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Economic Analysis of the Driving Mechanism of Japan Cement Industry Development and Enlightenments

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Abstract

As one of the nations with well-developed cement industry, Japan cement industry has experienced three developing stages since the 1980s under the influence of macroeconomics, resources, and energy. The cement industry in Japan has achieved remarkable results owning to the proper adjustments of its structures and the low-carbon technology innovations. Here, the author aims to unearth the key of success of Japan cement industry by analyzing the driving mechanism of its development from an economic perspective, and thus provide some insights and enlightenments for improving the international competitiveness of China cement industry.

Key words: Japan cement industry; Driving mechanism; Industrial structure; Circular economy; Enlightenments

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The cement industry is one of the most important industries in the history of modern human industrial development due to its close relations with national economy and people's livelihood. Because of its large consumption of energy and generation of waste (of both water and gas), the sustainable development of the cement industry has attracted much attention worldwide, leading to the emergence of studies of the cement industry economics. The main raw material used in cement production – limestone – is a non-renewable resource. Increasing in cement demand will lead to shortage and eventually exhaustion of limestone. Bateer, Vice Chairman of Chinese People's Political Consultative Conference (CPPCC) National Committee, Deputy Minister of the United Front Work Department of Communist Party of China (CPC) Central Committee, and Director and Secretory of National Ethnic Affairs Commission of the People's Republic of China (PRC), has pointed out that the fundamental requirements of China cement industry development include economic prosperity and sustainable development, environmental management, and social responsibility. In his study, Runqing Yue connected the cement industry with circular economy, proposing the practices of cement industrial economic under circular economy should be divided into three stages: consumption reduction, reuse, and recycle. The well-advanced cement industry is mainly resulted from the large amount of limestone reserves in Japan. Though there has been overcapacity in Japan cement industry, which has been limited by macroenvironment, energy consumption, and ecological issues, due to the economic recession over the past four decades, Japan cement industry hold valuable experiences in the sustainable development of the industry through industrial restructure and low-carbon technology innovations. This article aims to provide a more in-depth economic analysis of the driving mechanism of Japan cement industry development and strategies for improving the international competitiveness of China cement industry.

1. HISTORY OF JAPAN CEMENT INDUSTRY DEVELOPMENT

Japan cement industry has a history of over 140 years since the Meiji Restoration, and its industrial technology is very mature. It has reached the modern production stage ever since the end of 20th century due to its high productivity and efficient production process. Despite being challenged by the global economy instability,

global resources shortage, and energy and environment limitations, Japan cement industry has made great achievements in being eco-friendly and sustainable by continuously increasing its scientific research, and obtains a strong international competitiveness. From the perspectives of economy, production capacity, and technological innovation, the history of Japan cement industry development over the past 30 years can be roughly divided into three stages.

1.1 Rapid Development (1985-1991)

With the rapid economic growth of Japan in mid-1980s (No.1 growth rate among all developed countries), the real estate of Tokyo and the stock market had skyrocketed. The Japanese government proposed an increasing domestic demand-based economic strategy, which is based on investments at both the national and private level and an expectation of personal consumption expenditures expansion, and it led to an increase in large-scale infrastructure and real-estate constructions. Because of the 'Announcement of the Ministers of Finance and Central Bank Governors of France, Germany, Japan, the United Kingdom, and the United States' in 1985, the Japanese yen appreciated drastically: twice compared with the value of Japanese yen under the fixed exchange rate system in 1971. As a result, the prices of Japanese exports rose, which weakened its competitiveness in the international market. However, a series of fiscal and financial measures taken by the government increased the demand in the domestic market. Japan cement industry developed rapidly during this time. The domestic consumption of cement increased almost linearly from 67 million tons to 86 million tons, and its production amount became 3rd in the world.

