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Is Japan a Pioneer in High Technology Exports?

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Abstract

One of the most powerful economies in the global economic system is Japan. Nowadays the global economic system is facing many economic and political challenges. Owing to the fact that Japan is one of the most powerful economies, it has to maintain or enhance its economic power in order to face the upcoming challenges. Japanese economic growth is a combination of export growth, private investment and consumption. In order to overcome slow growth, Japan launched “Abenomics”, a policy based on three “arrows”: bold monetary policy, flexible fiscal policy, and a growth strategy. Despite the adoption of Abenomics, Japan’s economy has to overcome three major challenges. First, government debt continues to rise as a percentage of GDP. Second, Japan is faced with declining population growth, which reduces its potential economic growth. The Japanese population is aging fast and, as a result this will limit growth and productivity because of a shrinking and aging labour force. The most important challenge for the Japanese economy is potential economic competition from China in high-technology products. Japan is facing increasing competition from China. The main economic advantage that Japan maintains is its high technological development in several sectors. The aim of this paper is to show whether Japan has a Revealed Comparative Advantage in high-technology exports. The methodology adopted is the theory of comparative advantage.

Keywords: Revealed Comparative Advantage, Economy of Japan, High Technology Exports, Competitiveness.

JEL Classification: F11, F14, F62

Introduction

Japan is one of the economic powers in the international economic system. Nowadays, the global economy is facing certain serious challenges. One of the threats to the global economy is the proliferation of protectionist measures, which could restrict investment growth, job creation, and consumption growth. Another issue is that wage growth continues to be restrained, especially for low- and

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middle-income classes. Collaboration is needed in order to face issues such as the new geopolitical and demographic changes, climate change, and the risks or opportunities that result from new technologies (Gurría, 2018). The most significant issue of the current global economy is China's economic rise, which has consequences for the world and especially for Japan. For example, from 2009 to 2017, the Chinese economy tripled in size, and by 2012 it had overtaken Japan as world's second largest economy (Siddiqui, 2018). What has powered the growth of Japan in recent years? According to the OECD (2018, pp: 145):

"Growth has been led by private consumption and business investment."

It is interesting, however, to show what is the main factor that contributed to Japan's economic strength. According to Valli (2012, pp: 3):

"The development of Japan in the post-World War II era can be divided into four major phases: the reconstruction period (1945-1953), the high growth period (1954-1973), the slowing-down phase (1974-1990), and the structural crisis period (1991-2011)."

The interesting point of this article is that, in all periods, the main means of progress is technology and R&D expenditure. During the reconstruction period (1945-1953) in particular, Japan could upgrade technologically by purchasing, or copying, more advanced technologies from countries such as the US, Germany, France, and the United Kingdom. Furthermore, during the high growth period (1954-1973), expenditure in R&D increased rapidly, first mainly as a result of the impetus provided by the government and afterwards by the massive investment of large corporations. Moreover, during the slowing-down phase (1974-1990), the Japanese economy continued to be technologically powerful, thanks to public and private R&D. Research & Development expenditure was higher than in the major Western European countries. Finally, during the structural crisis period (1991-2011), the large net outflow of capital from Japan significantly reduced the country's capability to finance its productive structure and to compete with the US in the high-tech sector. Thus, R&D expenditure and the high-tech sector are highly important for the Japanese economy.

Today, Japan is facing a major challenge. According to the Asian Development Bank, China has put an end to Japan's supremacy in Asia's high-technology exports. China's share of Asian exports of high-tech goods, such as medical instruments, aircraft, and telecommunications apparatuses, rose to 43.7 percent in 2014 from 9.4 percent in 2000 and Japan's share reduced to 7.7 percent in 2014 from 25.5 percent in 2000 (Yap, 2015).

The aim of this paper is to demonstrate whether Japan has a Revealed Comparative Advantage (RCA) in high technology exports, in order to show if Japan is capable of claiming its dominance in high-tech products. This study is

structured as follows: first, we present Japan's macroeconomic indicators for the period between 2007 and 2018, followed by a theoretical overview of Japan's comparative advantage and its definition. This research was based on the theory of Revealed Comparative Advantage. Finally, it was based on the analysis of the results to answer the research question.

