

Impact of Import and Export on Innovation Efficiency in Japan

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Abstract. Japan's economic development has always been a research hotspot in the academic community. Japan experienced a huge trade deficit in 2022, and in the four years before 2022, Japan's import and export fluctuations were very balanced and structurally stable. Based on the fact that Japan will experience a huge trade deficit in 2022, this paper analyzes the relationship and current situation of innovation and trade in Japan with existing theories and data. As an old developed country, Japan is hardly affected by the local competition brought by the trade impact on its local innovation at the present stage. Moreover, the independent research and development of its advantageous industries led by enterprises makes its advantageous industries more competitive in the trade market and obtain more export opportunities. More export opportunities promote innovation in large Japanese companies and create a virtuous cycle of innovation and exports in Japan.

Keywords: Innovation, Competitive effect, Independent research, Japan, Technology spillover.

1. Introduction

Japan experienced a huge economic crisis in the 1990s, which led to a decline in corporate output and a reduction in corporate innovation. In the early 2000s, the Japanese economy began to recover, again going through the economic cycle until the post-pandemic era. The Japanese economy began to recover, and corporate investment in innovation began to recover. In addition to the endogenous innovation generated by local enterprises, external factors caused by trade shocks also have a huge impact on the R&D innovation of local enterprises (). The record trade deficit in 2022 (since 1979) will turn into a trade surplus in 2023. Meanwhile, nominal and real GDP grew by 7.9% and 1.7%, respectively. Japan's total research funding for 2022 also reached a record high, an increase of 4.9 percentage points over the total research funding for 2021. Especially in the areas of biotechnology and artificial intelligence innovation. Although both research employment and total R&D funding in Japan saw significant growth in 2022 and reached an all-time high, the number of patent applications declined year after year since 2017 until the 2022 patent filing percentage trend began to pick up. At the same time, as one of the world's developed countries, Japan's innovation efficiency is affected by the import and export opportunities of intermediate goods. High-quality and low-cost intermediate goods from developing countries have made Japan dependent on technology, but its innovation efficiency, especially in biotechnology and artificial intelligence, has improved. Therefore, it is particularly important to study and analyze the current situation that Japan imports a large number of intermediate products under the current economic recovery and high trade deficit, which leads to the improvement of enterprise innovation efficiency and competition effect. By studying and analyzing the current situation of Japan's innovation trade, this study provides more progress for the subsequent research on trade innovation relations.

Yang et al. study the competitive effects of the export products of developing countries on the innovation of firms in countries with similar technological levels. Mainly confirmed that in the import, the competition effect will bring positive effects to the enterprise innovation. This innovation growth is even more significant in import-source countries with similar levels of domestic exports. But at the same time, due to the existence of the competition effect, high-quality low-price imports will emerge in the market, which will crowd out enterprises with insufficient productivity and cause market impact [1]. Tariffs are quantified and the impact of tariff structure on free trade is considered. Through the survey of China's manufacturing industry, it is confirmed that the impact of capital goods imports on domestic productivity is much greater than that of intermediate goods imports [2]. Zhang studies the

promoting and inhibiting effects of import on innovation are studied. It found how different imported goods contributed to the innovation of different types of importing firms. The main research results show that the import of capital goods can significantly improve the innovation efficiency of local enterprises, and the capital and intermediate goods from developed countries can inhibit the innovation of enterprises in imported developing countries. The import of capital goods and intermediate goods from developing countries, due to the same level of technology is similar or higher than the level of technology leads to the effect of promoting firm innovation. On the whole, the import of capital goods and intermediate goods helps the innovation of general trading firms but inhibits the innovation of trading firms engaged in mixing and processing [3].

Shu and Steinwender expound on the impact of different types of import shocks on the trade and innovation of enterprises in countries with different levels of development, but due to data limitations, they only investigate the innovation and import and export of large enterprises. In general, when large enterprises in developing countries or emerging economies face import competition, trade has a positive effect on enterprise innovation. And in the free trade of advanced economies, such as Europe. The effect of trade on the innovation role of large firms is very weak. This paper also points out the same research results as many literature, in the initial stage of enterprise, the higher the productivity of the company in the face of trade shocks, the more obvious the improvement of innovation efficiency and productivity caused by imports. On the contrary, the effect on enterprises with low productivity in the initial stage is more or less negative. In summary, firms in developed countries have a positive impact on innovation when faced with export opportunities and access to intermediate goods, while firms in emerging countries have a significant increase in innovation efficiency when affected by import competition and trade liberalization [4]. Roberts et al. created a dynamic model to measure investment, exports, and productivity of the business model. Through model decision analysis, the complex relationship between the three is studied. Highly productive firms of their own choice can drive firms to participate in exports and invest in research and development. Research and development and investment in innovation are both proportional to productivity. In discrete decision-making, high costs result in fewer R&D plants than exports [5]. Yu studies the correlation between technology import, technology import, and independent innovation on innovation quality and innovation quantity is demonstrated through the model. The results mainly show that technology import and independent research and development have a high impact on innovation quality, while technology import has a small impact on innovation quality. Independent innovation has greater elasticity to the number of innovations, which means that independent innovation has a proportional impact on the number of innovations, and the impact is large [6].