1.2 Industrial Restructure (1991-2000)

A serious economic bubble started to emerge during the early stage of the appreciation of Japanese yen, that is, during the rapid development of cement industry, the economic bubble burst in 1990. Beginning in 1990s, the average annual growth rate of Japan's GDP was only 1.1%. Japanese economists started to become aware of the three major issues: excessive investment, excessive equipment, and excessive employment. Although these issues were mitigated due to the short-lived economic growth after 1999, they continued to worsen after 2000. The cement production continued to drop after a brief increase in 1996 as a result of these issues. Meanwhile, challenged by global resource shortage, energy and environmental limitations, the threat to humanity imposed by greenhouse gases emission had become prominent. Japan cement industry had achieved great technology improvement in terms of CO_2 emission reduction and waste recycling. In the mid-1990s, Japan first proposed the term 'eco-cement', using municipal waste incineration ash and sewage sludge and other wastes as the main raw materials of cement production. During the process, the toxic substances in the waste are removed, and the quality of the cement produced is comparable to Portland cement. From that point, Japan cement industry gradually moved in the direction of an eco-friendly and sustainable development.

1.3 Circular Economy (2000- Present)

Japan's cement production in 2000 was 83.3 million tons. With an averaged decrease rate of 2 million tons/year and an overall reduction of 24%, the cement production of Japan fell to 73.2 million tons in 2006 and later 55.96 million tons in 2016, despite the slight increase in 2005. Meanwhile, Pacific Cement and other companies had invested 60% into building the world's first eco-cement manufacturing facility – Ichihara Eco-Cement Manufacturing Company – established in Chiba City, April 2001. This project was also a major part of the eco-city plan of Chiba to advance the concept of zero-pollution. In July 2002, eco-cement become the first eco-friendly product to be included in the Japanese industrial production standard 'Japanese Industrial Standard of Environment'. It was selected as the standard product in the Green Product Procurement Policy in March 2004. Despite the fact that the traditional cement industry was very mature, and research on traditional cement technologies was decreasing, universities and research institutes in Japan still valued the research and development of raw materials much, such as the discovery of new cement types and new materials for cement productions, and property, performance, and lifespan of cement and concrete. Even during the economic recessions, the biennial 'Cement Technology Conference' continued to be held in Japan. The 71st Cement Technology Conference of Japan was held in Tokyo in May 2017, many research proposals were discussed with a slogan 'Cement in 22nd Century'. The main research focuses in Japan with respective to cement and environment is alternative fuels, efficient usage of waste, and pollution reduction. The circular economy of Japan cement industry has officially started in 21st century.

2. DRIVING MECHANISM OF JAPAN CEMENT INDUSTRY DEVELOPMENT

The correlation between economic development and cement industry is demonstrated through the world population, GDP, per capita GDP, and cement production from 2010 to 2019 shown in Figure 1. The world economy was recovering back, and the world population was also increasing steadily. There is a positive correlation between cement production and economic growth; from 2010 to 2014, a 21% increase in GDP is accompanied by a 27% increase in cement production; between 2014 and 2015, the cement production decreased with an economic downturn. The economic development has an apparent effect on the cement industry development.

