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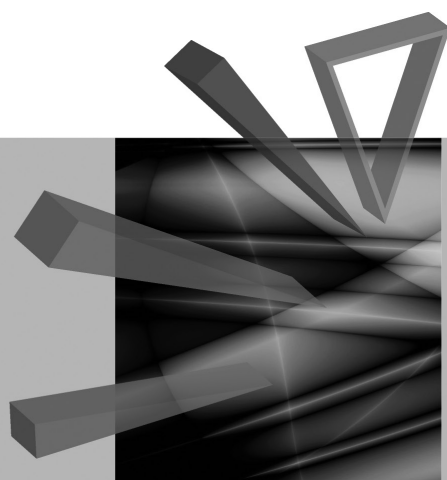
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# **Innovation Sources of Economies in Eastern Asia**



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## TECHNOLOGICAL INTENSITY OF JAPANESE MERCHANDISE TRADE

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**Summary:** Japan is perceived as a country which, thanks to technological development, has reached a high position in the international division of labour. It became noticeable especially after the crises of the 1970s and the early 1980s, when it appeared that Japan was offering successful high-technology products on international markets, and the share of these products in the total export of the country occupies an important place. In the first decade of the twenty-first century, the situation changed significantly. Japan, though still high in its technological position, started losing share in global flows of high technology goods (ICT among others), and the role of such products in total import and export flows of the country was declining rapidly. The negative trend can be observed in the case of the sectoral approach (sector of high, medium-high, medium-low and low technology) as well as the product one (products with high intensity in R&D).

**Keywords:** Japan, foreign trade, technology, international trade relations.

### 1. Introduction

The analysis of the long-term trends in international trade shows that merchandise exchange more and more increasingly included trade in goods with a high degree of technological development. One has to keep in mind that as a result of relatively short-term changes on markets, the share of commodity groups such as minerals or agricultural was temporarily increasing, but the permanent capacity to effectively engage and maintain its position in the international division of labour arose from the base, which was achieved by the level of technological development of the country, reflected in the structure of its production and exports. Progress in this area provided a basis for competitive advantage of the country as it influenced the growth of labour productivity, which, in addition to specialisation in production, is one of the most important determinants of long-term competitiveness of the national economy.<sup>1</sup> Technological leadership is an advantage, because the country is able to offer

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<sup>1</sup> See: B. Mucha-Leszko, M. Kąkol, *Analiza handlu towarami Unii Europejskiej w latach 1995–2008*, [in:] B. Mucha-Leszko (Ed.), *Pozycja Unii Europejskiej w handlu międzynarodowym*, Wydawnictwo UMCS, Lublin 2009, p. 42.

products on international markets, which are in high demand and which are generally sold at higher prices, thus affecting the growth of corporate profitability.

In the 1980s an example of such a country was Japan. After the Second World War the economic structure of the country was outdated, and its export offer contained mainly labour-intensive products. Technological progress which was established as a base of economic growth enabled Japan to become the world's technological leader. Japanese products started to be perceived as products of high quality with high technology content, yet offered at a reasonable price.

The main objective of this study is to analyse the importance of technologically advanced products in the Japanese foreign trade. Indication of trends in this regard will determine Japan's current position and also specifies the direction of change into which the Japanese economy is evolving. The basic research period is 2000–2010, but depending on the availability of statistical data, this period may be longer or shorter. In order to achieve the purpose of the article, analytical-descriptive research methods were used. The article was based mainly on primary sources of information in the form of OECD and the World Bank's statistical databases.

## 2. Technological maturity of Japan

Japan is a country that in the period after the Second World War was promoted from the position of a developing country into one of the most developed countries. The basis of this promotion was the technical and technological progress, which in this country took place in a relatively short time.<sup>2</sup> A skillful use of the opportunities which appeared in the international environment but also consistent implementation of policies to promote technological development and behaviour of innovative firms in little more than twenty years caused Japan to catch up with technological leaders, such as the United States and some European countries.<sup>3</sup> The previously existing technological gap was offset, and Japan has changed its position of a technology imitator into its creator.