Branstetter analyzed the effect of foreign investment on technology spillover by taking Japanese multinational enterprises as samples through the framework. It assumes that international trade has a technology spillover effect and foreign investment has a direct regulating effect on the technology spillover effect. The empirical results show that foreign investment directly increases the technology spillover of Japanese firms [7]. Koike et al. mainly studied the Japanese government's policy on self-exploitation of resources. It studies the early goals of the Japanese government, the cooperative relationship between the government and enterprises, and various factors in the goal of overseas development. It mentions the Japanese government's vision of doubling the country's indigenous resources by 2030 [8].

Suzuki studied the trade relationship between Japan and the European Union. It also includes an analysis of Japan's complex trade relations with China, the United States, and the European Union, as well as an analysis of the impact of the trade war between countries on Japan and the relationship between Japan's domestic trade protection [9]. Tongurai studied the relationship between the Japanese banking system and the international banking system and studied the economic decision-making of the Japanese financial system under the international background from July to 2008. And try to prove the relationship between Japanese capital and banks [10].

2. The Situation of Japan's Imports and Exports

According to the 2022 annual data show released by the Japanese Customs in 2023, the main commodities imported by Japan are mainly intermediate goods with smaller technical barriers and bulk commodities. Such as semiconductors, communication machines, clothing, fossil fuels, etc. The largest share is fossil fuels, which account for 28.9 percent of Japan's total imports, or 33.7 trillion yen. In terms of the main exports, Japan's main exports are transportation equipment, electrical equipment, general machinery and so on. Among them, the largest proportion is transportation equipment, such as automobiles and ships. It accounted for 19.5 percent of total exports, reaching 19.1 trillion yen.

According to the study of Japan's imports and exports in 2022 for nearly 5 years (2019-2022), Japan's overall trade trend is very stable before 2022. The balance between imports and exports is well balanced and generally on the rise, except in 2020 due to the impact of the COVID-19 pandemic. However, from the perspective of the proportion, during the five years of 2022, Japan's overall export structure is very stable, and there is no major change in the export structure. At the import level, Japan's total imports in 2022 increased by 39.6 percent compared to 2021, contributing to Japan's huge trade deficit in 2022. In terms of import structure, Japan's imports of fossil fuels such as crude oil, liquefied natural gas, and petroleum products are much higher than in 2021. Its imports of fossil fuels in 2022 are 16.7 trillion yen higher than those in 2021, an increase of 98.1 percent.

In 2022, Japan's main trading partners in imports will be China, the United States, Saudi Arabia, Australia, and other countries. Among them, in Japan's import structure, China and the United States mainly export pharmaceutical products, general machinery, food, and daily necessities to Japan. In terms of energy import, Japan's main import countries are Australia, Saudi Arabia, and other countries. In terms of exports, Japan's main export trading partners are China and the United States. Its main exports to China are some capital goods and intermediate goods, while its exports to the United States are mostly final goods.

Due to geographical reasons, Japan lacks natural resources, and Japan is the third largest oil consumer in the world, so Japan's huge demand for oil needs to be met by imports. At the same time, the Japanese government also tried to develop its oil in the early 20th century, but with little benefit [8].

In 2022, the yen experienced a sharp depreciation, breaking through the 150 yen range for the first time. Since the fluctuations of the exchange rate system will also greatly affect the trend and direction of trade, it is necessary to study the relationship between the huge trade deficit faced by Japan and the international exchange rate in 2022. Therefore, it is very important for future literature to study the form of international currency exchange rate in 2022 to analyze Japan's trade, trade structure, different industries, and input in 2022.

3. Analysis of the Composition of Imports and Exports

As one of the most developed countries in the world, Japan has excellent technology in the high-tech field. Therefore, in the import and export market, Japan's electronics automobiles, and other goods, often have great competitiveness. According to Japan's foreign trade data, Japan's huge trade deficit in 2022 is mainly caused by a sharp increase in demand for products such as fossil fuels. Japan's total fossil fuel imports in 2022 increased by 98.1 percent compared to 2021. In the nearly 4-year range of 2022, except for 2020, the total amount of oil imports in the other years is very small fluctuation. The big fluctuations in 2020 are likely to be caused by the COVID-19 pandemic because, in addition to fossil fuels, other types of imports are also highly volatile in 2020. Japan is an island country surrounded by sea. In the interior of Japan, fossil fuels are scarce, and efforts by the Japanese government to develop the country's oil and other natural resources have not been successful. However, according to the findings of Koki, M. Mogi, the Japanese government is also committed to developing its mining capability in the future, and hopes to make a breakthrough by 2030.

