, a theoretical framework for the governance of global value chains was developed by Gereffi et al. (2005), who came to the conclusion that there are five different models of global value chain governance[3]. On the basis of their research of the traditional competitiveness of the previous writers, Coe et al. improved the theoretical framework of the so-called economic and political system of global production networks. Scholars have primarily examined regional economic growth from the standpoint of certain industries. Using the example of garment manufacture in Cambodia, Arnold et al. (2017) investigated the various power connections between capital and labor in global networks and take into account the role of cultural economics in doing so[4]. Based on an analysis of BMW's investments in East Bavaria, Germany, and Rayong, Thailand, Coe et al. (2004) examine the impact of strategic coupling on regional development in the context of global production networks and regional economies[5].

As a large multinational corporation, Apple's construction of its global production network is a crucial production strategy, and the building of its facilities in China gave China a chance to integrate into the world economy in the 1990s. However, domestic economists have noticed a considerable disparity in the standing of suppliers in the value chain between nations. Kang et al. (2019) deconstructed the value of Apple's cell phone components and analyze the status of suppliers in the value chain and its evolution across countries[6]. Based on the export complexity index, Qiu et al. (2012) found that although the value chain of China's manufacturing industry has been encouraged by the global production network, there are still industry gaps[7]. The variations in the profits made by suppliers in the product manufacturing chain across nations reflect the factors that businesses like Apple took into account when deciding on a worldwide production network strategy. From the perspective of the degree of market competition, specifically using Apple, Boeing, Intel as case studies, Liu (2011) concludes that manufacturing firms consider technology and cost trade-offs according to the strength of market competition and adopt different production segmentation approaches[8]. However, scholars mostly analyze from the perspective of value chain status, and there is not much literature that analyzes Apple's global production chain strategy from the perspective of the global production network and its risks, and with specific current events [9]. In summary, this paper will analyze Apple's global supply chain model based on the global production network theory, using its theoretical analysis of Cost- capacity, lead firm action strategy, and risk environment, and combining it with related events, such as the epidemic.

3. Theoretical analysis

3.1. Detailed introduction of global production network theory

Globalized production network shows when the multinational companies dividing their product value chain into different independent parts, and then distributing each part globally to find the lowest cost of production factory, and finally form a product value chain composed of several countries together, in addition which also includes different stages of the international division of labor.

Research has found that the global production network is constantly expanding and developing rapidly, the most obviously changing happens in the machinery industry in the secondary industry also the tool transportation industry.

Global production network theory 1.0 is mainly divided into the research on the strategic management value chain, network, the research of embedding and steering in relationship, actor-network theory, and GCCs and GVCs.

Michael E. Porter is the first person who introduced value chain analysis into strategic management. Starting from the internal environment of the enterprise, he put forward the value chain analysis to solve the original shortcomings of this theory. He mainly used the value chain analysis to analysis internal environment of the enterprise and competitive advantage. After that, this theory has been continuously developed and has become an effective way to control the cost of an enterprise.

Through the operation of enterprises, the performance of enterprises can be greatly improved and stabilized the risks, the enterprises that contribute to the environment will also be easily trusted by the market during economic crisis, making it easier to obtain debt financing and keep the prices of the stock in a stable trend.

With the outbreak of the global economic crisis in 2008, globalization went from an accelerated development to a period of deep adjustment. The growth rate of global trade decreased from 7% to 3%, and the speed of globalization was greatly reduced. At the same time, developed countries put forward industrialization strategies with the return of advanced production industry and the revitalization of manufacturing as the core; at the same time the risks and uncertainties are also increasing such as Brexit, Trade disputes between China and the United States, COVID-19, geopolitics, ecological pollution and control, Russo-Ukrainian War and other uncertainties.

GPN2.0 redefines the global production network and roughly divides the main factors that affecting it into four aspects: cost-capacity ratio, the agent of the market, financial constraints and market environment. GPN2.0 was born under the influence of more dynamic, subdivided and flexible consideration of multiple factors. GPN2.0 is divided into leading enterprises, strategic partners, professional suppliers (which industry-designated), professional suppliers (cross-industry), ordinary suppliers, major consumers, etc. to refine the entire supply chain. GPN2.0 explains the global production network more dynamically. With the deepening of globalization, all the links of production are driven by the whole body, therefore, comprehensiveness, dynamic and meticulousness are the main characteristics of GPN2.0[10].

3.2. Introduction to factor endowment theory

In the continuous promotion of global economic integration, a new production organization model of global production network led by multinational companies has gradually formed, and Apple is the leader among them. On the concept of "cost and capacity" in the global production network theory to explain the question of "why Apple chose global division of labor", Heckscher-Ohlin economist has put forward the factor endowment theory, which believes that the scarcity of factor endowment among different countries has laid the foundation of international trade. The basis of international trade. The cost of production depends on the price of factors of production and the proportion of the factor structure of the product. Factor Abundance measures a country's factor endowment. Factor abundance is defined by comparing the relative prices of factors, where represents a country's labor factor prices like wage rates, and represents the price of capital factors as the interest rate.