Japan is a country which for many years allocated a relatively big part of their funds for research and development (R&D). Throughout the postwar period the share of such expenses in relation to GDP was increasing, but at the turn of the century it exceeded 3%. In 2008 the rate was 3.4%, which gave Japan the third place among the OECD countries allocating the relatively biggest amounts of resources for research and development.<sup>4</sup> The following year, the share decreased slightly (3.36%), but it was considerably higher than the average for all OECD countries

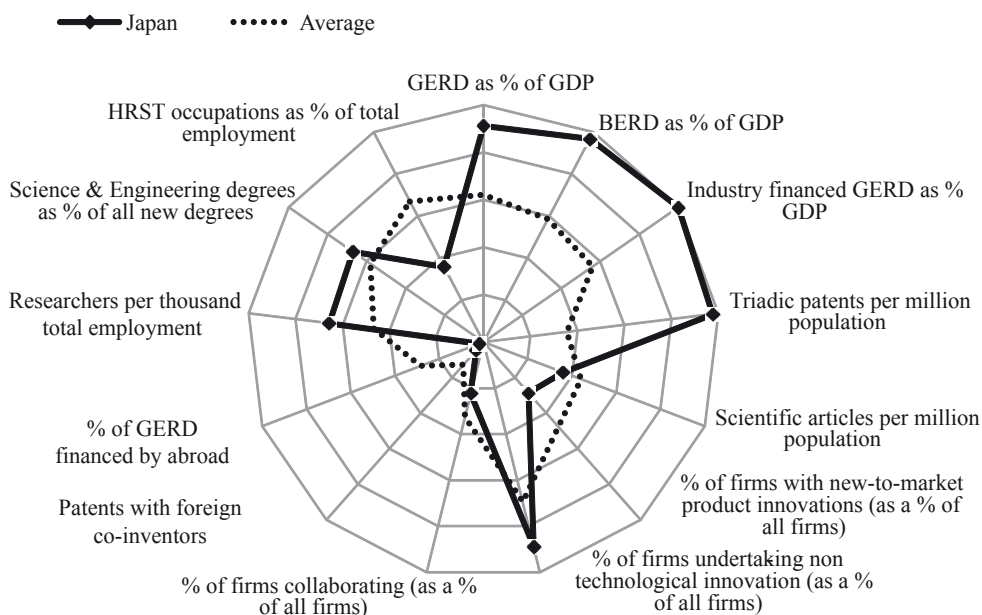
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<sup>2</sup> More on the problem see, e.g., P. Pasierbiak, *Miejsce Unii Europejskiej w zagranicznej ekspansji gospodarczej Japonii*, Biuletyn Europejski 1998, Wydawnictwo UMCS, Lublin 2008, pp. 46–48.

<sup>3</sup> See, e.g., H. Patrick, *Japanese High Technology Industrial Policy in Comparative Context*, Working Paper No. 1, Graduate School of Business, Columbia Business School, 1986, p. 33.

<sup>4</sup> *OECD Science, Technology and Industry Outlook 2010*, OECD Publishing, Paris 2010, p. 196.

(2.4%), the USA (2.9%) or for EU-27 (2.4%).<sup>5</sup> It is worth noting that the absolute value of disbursed funds rose steadily until 2008 (148.7 billion).<sup>6</sup> The following year, as a result of the global economic slowdown, spending on R&D in Japan, as in other countries, declined. In 2009 it amounted to 137.9 billion USD.<sup>7</sup> But one has to keep in mind that an absolute value of the resources spent on R&D investment is not a determinant of the technological level reached by the country. There are many other indicators that can be used to describe the country’s position, for example, in science and innovation, which affect widely understood technology. Figure 1 summarises the most important measures of the current position of Japan in this regard.



Attention: GERD – Gross Domestic Expenditure on R&D; BERD – Business Enterprise Expenditure on R&D; HRST – Human Resources for Science and Technology; GDP – Gross Domestic Product.

**Figure 1.** Science and Innovation profile of Japan Source: OECD Science, Technology and Industry Outlook 2010, OECD Publishing, Paris 2010, p. 196.

An analysis of the data presented in Figure 1 shows that the situation of Japan is the most advantageous in such areas as “triadic patents, industry financed GERD as % of GDP, BERD as % of GDP” and “GERD as a % of GDP” as well as “% of firms undertaking non-technological innovation”. The value of these indexes is

<sup>5</sup> *Science and Technology: Key Tables from OECD*, OECD 2012 (accessed: 18.05.2012).

<sup>6</sup> *Main Science and Technology Indicators*, Volume 2011/1, OECD Publishing, Paris 2011, p. 24.

