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THE CONTRIBUTION OF HIGH - TECH EXPORTS TO JAPAN'S ECONOMIC GROWTH

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Abstract

Japan is considered one of the strongest economies in the world. Exports are the primary determinant of the success of the economic development in Japan. Japan is also considered one of the most important countries, that exports advanced technology globally. The study aims to identify the development of these exports, the commercial importance of advanced technology exports, and the relationship between advanced technology exports and each of total exports, GDP, and average per capita GDP. Descriptive approach and analytical approach, along with some statistical analysis tools, were used to measure the impact of the relationship of advanced technology exports on each of total exports, GDP, and average per capita GDP. The results showed statistically significant relationship between advanced technology exports and GDP.

Keywords: *Advanced technology exports, Economic development, GDP, Per capita GDP, Total exports.*

JEL Code : *C02, E44 and O14*

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1. Introduction

Advanced technology exports are considered one of the most important indicators of economic development in developed countries. Japan is regarded as one of the most critical countries, exporting advanced technology globally. Exports are also the primary determinant of the success of the Japanese economy, especially in the light of Japan's success in marketing its products to the world (Seyoum, 2004). Japan has also succeeded in maintaining the competitive advantage of its exports for decades (Yang, Liu & Mai, 2017). The increase in exports leads to an increase in the GDP and drives economic development, especially the exports of cars, electronics, ships, and chemicals (Bakari, 2017). The study aims to identify the role of advanced technology exports and the most important factors, influencing the development of advanced technology exports. Among the most crucial advanced technology exports are aircrafts and spacecraft products, medicines, computing machines, television, communications equipment, and medical devices, in addition to the gaming software industry, which was created and developed by entrepreneurs with outstanding innovative skills, based on research and development (Storz, 2008). The study seeks to investigate the extent of the role played by advanced technology exports in advancing and developing the economic development process in Japan. The analysis assumes a statistically significant relationship between advanced technology exports and total exports, GDP, and per capita GDP. The descriptive approach and the analytical approach were employed, in addition to the use of statistical analysis tools, to measure the statistical relationships between exports of advanced technology and total exports and GDP.

2. Literature Review

There is positive bidirectional relationship between the increase in the volume of foreign exchange and economic growth in the South Asian region. However, the proportion of advanced technology exports in total exports is still low, with the focus on low-tech products (Islam, 2022). Japanese exports have faced intense competition, mainly from China, Korea, and other East Asian countries. This led to the depreciation of its currency and the launch of a new macroeconomic program, "Abenomics," which achieved relative success. Germany benefited from its EU membership and the adoption of the euro. Both countries were negatively affected by the COVID-19 pandemic and interruptions to international supply chains (Zestos et al., 2021). There is bidirectional causal relationship between advanced technology exports and long-term economic growth. Exports of advanced technology have increased economic growth, capital formation, employment, and productive capacity in the fifteen countries of the European Union (Erkisi et al., 2019). The competitiveness of Japanese exports has declined, requiring strengthening its primary sources of competitiveness. In contrast, the Chinese economy outperformed the Japanese economy in 2010 (Roukanas & Karakostas, 2019). Japan has clear comparative advantage in optical, photographic, cinematographic, measuring, checking, precision, medical or surgical product and electrical machinery. However, there is no Revealed Comparative Advantage for pharmaceutical products (Roukanas et al., 2019). There is causal relationship between high-tech exports and economic development in Turkey, but only in one direction, where high-tech exports affect the economic growth (Dereli, 2019). High-technology exports are essential for long-term economic development,

while low-technology exports are important for short-term economic growth. Countries should reallocate their resources to achieve competitiveness in advanced technology exports for long-term economic development (Demir, 2018).