The calculation formula for element abundance:

$$E = \frac{w}{r} \tag{1}$$

The larger the E value, the more abundant the capital factor of a country, and, conversely, the more abundant the labor factor. The relative factor abundance affects the country's choice in international trade, but in addition to this, enterprises should also consider the proportion of the composition of the factors of product production, i.e. factor intensity. Assumptions M country suppliers produce goods X the country produces goods N The country produces goods Y, let the wage rate be w_M , w_N and the interest rate is r_M , r_N , assuming that at the same relative prices of factors.

The supplier's production cost formula is:

$$C = w \times L + r \times K \tag{2}$$

The formula can be transformed into:

$$K = -\frac{w}{r} \times L + \frac{C}{r} \tag{3}$$

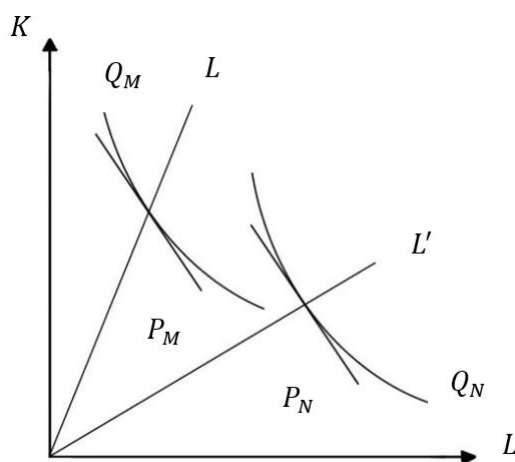


Figure 1. Production cost line of X and Y

Give hypothesis that the interest rate of country M is higher than that of country N, as $r_M > r_N$. The equal cost lines of both countries-- P_M and P_N are tangential to their equal production lines-- Q_M and Q_N at A and B point respectively. As shown by the graph L is steeper than L' and Q_M is closer to the capital vertical axis, while Q_N closer to the horizontal axis. So M country suppliers production X are capital-intensive, and N country suppliers production Y are labor-intensive.

4. Strategies and choices of Apple’s global manufacturers

Global production network theory is an important theoretical basis for Apple to choose producers, such as inter-enterprise control and inter-enterprise cooperation. Inter-enterprise control is a highly externalized business process that is directly outsourced and strictly controlled for the production and assembly of components, while the inter-enterprise cooperation provides supplier the chance to participate in the R&D process and have equal bargaining power. According to the characteristics of the products analyzed above, Apple reasonably uses the global production network theory to select suppliers and strategies of cooperation from different countries, so as to build its own global supply chain.

Among Apple's many manufacturers, Foxconn, as the main company which assemble the components, does not have the power to purchase components. Instead, it must purchase the components that provided by the manufactures designated by Apple and purchase them at a suitable price[11]. This approach greatly weakens the rights of manufacturers and has succeeded in establishing a strong and inseparable working relationship between Apple and these suppliers.

In addition, Apple uses its influence and scale to obtain the most cost-effective products at the most suitable price. Apple controls almost the entire complex supply chain. Apple's selection of

producers is very meticulous, including assessing the quality of supplied products, the technical capacity and scale of the manufacturer's factory, also the cost of production of each manufacturer.

4.1. Visit manufacturers in the early stage

The first important part is to investigate the ability of manufacturers. Before selecting a manufacturer, Apple will send their employees to visit multiple manufacturers which produce the same types of products with a complete and professional set of criteria, such as whether the supplier can produce the high-quality products that Apple required, the number and quality of factory workers and capital such as machinery, also check whether the manufactures can produce the products in limited time with high quality.

4.2. Negotiation with suppliers before signing the contract

Apple will conduct many detailed negotiations with the manufacturer before officially signing the contract. Ensure that the cooperation between the two sides is based on the premise that they can both be profitable. Apple will not choose only one producer for each part, instead, it will choose multiple suppliers to negotiate at the same time. In this process, while comparing the cost performance of producers, it can also judge the company's production and operation situation through negotiation to minimize the risks.

4.3. Cooperation mode

Once everything is confirmed and a contract is signed, Apple will provides these manufacturers with full information and the production processes of the products that they need to ensure that the products produced satisfied the company's needs at a greatest possible extent. While starting production, Apple will send a team with business knowledge and professional skills to the manufacturer to supervise and inspect the whole production process to ensure that the products produced meet Apple's requirements[12].