<sup>7</sup> *Ibidem*.



considerably higher than the average for the OECD. At the same time, it is worth pointing out that in some areas Japan has still a lot to do in order to catch up with other economies. For example, in Japan there is virtually no expenditure for R&D by foreign capital.<sup>8</sup> This situation is a consequence of a limited commitment of foreign direct investors on the Japanese market. The lack of foreign investment also results in poor performance in patenting activity in which one cooperating party is a foreign partner. In that case, the comparison of Japan to the OECD average falls in favour of the latter.

On the basis of this general overview of the technological situation of Japan, it can be said that Japan has a technologically advanced economy, whose structure allows for the production of goods with high technological intensity. Their role in the foreign trade of the country will be presented in subsequent parts of the study.

### 3. Japan's trade in high technology goods

Japan's foreign trade turnover in the period between 2000 and 2010 showed large fluctuations in value. The main reason for the change was the state of the world economy and the country's internal situation. In 2000, Japan's total export value amounted to 479.2 billion USD, in the next year it reduced to 402.6 billion USD.<sup>9</sup> This was a result of the global economic slowdown caused by a bursting speculative bubble on the IT market. Major world economies have reduced the pace of its growth, and some have even experienced negative GDP growth. In subsequent years, exports of Japanese goods increased, but in 2009 it underwent a sharp collapse. In comparison to the previous year, the value of exports from Japan fell by 25.7% (to 580.7 billion USD) and imports by 27.6% (552 billion USD). The sharp decline in external demand took place because of the global financial crisis, by which Japan has been hit hard as a country which based its growth on exports. Due to the fact that the structure of Japanese exports was dominated by medium-high and high technology goods, the conjuncture of the country deteriorated because of the decline in exports of the country.<sup>10</sup> In 2010, Japan's exports widened to 769.8 billion, which almost corresponds to its value before the crisis (2008). Imports amounted to 694.1 billion, to account for a nearly 70 billion USD lower level than in 2008.

As already mentioned, the Japanese foreign trade structure (especially exports) in a fairly large extent rests on the goods/sectors with a high degree of technological

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<sup>8</sup> In 2009 only 0.52% of the private sector expenses for R&D was financed by foreign capital. In comparison, in Poland it was 4.46% and in Austria as much as 23.34%. *OECD Science, Technology and Industry Scoreboard 2011*, Paris 2011, p. 92.

<sup>9</sup> OECD Database: *International Trade by Commodity Statistics*, SITC Rev. 3, OECD iLibrary (accessed: 19.05.2012).

<sup>10</sup> High and medium-high technology goods are particularly sensitive to cyclical changes of economic conjuncture. See: *OECD Economic Surveys: Japan 2009*, OECD, Paris 2009, p. 25.

intensity.<sup>11</sup> However, analysing the changes in this respect, we can see some negative trends. Taking into account the sectoral approach, one may note that in 1994 the structure of Japanese exports of manufactures was dominated by products from a group of medium-high technology industries (with 51.1% share), followed by a high-technology group (31.2%), medium-low technology industries (12.4%) and the low technology ones (5.4%).<sup>12</sup> In subsequent years, the changes included a decrease in the share of high technology group (to 28.9% in 2003), medium-low technology industries (11.8%), low-technology (5.1%) and growth of a medium-high technology group (to 54.2% in 2003). The share of goods from the industries of high and medium-high technology was more than 80% of total exports of processed goods. If one analyses the change in these groups in Japan's exports against the background of similar changes in other OECD economies, it can be noted that in Japan the average annual growth rate of exports of high and medium-high technology in the period between 1996 and 2005 was the lowest of OECD countries.<sup>13</sup> This resulted in a decline of Japan's total exports of goods from the OECD group of high and medium-high technology by 3.3 percentage points – to 11.8% in 2005, the highest fall among OECD countries recorded in the period between 1996 and 2005.

The conclusions drawn from the sectoral approach to changes in technological intensity of Japanese exports are also confirmed by the product approach. What is more, the tendency to fall in the share in the exports of processed products was characteristic of not only the Japanese economy, but also of the United States, the European Union and even world-wide export. A graphical illustration of this problem is presented in Figure 2.