3. Statement of the Problem

Japan is considered one of the leading countries in advanced technology exports in the world. Several factors contributed to the development of exports, including the Export Incentives Law and adoption of the highest comprehensive quality standards. However, advanced technology exports declined at the end of the period 2007-2021, due to the Corona pandemic. It was also negatively affected by the global financial crisis and the rise in oil prices. Hence the problem of the study lies in analyzing the role of advanced technology exports in economic development in Japan, as measured by the variables adopted in the research, like total exports, GDP, per capita GDP and to what extent high-technology exports affected Japan's economic development.

4. Need of the Study

The study derives its importance from the need to understand the role of advanced technology exports in the economic development in Japan, especially the reputation and high quality that Japanese advanced technology exports enjoy in countries around the world, as revealed by the increase in total Japanese exports from about 792 to 910 billion dollars during the period 2007-2021. However, advanced technology exports declined from about 128 to 117 billion dollars. Then, the contribution of advanced technology exports to total exports fell from 16% to 12.8% during the same period, indicating the importance of studying and analyzing the role of advanced technology exports.

5. Objectives of the Study

The study aims to verify the impact of advanced technology exports on total exports of goods and services, on GDP and on per capita GDP.

6. Hypotheses of the Study

The hypotheses, on which the study was based, are as follows:

H1: There is statistically significant relationship between the number of researchers working in research and development and exports of advanced technology in Japan.

H2: There is statistically significant relationship between exports of advanced technology and total exports of goods and services in Japan.

H3: There is statistically significant relationship between the exports of advanced technology and the gross domestic product in Japan.

H4: There is statistically significant relationship between exports of advanced technology and per capita GDP in Japan

7. Methodology

7.1 Sample Selection

The sample of this research included advanced technology exports and some economic indicators (GDP, total exports, per capita GDP) during the period 2007-2021. Japan was chosen because it is one of the most important advanced industrial countries in the world. The study was based on a simple linear regression coefficient, to determine the relationship between advanced technology exports as an independent variable and the GDP, total exports, and per capita GDP, as dependent variables.

7.2 Source of Data

The data were gathered from numerous platforms of sources, accessible in websites. This paper utilized data from peer-reviewed scientific journals and World Bank websites.

7.3 Period of Study

This research covered a period of 15 years, from 2007 to 2021.

7.4 Tools used in the Study

To test the hypotheses, the correlation coefficient, determination coefficient and regression coefficient were used, to analyze the relationship between advanced technology exports and GDP, total exports and per capita GDP.

8. Factors for the Development of Japanese Exports

The growth of Japanese exports depended on several factors, the most important of which are the following:

8.1 Promotion of SMEs

Japan built its economic growth on SMEs, eliminating export obstacles and encouraging large institutions to rely on SMEs for parts production. This led to the growth of the Japanese economy (Kawai et al., 2002).

8.2 Geographical Distribution of Industry

The government distributed the industrial sector in rural areas as much as in urban areas, to achieve regional development balance, meet local market needs and develop industrial exports (Tiwari et al., 2003).

8.3 Export Incentives

The government issued an export incentive law, including provisions like deducting export expenses from the corporate tax base, to boost Japanese exports (Zhang et al., 2012).

8.4 Quality of Products

Japan is a global model in total quality management. No product is exported until it passes rigorous quality tests, increasing demand and recognition for Japanese exports (Suhaily et al., 2017).

8.5 Promotion of Exports

The Foreign Trade Authority was established to promote Japanese exports through various means, including organizing international exhibitions and providing market information (Martin et al., 2005).

8.6 Strategic Marketing

The marketing strategy included entering the market with high-quality products, at reduced prices, choosing appropriate distribution outlets and hiring foreign marketing research agencies (Sasaki, 2002). Market analysis was undertaken to facilitate speed of response to consumer needs (Ismail and Azab, 2023)

8.7 Research and Development (R&D)

Investment in R&D drives economic growth and competitive advantage. Japanese companies have used technology to develop various industries, from cosmetics to automobiles, and have implemented strategies for global market development (Tokuga et al., 2011; Buckley et al., 2009; Storz, 2008).