In terms of exports, Japanese products are very competitive. According to a report by the Ministry of Commerce in Osaka, Japan, Japan's main export industries are automobiles, machine tools, and robots. Among them, the investment in advantageous industries also occupies a large part of each plate. At the same time, according to the Japan Patent Office's report on Japan's independent research and development and scientific research in 2022 released in 2023, Japan's overall scientific research investment in 2022 is very huge. 20.7 trillion yen is a record high for Japan. Meanwhile, among all industries, Japan has increased the proportion of research investment in AI and biotechnology. At the same time, in the advantageous industries such as AI and biotechnology, Japan's main R&D investment comes from enterprises, and the proportion of investment by non-profit groups is very low, and the proportion of investment by universities is also increasing year by year.

According to the comprehensive analysis and the existing theory, as a developed country, Japan is very dependent on the import of natural resources from other countries. At the same time, Japan is also importing low-technology normal goods produced in developing countries, as well as low-priced or high-quality intermediate goods that require secondary processing. Such as electronic parts, semiconductor parts, etc. According to Shu and Steinwender's theory, it is difficult for Japan, as an advanced economy, to have any significant positive effect on its local innovation in the face of import competition, but Japan can significantly promote the improvement of its local innovation quality or efficiency when it is faced with a large number of export opportunities. At the same time, as an old developed economy, Japan, as a developed country, will not face a lot of import competition in markets other than emerging industries. According to Robert, Shu, and Steinwender, current productivity in the face of trade shocks to local firms often determines how efficiently firms innovate in the face of competition. Low productivity in the face of trade shocks, is often because the productivity is not enough to effectively maintain their core industries, resulting in withdrawal from the market. Therefore, long-term trade shocks and competition will gradually make small enterprises with low productivity gradually withdraw from the market, while large enterprises will benefit from trade competition due to their high productivity and improve their innovation efficiency. Due to Japan's early period of opening up to trade, and its long history of world-leading industries and developed economies, Japan's local innovation in 2022 will not be benefited by a large number of imports, and Japan's large enterprises have been stabilized. At the same time, according to Yu and Li's theory, Japan has a high tendency toward independent research and development, because of its technological advantages in a large number of industries, it cannot rely on technology spillover from technology introduction and import. According to the data released by the Japan Statistics Bureau, the proportion of innovation investment of Japanese enterprises in Japan's advantageous industries is more than 50 percent. Therefore, Japan's advantageous industries have enough enterprises to independently invest in research and development products to maintain the competitiveness of products in the international market and export opportunities.

According to Zhang's theory, the general type of Japanese enterprises will have a positive effect on their innovation in the import of intermediate goods, while the enterprises engaged in trade processing will be negatively affected by innovation. High-quality intermediate goods will make local enterprises rely on it, and in Japan's intermediate goods import structure, most of the intermediate goods are imported from China and the United States. Therefore, when the technological difference between the two sides and the product is small, the local Japanese enterprises will be at a disadvantage when facing the competition of low-priced intermediate products and make other enterprises rely on low-priced intermediate products, which will hurt productivity and innovation effect.

4. Conclusion

This paper finds that the huge trade deficit Japan faces in 2022 is mainly due to the doubling of total imports of fossil fuels, while the proportion of imports and exports of other commodities has stabilized over the four years. Therefore, from the perspective of innovation, until the emergence of new global trend industries, Japan's import and export structure will not change again. At the same

time, as an economically developed country, Japan's main advantageous industries are biotechnology and AI. Japanese enterprises have the highest proportion of scientific research investment in advantageous industries in all types of institutions, so Japan's products have high competitiveness in the import and export market due to the independent research and development led by high enterprises.

Japan has faced trade competition for many years, so only large companies in non-emerging industries remain in the industry. Japan's trade structure can only be disrupted by emerging global industrial trends. At the same time, Japan's highly independent research and development leads to higher innovation quality and makes it more competitive in export, and greater competitiveness makes Japan's large enterprises face more export opportunities and once again promote the innovation efficiency of its large enterprises and form a virtuous circle.

Based on the background and theory of innovation, this paper analyzes the current trade deficit, trade status, trade structure, and trend of Japan in 2022. However, in international trade, exchange rates and international relations will have a huge impact on Japan's trade. Therefore, studying the exchange rate and international relations in 2022 will also play an extremely important role in analyzing Japan's trade. At the same time, the research on the Japanese government's policy trends such as the independent exploitation of crude oil can better supplement the blank of the policy background in the analysis of Japan's huge trade deficit in this paper.

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