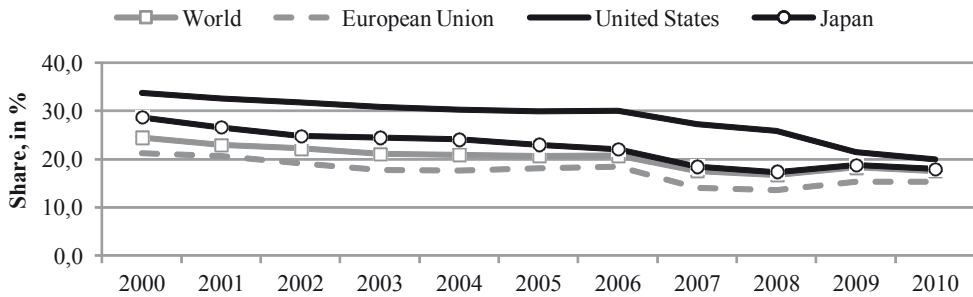
The data in Figure 2 clearly indicate the global trend of a decline in the share of high technology products in the exports of processed goods of major world economies. In 2000–2010 the most affected countries were the United States and Japan. However, both countries have a higher share than average for the world and for the European Union. The changes in the value of the exports of high technology goods in 2000–2010 are presented in Table 1.

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<sup>11</sup> Two main approaches are used to identify technology intensity: the sectoral and the product approach. The sectoral approach considers the technological intensity of sectors expressed as R&D expenditure/value added and classifies the sectors as high, medium or low technology according to the obtained score. High-technology product groups are defined according to the R&D intensity of products following the concepts developed by the OECD – R&D expenditure/total sales. These can be classified in the following nine groups: aerospace, computers-office machines, electronics-telecommunications, pharmacy, scientific instruments, electrical machinery, chemistry, nonelectrical machinery and armament. For more details see: *Science, Technology and Innovation in Europe. 2012 Edition*, Publications Office of the European Union, Luxembourg 2012, pp. 136–137.

<sup>12</sup> *OECD Science, Technology and Industry Scoreboard 2005*, OECD Publishing, Paris 2005, pp. 207–208.

<sup>13</sup> For the first group it was 2% and for two groups together 3.7%. See: *OECD Science, Technology and Industry Scoreboard 2007*, OECD Publishing, Paris 2007, p. 215.



Attention: High-technology exports are products with high R&D intensity, such as in aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery.

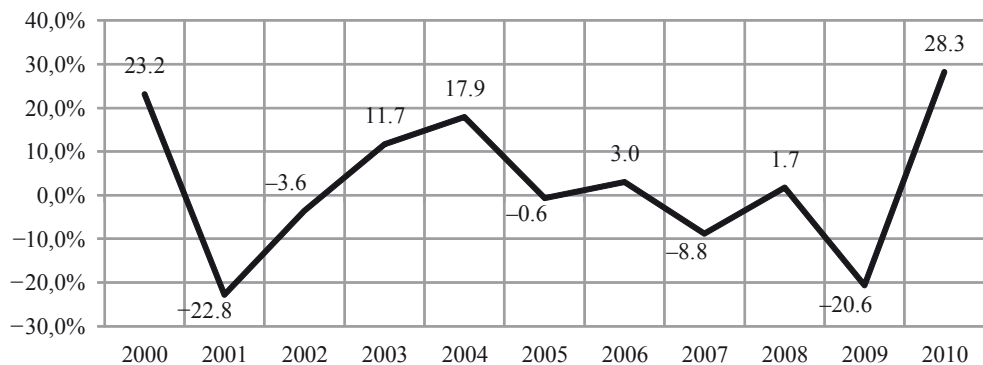
**Figure 2.** High technology exports as a percent of manufactured exports of Japan, the EU, the USA and the World

Source: author's own work based on World Bank's Database, <http://data.worldbank.org/indicator/TX.VAL.TECH.MF.ZS/countries> (accessed: 20.05.2012).

**Table 1.** Value of high technology exports between 2000 and 2010, in billion USD

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
World	116.4	1053.4	1069.9	1192.9	1432.2	1588.8	1825.3	1766.8	1840.8	1572.1	–
EU	390.3	386.2	385.3	421.4	499.9	552.0	624.6	554.3	581.9	511.1	574.3
USA	197.5	176.2	162.1	160.3	176.3	190.7	219.0	218.1	220.9	132.4	145.5
Japan	128.9	99.5	95.9	107.1	126.2	125.4	129.2	117.9	119.9	95.2	122.0

Source: author's own work based on World Bank's Database, <http://data.worldbank.org/indicator/TX.VAL.TECH.MF.ZS/countries> (accessed: 20.05.2012).