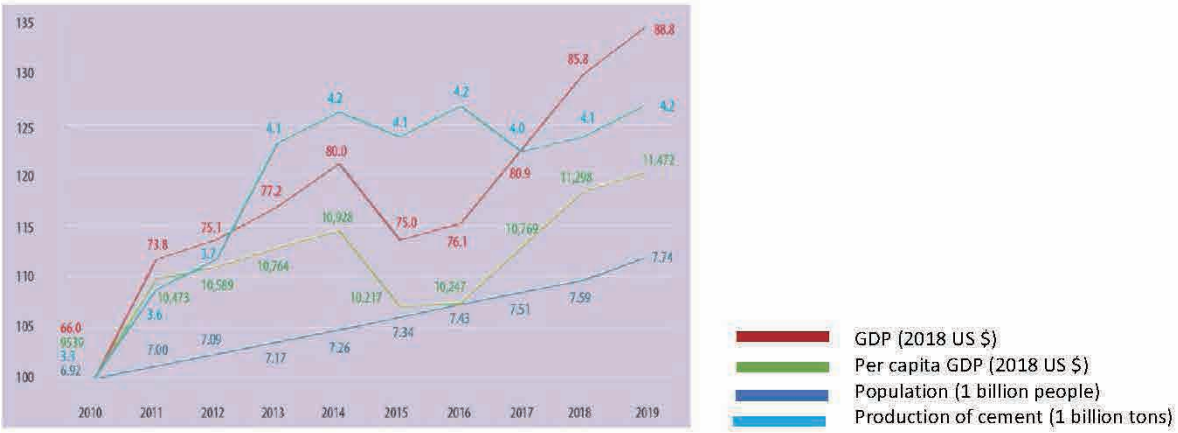

Figure 1
The world population, GDP, per capita GPD, and cement production from 2010 to 2019.
Source: Data from World Bank Data Indicator, USGS.

The correlation between economic growth and cement industry development was also confirmed in Section I. In addition, Japan cement industry was affected by four factors. The first one was the government. In 1985, Japan economy was gradually transforming from an export-led growth to a consumption-led growth. The government had planned to spend 430 M yen on public utility construction, which was equivalent to 1.6 times of the amount of investment in the period of 1981 to 1990. The huge investment on public utility construction by the government greatly increased the demand of cement and pushed the development of cement industry in Japan further. The second factor was the innovation of new technology. In order to survive in the highly competitive market, Japanese cement companies had invested heavily on technology development, setting off a third wave of technological innovation in the manufacturing industry such as preparation and production of raw material, technological advance in sintering and grinding, and energy efficiency. With a steady double-digit increase of private investment, equipment that was more eco-friendly and energy saving had been invented and produced, which greatly promoted the scientific and technological development of Japan cement industry. The third factor was the weakening of domestic demand caused by the economic recession. The domestic demand for cement in Japan depended mainly on public utility investment and civil construction investment. Based on the results of annual private investment surveys issued by the Industrial Bank of Japan in March 1992, private investment in 1992 had decreased by 4% compared to 1991. This was the first sign of economic growth slowdown since 1984. Though the official insisted that the economic growth would be 3.5% for the fiscal year of 1992, the beginning of an economic recession was apparent, and the domestic demand on cement had begun to decline. Investment in public utility construction by the government served as a buffer in the development of cement industry at that time. Overall, the growth rate of domestic cement demand was decreasing. The last factor was the impact of international market on Japan's cement exports. Due to the decrease in domestic demand on cement, Japanese cement companies were forced to enter the international market using multiple management methods. Japan's cement exports reached a peak of 8.32 million tons in 1985, later it fell to 434.6 million tons in 1987, followed by a slow increase for the next few years, and it reached 6.964 million tons in 1989, showing a high instability. This was partly due to the decrease of Hong Kong's cement import from Japan and partly due to the 'Antidumping Duty Order' issued by the United States against the gray Portland cement and cement clinker from Japan. In addition, more countries in Asian had joined the cement export market, making it more difficult for Japan.

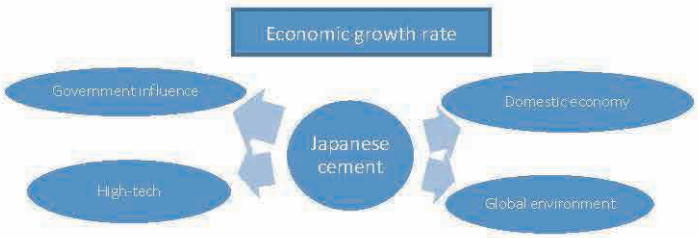

Figure 2
Demonstration of the driving mechanism of Japan cement industry development