The Economy of Japan

This chapter will provide an overview of Japan's economy for the period 2007-2018. The macroeconomic indicators to be reported are as follows: GDP, Real GDP Growth, Government Debt, General government net lending /borrowing, Inflation rate, Unemployment rate, and the Current Account Balance. Table 1 shows the basic macroeconomic indicators of Japan for the period 2007-2018.

Table 1. Macroeconomic Indicators of Japan for the period 2007-2018

Year	GDP, current prices (Billions of U.S. dollars)	Real GDP growth Annual % change	Government Debt (% of GDP)	General Government net lending/borrowing (% of GDP)	Inflation rate, average consumer prices Annual % change	Unemployment rate %	Current account balance (% of GDP)
2007	4.52	1.7	175.4	-3.2	0.1	3.8	4.7
2008	5.04	-1.1	183.4	-4.5	1.4	4	2.8
2009	5.23	-5.4	201	-10.2	-1.3	5.1	2.8
2010	5.7	4.2	207.9	-9.5	-0.7	5.1	3.9
2011	6.16	-0.1	222.1	-9.4	-0.3	4.6	2.1
2012	6.2	1.5	229	-8.6	-0.1	4.3	1
2013	5.16	2	232.5	-7.9	0.3	4	0.9
2014	4.85	0.4	236.1	-5.6	2.8	3.6	0.8
2015	4.39	1.4	231.3	-3.8	0.8	3.4	3.1
2016	4.95	1	235.6	-3.7	-0.1	3.1	3.9
2017	4.87	1.7	237.6	-4.3	0.5	2.9	4
2018	5.07	1.1	238.2	-3.7	1.2	2.9	3.6

Source: (IMF, 2019a)

The macroeconomic overview shows that Japan's GDP for the period 2007-2018 ranges from 4.39 (the lowest value in 2015) to 6.20 (the highest value in 2012). Real GDP growth in percentage terms has remained stable during the period under review, with the exception of the years 2009-2010, because of the global crisis of the 2008. Government Debt is, more or less, continuously rising year-on-year, with the highest value recorded in 2018 and the lowest in 2007. General

government net lending/borrowing is still negative for the period 2007-2018 and increased by 5 points because of the financial crisis of 2008, but tended to decrease until 2018. The percentage change of the inflation rate for the period 2007-2018 ranges from -1.3 in 2009 to 0.8 in 2015. The average unemployment rate stands at 3.9 and its highest values were recorded in 2009 and 2010 because of the crisis, only to decrease afterwards. Finally, the Current account balance, as a percentage of GDP, registered its lowest value in 2014 at 0.8, and its highest value in 2007 at 4.7. In general, the financial crisis of 2008 has worsened many of the macroeconomic indicators of Japan that are under review here, as it did in many countries of the world as well. Japan's GDP has been declining and this decline is due to low real growth and outright deflation (JMA, 2019). According to the IMF (2019b, pp:23):

".... sustained monetary accommodation will be necessary to lift inflation expectations and progress toward the central bank's target. Fiscal policy should be geared toward ensuring long-term fiscal sustainability while protecting growth. The coupling of the planned October increase in the consumption tax rate with fiscal measures to support near-term activity is welcome. A sustainable debt trajectory calls for further gradual and steady increases in the consumption tax rate and reforms of the social security framework. The success of the broad Abenomics agenda of reflating the economy depends crucially on also lifting productivity growth and wage inflation, for which reducing labor market duality to increase productivity of nonregular workers remains vital. Durably counteracting the aging-induced decline in labor force growth will require, among other initiatives, further raising female labor force supply and encouraging more use of foreign labor." According to Noland (2007, pp: 17):

"For approximately four decades following the Second World War Japan achieved unusually rapid growth and development, but since roughly 1990 it has experienced a protracted period of relative decline. The latter development reflects macroeconomic policy errors, compounded by the difficulty of transitioning from a strongly state-influenced model of economic development geared toward catch-up to a more market-driven decentralized approach more appropriate to Japan's current position on the technological frontier."

The major challenge that Japan is facing is that it has been the most indebted developed country, with government debt more than twice as large as its GDP. Moreover, there are other challenges as well, such as weak wage growth (Shane, 2017). The nation's changing demographic structure is another challenge (Abe, 2010). But what are the main reasons why government debt is the major challenge to the Japanese economy?