8.8 Evolution of R&D Researchers

R & D has positively affected both foreign trade and GDP, in the short and long term (Jorgenson et al., 2005; Altuzarra, 2019; Ziesemer, 2020; Lee et al., 2003; Wakasugi et al., 2008). State support for scientific research leads to an attractive and reliable investment environment that contributes to increasing economic development (Azab, 2022). The study by Tokuga et al. (2011), suggested that adjusting spending on R&D was

associated with actual profit management by Japanese electronics exporting companies. This implies a direct relationship between R&D spending and export profits. Another study (Gurler, 2021) found that R&D expenditures, patents and foreign direct investment positively impact exports of advanced technology. Researchers, obtaining patents, eventually lead to increased exports. In contrast, Jokanović et al. (2017) did not find any significant correlation between R&D workers and advanced technology exports in Japan.

8.9 Commercial Importance of Advanced Technology Exports

The commercial significance of high-tech exports is due to the percentage of high-tech exports covering Japanese imports and the contribution of high-tech exports to total exports of Japanese goods and services during the research period.

8.10 Impact of Global Events on Trade

The rise in oil prices led to a decline in trade exchange rates and a reduction in per capita GDP, slowing global trade growth due to the global financial crisis (Wong, 2010; Hannan, Appendino, et al., 2015). The dramatic rise in oil prices also led to a decline in the GDP growth rate, affected by the decline in external demand for total Japanese exports and advanced technology exports in 2015 (Taghizadeh-Hesary et al., 2019, Ismail., 2022). At the end of the period, the GDP, advanced technology exports, and total Japanese exports witnessed a massive contraction due to the COVID-19 pandemic, which negatively affected the global economy (Vidya et al., 2020).

8.11 Per Capita GDP

Table -3 shows a decline in advanced technology exports by about 9% (2007-2021) while total exports and GDP increased by about 15% and 8%, respectively. Per capita GDP

increased by about 10%. Advanced technology exports recorded their highest value in 2011, amounting to \$133.09 billion, accounting for about 14.5% of total exports and about 2.1% of the total GDP. In 2021, advanced technology exports accounted for about 12.8% of total exports and about 2.4% of the GDP. Japan was severely affected by the global financial crisis, the decline in total exports, the collapse in global industrial production, the erosion of the capital base of commercial banks, and the rise in oil prices (Kawai & Takagi, 2011; Hannan et al., 2015). The COVID-19 pandemic in 2020 led to a massive contraction in the GDP and world trade, affecting high technology exports, total exports, GDP, and per capita GDP in Japan (Vidya et al., 2020). Despite the decline in exports of advanced technology in Japan since the early nineties, Japanese exports are still the most developed and the best in terms of quality in Asia (Thorbecke et al., 2015; Seyoum, 2004). Studies indicate positive relationship between exports and economic development in Japan (Kiyota et al., 2008; Mahadevan et al., 2008).

9. Statistical Analysis of Data Regarding Contribution of High-Tech Exports to Japan's Economic Growth

Tables 1 & 3 reveal the relationship between exports of advanced technology, and total exports of goods and services in Japan. The correlation coefficient was 0.47, indicating a moderate positive correlation. The determination coefficient (R-squared) was 0.22, suggesting that 22% of the variation in total exports could be explained by advanced technology exports. The calculated F-value was 3.35, and the associated p-value (level of significance) was 0.09. Since the p-value was greater than the common significance level of 0.05, the result was not statistically significant. Therefore, the null hypothesis was accepted,

which states that “there is no statistically significant relationship between exports of advanced technology and total exports of goods and services in Japan.” These results differ from a study by Ekananda et al. (2017), which found positive relationship between advanced technology exports and total exports, leading to GDP growth. The study also highlights close correlation between advanced technology exports and the import of raw materials for advanced technology production. Jokanović et al. (2017) reported close relationship between science and technology inputs, R&D workers, and economic growth.