**Figure 3.** Changes in high technology exports in Japan, y-o-y in %

Source: author's own preparation based on World Bank's Database, <http://data.worldbank.org/indicator/TX.VAL.TECH.MF.ZS/countries> (accessed: 20.05.2012).

According to the data, all the listed economies showed a large variation in relation to the value of exports of high technology products. Shortly after the collapse of the IT market in the United States at the turn of the century, the value of exports declined in all the analysed countries. In subsequent years there was a trend of growing, but the collapse of global trade, which took place in 2009, was reflected also in the field of high technology trade. The illustration of the changes that have occurred in this area for the Japanese export is in Figure 3.

According to the data gathered in Figure 3, in 2000–2010 there were major changes in the dynamics of exports of high technology products. First, there was a large variation in the occurrence, which consists of a five-fold decrease in the value of exports and six-fold growth, and second, the dynamics of change was high at the beginning and end of the period. Analysing these changes and keeping in mind a declining share of exports of high technology products in total Japanese exports, one needs to note that the negative development also took place in almost every group of high technology products. The trends in this area are illustrated by the data in Table 2.

**Table 2.** Trade balance and export market share of Japan in high-technology exports, in million USD and %

Industry	Trade balance [million USD]			Export market share [%]		
	2003	2006	2009	2003	2006	2009
Aerospace industry	-4 501.0	-5 115.0	-4 482.4	1.5	1.5	1.6
Electronic industry	40 058.4	38 900.1	23 416.6	11.1	8.2	6.8
Office machinery and computer industry	-47.1	-2 249.9	-1 595.9	6.4	4.6	3.9
Pharmaceutical industry	-3 239.7	-5 244.4	-10 863.0	1.9	1.4	1.1
Instruments industry	11 224.6	11 548.5	10 238.5	11.3	9.4	7.1

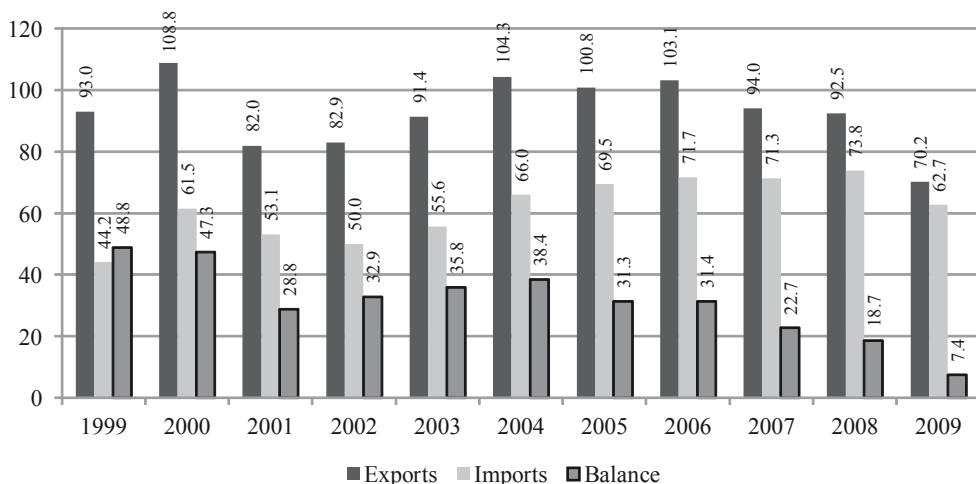
Source: author's own work based on Main Science and Technology Indicators, Volume 2011/1, OECD, Paris 2011, pp. 95–99.

Based on the information contained in Table 2, one can say that Japan's competitiveness as a country exporting high technology goods is getting smaller. It is evidenced by the participation rates of the country in world exports of these products. Out of the five groups of products specified in the table, only "aerospace industry" increased its share, but it was a modest increase from 1.5% (2003) to 1.6% (2009). At the same time, it should be noted that the balance of trade in this group of goods was negative. The share of all other commodity groups also showed decreases, with the largest in the "electronic industry" (from 11.1% to 6.8%) and the "instrument industry" (from 11.3 to 7.1%). The analysis of the data from Table 2 clearly indicates worse and worse achievements of Japanese exports, which is reflected either in a declining trade surplus (electronic industry, instruments industry, office machinery and computer industry), or in a growing trade deficit (pharmaceutical industry). This

trend can be considered as a permanent feature of the Japanese trade in goods of high technology in terms of the product approach.