There are certain factors that caused Japan's government debt ratios to increase. According to Akram and Li (2018, pp:8), these factors are:

“First, the country has experienced persistent primary/fiscal deficits. Second, the GDP has been stagnant due to slow growth, low inflation, and deflation. Third, the rapid aging of the population requires substantial fiscal transfers. Fourth, the authorities have often undertaken fiscal stimulus in response to the weakness of effective demand.”

That said, competitiveness plays a major role and, according to Slav’yuk and Slaviuk (2018, pp: 154):

“... countries with the competitive economy can service a higher level of government debt (like Japan).”

So, competitiveness is an important factor in controlling the course of the debt.

One serious problem that Japan is facing is the demographic situation. According to the IMF (2018a, pp: 35):

“Japan’s rapidly shrinking labor force poses a direct threat to its future economic growth and productivity. Japan’s severe demographic challenges are well known – possessing the fastest decline of total and working age population among its economic peers.”

In order to liberalise the country, Japan’s Prime Minister Shinzo Abe, introduced in early 2013, a multi-dimensional economic platform, called “Abenomics”. This economic policy has been based on the so-called “three arrows”, namely, aggressive monetary policy, fiscal consolidation, and structural reforms (Bobowski, 2016).

What are the prospects of the Japanese economy? According to the IMF (2019c, pp: 4):

“Japan’s economy is set to grow by 1.1 percent in 2019 (0.2 percentage point higher than in the October WEO). This revision mainly reflects additional fiscal support to the economy this year, including measures to mitigate the effects of the planned consumption tax rate increase in October 2019. Growth is projected to moderate to 0.5 percent in 2020 following the implementation of the mitigating measures.”

But what are the proper policies that Japan should apply? As stated by the International Monetary Fund (2018b, pp: 1):

“Mutually-supportive, reinvigorated, and credible policies are needed to bring Abenomics to full strength, to boost productivity and raise potential growth. Budgetary and income policies anchored by a well-specified and gradual medium-term fiscal consolidation plan would help support the Bank of Japan’s reflation efforts and ensure debt sustainability. Macro-structural reforms – with a level of government commitment and steady implementation that inspire public confidence – are imperative to unleash productivity gains, lift long-run growth, stabilize government debt, and counter deflationary effects. Monetary policy accommodation should be maintained, but more can be done to further

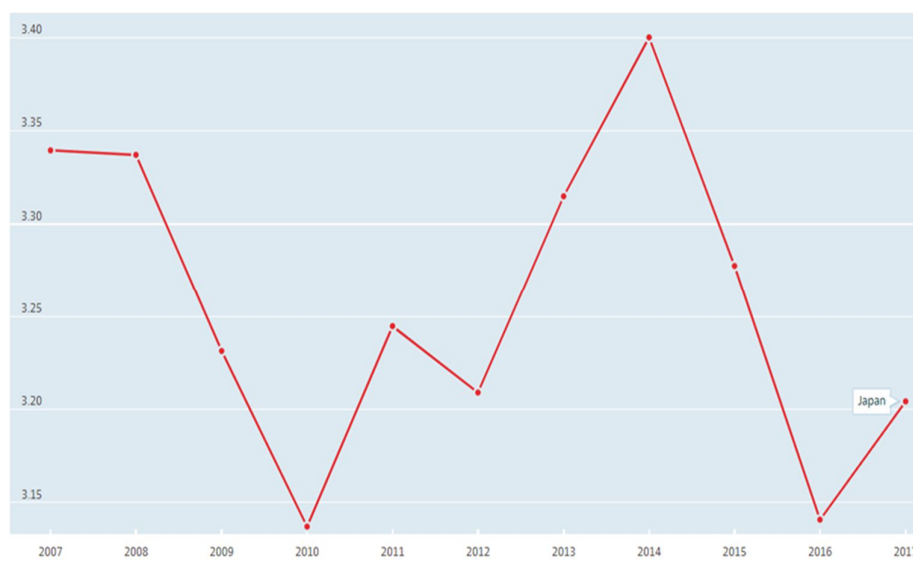
strengthen the monetary policy framework and lift inflation expectations. Strengthened financial sector policies would lessen the financial risks from demographic headwinds, prolonged low interest rates, and low profitability.” Moreover, the OECD (2012) had recommended some policies in order to enhance Japanese growth such as diminishing labour market dualism; broadening the openness of the economy to foreign goods, capital and workers; advancing the framework for innovation; increasing productivity in the service sector; and alleviating the drop in the labour force by boosting participation, mainly of women.