Tables-2 & 3 display the relationship between high-tech exports and GDP in Japan. The correlation coefficient was 0.60, indicating a strong positive correlation. The determination coefficient (R-squared) was 0.36, suggesting that 36% of the variation in GDP could be explained by high-tech exports. The calculated F-value was 6.82, and the associated p-value (level of significance) was 0.02. Since the p-value was less than the common significance level of 0.05, the result was statistically significant. Therefore, the alternative hypothesis was accepted, which states: “There is statistically significant relationship between high-tech exports and GDP in Japan.” For every increase of one billion dollars in exports of advanced technology, Japan’s GDP rises by approximately 24.60 billion dollars. This highlights the substantial impact of high-tech exports on the overall economic performance of Japan. The findings concur with the study by Belderbos (Capannelli et al., 2001), which emphasized that research and development intensity contributed to the development of high-tech exports in Japan. Attracting domestic and foreign investment, particularly in sectors like electronics, played a role in increasing Japan’s GDP. Similarly, Erkişi et al. (2019) found that advanced technology

exports can potentially boost GDP in European Union countries, emphasizing positive bidirectional relationship between high-tech exports and economic growth.

The study also revealed the relationship between exports of advanced technology and per capita GDP in Japan. The correlation coefficient was 0.57, indicating a moderate positive correlation. The determination coefficient (R-squared) was 0.33, suggesting that 33% of the variation in per capita GDP could be explained by high-tech exports. The calculated F-value was 5.91, and the associated p-value (level of significance) was 0.03 (less than 0.05). Therefore, the result was statistically significant. Consequently, the alternative hypothesis was accepted: “There is statistically significant relationship between high-tech exports and per capita GDP in Japan.” For every increase of one billion dollars in exports of advanced technology, Japan’s per capita GDP would rise by approximately \$181.10. Yang and Greaney (2017) found mixed results, regarding trade openness’s impact on income inequality.

The distribution of per capita GDP positively contributed to Japan’s economic development but negatively affected South Korea’s economy. While the redistribution of per capita GDP may have posed challenges to Japan’s growth, the country has successfully managed income inequality. At the beginning of the period (2007-2021), per capita GDP increased alongside the rise in advanced technology exports. By the end of the period, both advanced technology exports and per capita GDP stabilized, consistent with the statistical analysis. The results of **Yang et al. (2017)** indicate that Japanese exports may harm per capita GDP in importing countries. Advanced technology exports and capital-intensive exports (such as modern machinery and transportation equipment), used by most ASEAN countries, may be less competitive.

10. Findings of the Study

- There was statistically significant relationship between advanced technology exports and Japan's GDP, as every increase in advanced technology exports, at a rate of one billion dollars, would lead to a rise in Japan's GDP to 24.60 billion dollars.
- There was statistically significant relationship between advanced technology exports and the per capita GDP in Japan, as every increase in advanced technology exports by a billion dollars would lead to a rise in the per capita GDP in Japan, by an average of 181.10 dollars.
- No statistically significant relationship was found between advanced technology exports and total exports of goods and services in Japan.

11. Suggestions

To increase exports of advanced technology, it is important to focus on various aspects such as education, training, research and development, infrastructure development, promotion and attraction of domestic and foreign investment. This can be done by providing tax, customs, and credit incentives, and by developing investment legislation. It is important to rely mainly on multinational companies, with technological expertise and knowledge, which will help to increase exports of advanced technology. This, in turn, will improve the trade balance and drive economic development.

12. Conclusion

This research addressed the role of technology exports in economic development in Japan, by applying the correlation coefficient and regression coefficient, during the period 2007-2021. The results showed that advanced technology exports did have significant impact on GDP and per capita GDP, though advanced

technology exports did not have significant impact on total exports. Despite the strength of the Japanese economy, it was negatively affected by the global financial crisis and the Corona pandemic. Hence Japan may need to spend more on research and development and increase the opening of foreign markets to advanced technology exports.