It is because of these meticulous steps that Apple repeated over and over when selecting suppliers, and also Apple's high requirements and details. This helps Apple to increase its proportion in the market.

5. Risks to apple's global production network

A global production network can leverage the resources, labor, policies, and other advantages of various nations and areas throughout the world to their fullest potential for production operations, reducing costs and maximizing profits. Despite the substantial advantages of this sprawling industrial network, there are nevertheless risks. Recent events like the British leaving the European Union, trade tensions between China and the United States, the effects of the COVID-19 outbreak, geopolitics, ecological pollution, and governance should make environmental hazards the most obvious issue. The following factors increase the dangers and uncertainties that multinational corporations and global economic organizations must deal with.

5.1. Impact of the US-China commercial war.

The US put roughly 300 businesses on a blacklist and applied duties; more than 90% of these companies are suppliers of electronic and replacement parts, including many of Apple's manufacturing partners. This marked the beginning of the Sino-US trade war [13]. When the list was made public, Apple initially changed a number of suppliers. However, the list includes a number of producers of raw materials in addition to manufacturing providers, which raises the price of raw materials and increases the cost of transportation for the creation of Apple products. This resulted in a substantial rise in goods pricing. Because of the price increase, consumer demand fell, which negatively impacted the company's profits. This instance demonstrates that political factors continue to have a significant role in the functioning of the corporation and choice of suppliers.

5.2. The impact of the Covid-19 epidemic on the worldwide

The Covid-19 virus unexpectedly emerged in early 2020, and many nations shut down in reaction. As a result, only 36–40 million Apple phones were shipped in the first quarter of 2020 [14]. Again, the severe pandemic that hit Shanghai earlier this year had a big effect on Apple's supply chain. More than half of Apple's top suppliers have facilities in Shanghai, and some of those firms' production is subject to relatively severe epidemic control procedures in Shanghai, according to the manufacturer list that Apple has disclosed. The launch of Apple's computer line items has been delayed by at least 3–5 weeks due to a nearly two-month labor stoppage and production slowdown [15]. It is clear how the outbreak has affected production. Additionally, Apple recently sent out a notification alerting some of its suppliers that it plans to successively construct new plants outside of China and expand output. Possible risks of shifting some production factories to Southeast Asia.

5.3. Impact of factory relocation to Southeast Asia

Apple is actively altering the structure of its production network in response to the various pressures of rising labor costs, Sino-US trade tension, and the new crown epidemic. Apple has extended its presence in Southeast Asia in recent years, particularly in Vietnam and India. Assembled items are evolving from headphones to low-end mobile phones, and Apple's suppliers in Vietnam have increased from 14 in 2018 to 23 in 2021 [16]. Suppliers in India have also increased from 1.3% in 2019 to 3.1% in 2021. Unquestionably, when it comes to labor prices, nations like Vietnam and India have a clear advantage over China. Although both nations' infrastructure is subpar, logistics are inefficient, and the industrial and supply chain systems are inefficient, it is still unclear whether Apple's Southeast Asian production network can cut prices.

6. Conclusion

In conclusion, as economic globalization continues to advance and deepen and the economic climate changes, Apple has benefited greatly from the production network's global production architecture, earning it a top spot in its sector and large profits. By locating suppliers globally, Apple has also exploited its extensive production network to create a reliable supply system, lowering production costs and boosting productivity. Additionally, the global production network can support the continuous expansion of the global market and create crucial interests to deepen the international division of labor by allowing each nation to capitalize on its advantages and increase the scale of production to make up for its own production-related weaknesses. Additionally, it can encourage global competition, which will considerably raise labor productivity and innovation levels, improving global competitiveness. The design of the global production and manufacturing chain, however, is not without its flaws and instability. Using Apple as an example, it can be seen that the company has a dominant and unbeatable advantage when it comes to using a globalized production network to find suppliers. This is very unfavorable for Chinese producers, who lack the right to make decisions and are easily replaced, which also increases the risk of rising unemployment in China and makes employment more unstable. Given the circumstances, Apple and Apple's Chinese suppliers are advised to do the following:

6.1. To Apple: To Address the Supply-side Shortage

Apple should intensify management of the global production supply chain, prompt encouragement of qualified companies to resume work and production, and expedited decentralization of the global production supply chain, which would increase the global production network and transfer risks to specific regions. Alternately, decentralize and hedge other sectors to create a larger, more developed, more stable global production network.

6.2. To Apple's Chinese producers

Outside of the dry midstream and downstream segments, Chinese manufacturing enterprises are the most readily abandoned in the whole Apple supply chain. Chinese businesses can only shift China's place in the world's production network by working to advance technology, shift from labor-intensive to technology-intensive production, and build a diverse client base to lessen their reliance on American firms like Apple.

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