To some extent, this trend is confirmed by developments of Japanese trade in ICT goods. Figure 4 shows data illustrating the import, export and trade balance of Japan with the world in the field of ICT products since 1999. After a fall in exports and imports in 2001, the next year saw a faster growth in exports than imports, which meant that by 2004 Japan's trade balance rose to 38.4 billion USD surplus. However, since 2005, imports increased steadily, while exports showed fluctuations, with the overwhelming tendency for its decrease. The critical year was the year of the collapse of the world trade (2009), when both exports and imports of Japan fell sharply, causing a reduction of a country's surplus to its lowest level since 1999 (7.4 billion). The main reasons for these negative changes were:

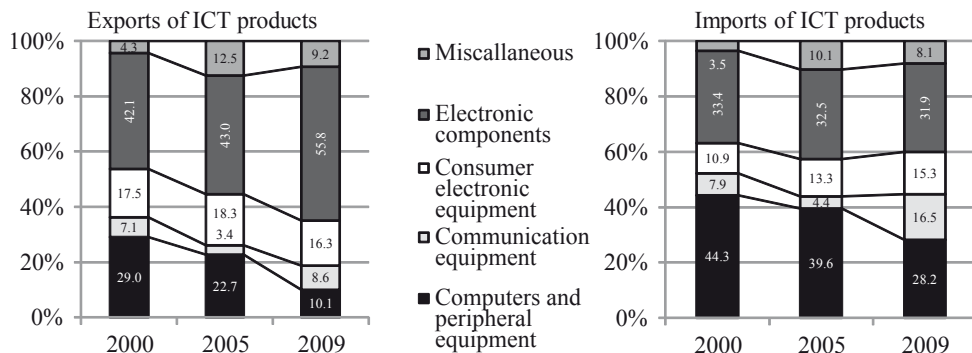
- reduction of the surplus in the group of computers and peripheral equipment (from 48.8 billion in 1999 to 7.4 billion in 2009);
- exchange surpluses in the field of communications equipment (10.3 billion in 1999) into deficit (−1.5 billion in 2003 and −10.6 billion in 2009);
- decline in the surplus in the group of electronic components from 13.2 billion to 1.8 billion USD.



**Figure 4.** Japanese trade in ICT products 1999–2009, in billion USD

Source: author's own work based on OECD ITCS Database, Dataset: Harmonised System 1996: ICT Goods (accessed: 20.05.2012).

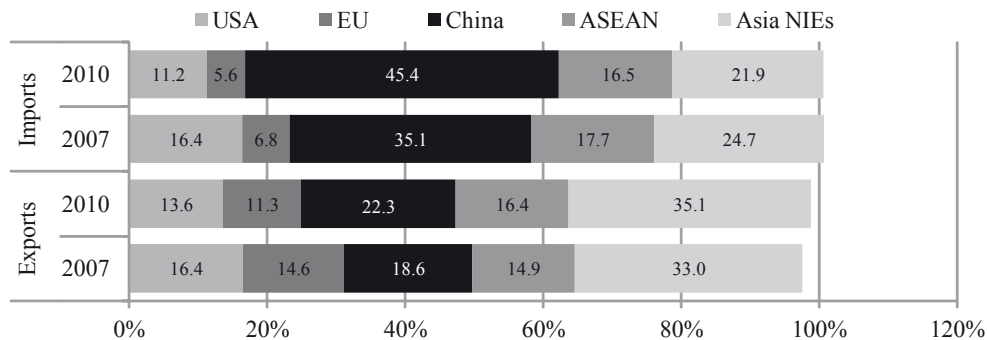
If one also takes additionally into account the change in the commodity structure of exports (*vide* Figure 5), i.e., the growing importance of electronic components group and a decline in the importance of communications equipment group, the changes do appear serious and permanent.



**Figure 5.** Product breakdown of Japanese ICT products exports and imports, in %

Source: author’s own preparation based on OECD ITCS Database, Dataset: Harmonised System 1996: ICT Goods (accessed: 20.05.2012).

The changes visible in Figure 5 are not surprising if one takes into account geographical breakdown of Japanese turnovers of ICT products. Figure 6 clearly indicates the direction of change in this respect. The share of developed countries in Japanese exports falls but, at the same time, the share of Asian developing countries (China, ASEAN and Asian NIEs) shows a tendency to growth.