13. Limitations of the Study

This research suffered from several limitations, especially from data accessibility. The study could use only 15 years, for the study of contribution of high-tech exports to Japan's economic growth.

14. Scope for Further Research

Further research could investigate several dimensions, related to Japan's advanced technology exports. For instance, scholars could explore the effects of research and development expenditure on the development of such exports, as well as on their competitiveness. Additionally, researchers could assess the impact of advanced technology exports on employment, productivity, and foreign trade in Japan. By analyzing these dimensions, one could gain a better understanding of the role of advanced technology exports in Japan's economy and society.

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Table - 1: Relationship between Advanced Technology Exports and Total Exports and Imports During the Period (2007-2021) in Billion Dollars

Year	Japanese advanced technology exports billions of dollars	Exports of goods and services from Japan In billion dollars	Imports of goods and services to Japan in billions of dollar	Percentage of advanced technology exports in total Japanese exports in billions of dollars	The percentage of coverage of advanced technology exports to Japanese imports in billions of dollars
2007	128.31	791.8	711.12	<u>16.20%</u>	<u>18.00%</u>
2008	130.25	880.16	862.72	14.80%	15.10%
2009	103.71	656.17	633.18	15.80%	16.40%
2010	129.81	859.17	782.08	15.10%	16.60%
2011	133.09	920.91	961.18	14.50%	13.80%
2012	129.2	904.15	1000.01	14.30%	12.90%
2013	111.06	822.72	948.36	13.50%	11.70%
2014	107.37	852.99	980.02	12.30%	<u>11.00%</u>
2015	98.25	775.05	799.67	12.70%	12.30%
2016	99.1	803.49	763.17	12.30%	13.00%
2017	106.18	867.41	928.25	12.40%	11.40%
2018	110.74	923.23	922.23	12.00%	12.00%
2019	103.9	894.08	908.95	<u>11.60%</u>	11.40%
2020	102.75	785.37	796.34	13.10%	12.90%
2021	116.51	910.49	936.41	<u>12.80%</u>	<u>12.40%</u>

Source: World Bank database (<https://data.albankaldawli.org/>)

Table - 2 : The Evolution of Advanced Technology Exports, Total Exports, GDP and Per Capita GDP During the Period (2007-2021)

Items Year	Japan's per capita GDP in dollars	Japan's GDP In billion dollars	Exports of goods and services from Japan In billion dollars	Japanese advanced technology exports in billions of dollars
2007	35,779.00	4580.00	791.80	128.31
2008	39,876.30	5110.00	880.16	130.25
2009	41,309.00	5290.00	656.17	103.71
2010	44,968.20	5760.00	859.17	129.81
2011	48,760.10	6230.00	920.91	133.09
2012	49,145.30	6270.00	904.15	129.20
2013	40,898.60	5210.00	822.72	111.06
2014	38,475.40	4900.00	852.99	107.37
2015	34,960.60	4440.00	775.05	98.25
2016	39,375.50	5000.00	803.49	99.10
2017	38,834.10	4930.00	867.41	106.18
2018	39,727.10	5040.00	923.23	110.74
2019	40,458.00	5150.00	893.78	103.90
2020	39,918.20	5060.00	785.06	102.75
2021	39,312.70	4940.00	911.09	116.51

Source: World Bank database (<https://data.albankaldawli.org/>)

Table-3: Statistical Analysis of Data Regarding Contribution of High-Tech Exports to Japan's Economic Growth

Item	correlation coefficient	The coefficient of determination R Square	F value	B regression coefficient	significance level
The relationship between high technology exports and total exports of goods and services in Japan.	0.47	0.22	3.35	2.58	0.09
The relationship between high-tech exports and GDP in Japan.	0.6	0.36	6.82	24.6	0.02
The relationship between high-tech exports and per capita GDP in Japan.	0.57	0.33	5.91	181.1	0.03

Source: World Bank database (<https://data.albankaldawli.org/>) and computed using SPSS.