3. EXPERIENCES OF JAPAN'S ADVANCED CEMENT INDUSTRY DEVELOPMENT

3.1 Implementation of the Sustainable Development

Eco-friendly and sustainable development is the inevitable future of the modern cement production. It is necessary to increase the amount of research related to collaborative disposal of waste. It is very likely that the cement industry can become an eco-friendly industry, as demonstrated by the remarkable achievements of Japan cement industry. Cement companies in Japan mainly focuses on energy saving and being eco-friendly. In order to reduce the costs, cement companies promote alternative fuels to all factories. They also effectively reuse industrial wastes from other industries, including tires, plastics, ashes from thermal power plants, and sewage sludge. This not only helps reduce the costs, but also saves resources and contributed significantly to environmental protection. Because of the energy intensive nature of cement industry, Japan cement industry had focused on energy efficiency and conservation and being eco-friendly from the start. It has invented and developed several measures and technologies of increasing energy efficiency with low emission. In addition, the cement industry recycles waste and by-products from other industries, including slag, ashes, and tires as the raw fuels and blend materials for cement production, with an annual recycling capacity of approximately 28 million tons. The Japanese government had set an annual target of 400 kg of waste/ton of cement back in 2001. Through improving manufacturing techniques, continuous innovation of high-tech, and recycling of industrial wastes, Japan cement industry is able to produce cement and concrete that are multifunctional with low emission and long lifespan.

3.2 Industrial Structure Reform Has Effectively Mitigated Overcapacity

In early 1980s, Japan had experienced serious overcapacity, and the utilization rate of cement kilns had dropped to 80%. The 'General Plan of Cement Industry Reform' proposed by the Ministry of International Trade and Industry in August 1984 had a great positive impact on the successful response of the cement industry to the crisis of overcapacity. The plan mainly focuses on the following four aspects: (1) Substantial reduction of excess capacity. The cement production capacity was reduced by 31 million tons, accounting for 24% of the total production capacity at that time. It eliminated mostly the excess and outdated equipment in the industry. This elimination was mostly completed by the end of March 1985 and completely finished by March 1986; (2) Limitation of cement production capacity. No new production lines were allowed before June 30th, 1988, except for technical renovation; (3) Mutual assistance among enterprises. Joint cement enterprise was established among cement companies aiming for a stable operation and market; (4) Other supporting measures. Special considerations were given to important issues including supporting small and medium-sized enterprises, employments, regional economic stability, and transformation of enterprises. In 1991, industrial structure transformation and reconstruction of Japan cement industry were carried out, and joint cement enterprise was established. The per capita cement production was approximately 8,000 tons in Japan. The structural change in the industry is a reflection of changes in the cement production capacity. Currently, there are 17 cement companies companies and 30 manufacturing factories in Japan. In additions, there are three cement plants due to the special nature of the products. We are not going to discuss them here.

3.3 Circular Economy: From Overcapacity to Eco-Friendly

The domestic cement industry in Japan had suffered from overcapacity since 1990s. Nowadays, most cement companies in Japan have achieved production capacity control and become eco-friendly. Though the overcapacity issue has not been solved completely, the situation had definitely improved much. The excess capacity became useful during the reconstruction period after the earthquake in the East Japan in 2011. Disposal and recycling of waste became the new function of cement plants, and this new function helped keep the plants running. The Japanese government has also increased the research and development of technologies to remove heavy metals and chlorine from waste. In addition, domestic cement companies in Japan have recently shifted to high-tech production and have already entered the industrialization stage of high-tech production. They have built new factories or cooperated with other companies through bidding in order to engage in the research and development of high-tech production of fine ceramics, electronics materials, and electronic parts. The extension of this industrial chain has allowed Japan cement industry to improve their eco-friendly, high-tech productions.