Attention: In the case of imports a sum of shares exceeds 100% because both ASEAN and Asia NIEs groups include Japanese trade flows with Singapore.

**Figure 6.** Geographical breakdown of Japanese ICT products exports and imports 2007–2010, in %

Source: author’s own work based on: 2009 JETRO White Paper on International Trade and Foreign Direct Investment, Global Strategy for Japanese Companies: Environment as a New Growth Engine, JETRO, Tokyo 2009, pp. 241–242; 2010 JETRO Global Trade and Investment Report, A Global Strategy for Japanese Companies to Open New Frontiers in Overseas Markets, JETRO, Tokyo 2010, pp. 135–136; 2011 JETRO Global Trade and Investment Report, International Business as a Catalyst for Japan’s Reconstruction, JETRO, Tokyo 2011, pp. 118–119.

The changes in exports, however, are only minor compared with the changes observed in the field of imports. Within just four years the combined share of the US and the EU decreased by 6.4 percentage points, while the share of China alone increased by 10.3 points. It is also worth noting a diminishing importance of the Japanese supply markets, such as ASEAN and the newly industrialised economies of Asia. Dynamics of changes in the ICT trade is high, so one can expect further modification of the geographical structure of Japanese exports and imports. The Asian region (mostly developing countries) has become the factory of the world, so ICT products are increasingly produced in these locations. This will mean a future decline in the importance of Japan as a manufacturer of such goods; therefore, this will also reduce the importance of the country in world exports, while increase in imports.

#### 4. Conclusions

Japan is a country that after the Second World War reached a high level of technological development. Offering on international markets technically advanced products has become the source of the country's economic success. In the first decade of the twenty-first century the technological position of the country still remains high; however, some measures describing the situation differs from those of the most industrialised countries (OECD). What seems of particular importance is to direct large amounts on research and development, which positions Japan among the highest in the world. On the other hand, the relatively high aversion to foreign capital results in low rates of technological development in the area of cooperation with foreign subjects.

The analysis of Japan's foreign trade development in terms of its technological intensity in 2000–2010 allows formulating some conclusions. First, the share of exports of high technology products in total exports of Japan has been decreasing. Second, according to the sectoral approach, it can be argued that there is a fall in Japan's share in exports of goods produced by the sectors of high technology and growth in sectors of medium-high technologies. Third, the analysis in terms of the products approach confirms the negative trends in the exports of Japan – in all the subgroups under consideration trade surpluses were reduced and deficits deepened. Fourth, the analysis of trade in ICT products confirms the aforementioned trend of worsening the situation of Japan. The surplus is still maintained but since 2004 it has started to shrink. This is due to movement of the production centres to locations that offer more favourable conditions (including lower costs among others).

The conclusions from the analysis have a clearly negative connotation. But one should bear in mind that nowadays, because of the globalisation of the enterprises' value chain, production processes of varying complexity can be located in different countries. Therefore, even a high share in exports of high technology does not necessarily reflect the complex, sophisticated industrial activity of countries. It can

be concluded that the decrease in high technology products in the exports of Japan does not mean a drop in the level of technological development of the country.

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## INTENSYWNOŚĆ TECHNOLOGICZNA JAPOŃSKIEGO HANDLU TOWAROWEGO

**Streszczenie:** Japonia jest postrzegana jako kraj, który dzięki rozwojowi technologicznemu osiągnął wysoką pozycję w międzynarodowym podziale pracy. Szczególnie wyraźnie zauważalne stało się to po okresie kryzysów lat 70. i początku 80. XX w., kiedy okazało się, iż Japonia na rynkach międzynarodowych oferuje z sukcesami produkty wysokich technologii, a udział tych produktów w eksporcie kraju zajmuje ważne miejsce. W pierwszej dekadzie XXI w. sytuacja zmieniła się znacząco. Japonia, mimo wciąż wysokiej pozycji technologicznej, traci udziały w światowych przepływach dóbr wysokich technologii (m.in. ICT), a rola tego rodzaju produktów w całkowitych strumieniach eksportu i importu kraju szybko się zmniejsza. Negatywne tendencje dają się zauważyć w przypadku ujęcia sektorowego (sektor wysokich, średnio wysokich, średnio niskich i niskich technologii), jak również produktowego (produkty w wysokiej intensywności wydatków na B+R).

**Słowa kluczowe:** Japonia, handel zagraniczny, technologia, międzynarodowe relacje handlowe.