4. ENLIGHTENMENTS FOR CHINA CEMENT INDUSTRY DEVELOPMENT

Japan cement industry has a long and established history. After a long period of industrial structure adjustment and reform and technological progress, its technology, equipment, management, quality, and environmental protection are the best in the world. It meets the high quality and high performance requirement of cement used for major projects while keeping it sustainable and eco-friendly. Since China's reform and opening up in 20th century, the cement industry in China has developed

rapidly along with great progress of its production technology, and China has become the world's largest cement producer with the largest export of cement. However, China cement industry still needs improvement in many aspects, such as technology advances and management. Many of the small and medium-sized cement companies in China are still below the international standard in terms of technology, equipment, management, cement quality, environmental protection, and other technical and economic aspects. Issues such as uneven development of companies, overcapacity due to disordered construction, lack of elimination of outdated production capacity, insufficient profitability need to be addressed urgently. During the new economic era, under the circumstances of frequent occurrences of 'The Black Swan' and 'The Gray Rhino' global economic events and lack of cement demand in the market, improving the international competitiveness of China cement industry has become more prominent than ever.

4.1 Rely on Technological Innovation and Promote Sustainable Development

Japanese cement companies like to apply the latest scientific and technological achievements into practice. Many assembling lines of outdated kilns such as vertical kiln, wet kiln, and outdated dry kiln were closed, dismantled, or replaced by assembling lines of new models such as cyclone preheat kiln. The cement companies focus on development of new technologies to improve production efficiency, decrease energy consumption, reduce emission, enhance the process of removing heavy metal and chlorine in industrial and municipal waste, and improve the technology of cement industry. Together with its technological innovation ability and modern enterprise management, Japan cement industry obtains the most advanced energy-conserved, waste material utilization technology. Under the economic globalization, China cement industry should strengthen the integration of service and facility and reduce of outdated equipment in order to improve its logistic efficiency, achieve the target of 10% waste utilization rate of the raw materials, maintain a steady revenue rate in the domestic market, and improve the production efficiency and adaptability. China cement industry should seek cooperation with Japan about the key technologies such as energy conservation and waste utilization through ODA integration with financial supports from NEXI and JBIC and expand the emerging economy markets by merging and investments. The cement industry in China should also promote the establishment of international standards of energy conservation and emission of greenhouse gases and strengthen the competitiveness of our environmental protection ability through emission reduction technologies such as low-temperature clean combustion and non-concrete utilization. We must fully promote the new dry-process cement production technology and eliminate companies with outdated technology, and let the technological innovation leads us toward a sustainable development of cement industry.

4.2 Government + Market' Driven Industrial Structure Adjustment and Reform

The economy system in developed economies is relatively mature, and industrial development is mainly mediated by free market with little intervention from the government. Countries that attach great importance to industrial policy, such as Japan, intervene the development of industrial enterprises, affect the industrial allocation, and promote industrial structure adjustment and reform through issuance of industrial policies by the Ministry of International Trade and Industry. We have shown earlier that the economy has a significant impact on the allocation of cement industry. During the rapid economic development, the production capacity is relatively large; during periods of a steady economy or economic recession, cement companies would focus on expanding their industrial chain or opening up international markets to gain profits from other industries. It is essential to give full play to the leading role of the government in the industrial structure optimization process. The government should formulate industrial structure strategies suitable for economic development based on its national interests, issue policies that promote effective economic structure adjustment, establish and improve the market system, regulate competitions within the market, and create a stable environment for economic structure adjustment. We should promote the technological innovation and progress, development of advanced technologies, elimination of outdated production capacity, and enhancement of the overall development level of the cement industry through both a positive and ordered market competition and an effective administration.

4.3 Develop Circular Economy and Guide the Industrial Chain Extension

China cement industry should focus on the production model reform and the development of the circular economy. On one hand, we should improve our technologies in energy conservation and environmental protection, adopt multiple measures and means to reduce energy consumption and gases emission, as well as recycling and reusing the by-products of other industries, such as slag, ashes, plastics, and tires, as the raw or blending materials for cement and concrete production, which will allow us to lower the costs, save the natural resources, being eco-friendly at the same time; on the other hand, we should learn the business strategic planning from Japan cement industry, keeping cement as the key product while extending the industrial chains to other related fields, and construct a new industrial structure through the continuous promotion of extending and expanding of the industrial chain.

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