According to Kabaklarli, et. Al. (2018, pp: 48):

“High technology (high-tech) is used in the sense of goods and services created by innovative and advanced technology companies and industries. Such firms are generally reliant on advanced scientific and technological expertise and are generally characterized by high R&D spending (employment) in their labour force (total labour force).”

How much does Japan spend on R&D expenditure? Figure 1 shows the course of R&D expenditure for the period 2007-2017.

Figure 1. Gross domestic spending on R&D Total, % of GDP, 2007-2017



Source: (OECD, 2019)

The growth of exports is very important for the economic growth of Japan. According to Kobayashi and Hirono (2018, pp: 2):

“... The other major positive factor for 2017 was growth in exports, but now they are showing signs of peaking out, reflecting the slowdown in the global economy.” In the next chapter the revealed comparative advantage in high tech exports of Japan is going to be examined, because the intensity of technology is the force of Japanese competitiveness. As argued by Pasierbiak (2013, pp: 22):

“... it can be concluded that the technological progress and innovation which took place in Japan in the postwar period was one of the most important factors contributing to the improvement of its international competitiveness.”

The Revealed Comparative Advantage Approach

In this chapter, we will study Japan's comparative advantage in determining both the competitiveness its high-tech exports and the development of the comparative advantage revealed during the 2007-2016 period, on the basis of the available data. First, we will examine Japan's high-tech exports in general and, second, we will examine certain sectors of its economy, i.e. “Pharmaceutical products” “Optical, photographic, cinematographic, measuring, checking, precision, medical or surgical” and “Electrical machinery and equipment and parts thereof; sound recorders and reproducers, televisions”. The choice of these products is based on the classification of manufacturing industries into categories based on R&D intensities. In particular, classification is based on R&D intensity embodied in intermediate inputs (Galindo-Rueda & Verger, 2016).

According to Hatzichronoglou (1997, pp: 5):

“Four groups of manufacturing industry were identified :

i) high-technology, ii) medium-high-technology, iii) medium-low- technology and iv) low-technology ... Industries in a higher group are more R&D-intensive than those in a lower group.”

Products such as aircraft and spacecraft, pharmaceuticals, office accounting and computing machinery, radio, TV and communications equipment, medical, precision and optical instruments, are characterised as high-technology industries (OECD, 2011).

Comparative advantage provides the theoretical background for studying the benefits of international trade. The Revealed Comparative Advantage (RCA) method is the traditional method for revealing comparative advantage. Bela Balassa gives the definition of the comparative advantage in his article (1965) “Trade Liberalization and Revealed Comparative Advantage.”

According to the World Trade Organization (2012, p. 26):

“Revealed Comparative Advantage, is the ratio of the share of product k in the exports of country i , to its share in international trade.”

In formula form:

$$RCA_i = (X_{i,j} / \sum X_j) / (X_{i, World} / \sum X_{World}) \quad (1)$$

Where:

RCA_i = revealed comparative advantage for good i.

X_{i,j} = exports of good i by country j

∑X_j = total exports by country j

X_{i,World} = world exports of good i

∑X_{World} = total world exports

Any value of the Revealed Comparative Advantage that is greater than the unit (RCA > 1) for the country (or sector) *k* of country *i* means that country *i* has a comparative advantage in this field.

Table 2 shows the exports of High Technology Exports and Total Exports of Goods for Japan and the World for the period 2007-2016.

Table 2. High Technology Exports and Total Exports of Goods for Japan and the World for the period 2007-2016

Years	Japan		World	
	High-technology exports (billions) \$	Exports of Goods* (billions) \$	High-technology exports (billions) \$	Exports of Goods* (billions) \$
2007	117,858	680,623	1,768,000	13,771,566
2008	119,915	749,117	1,842,000	15,858,122
2009	95,159	548,145	1,565,000	12,292,457
2010	122,102	735,436	1,780,000	14,980,919
2011	126,478	789,951	1,942,000	17,987,229
2012	123,393	776,640	2,002,000	18,238,928
2013	105,076	694,939	2,110,000	18,649,939
2014	100,955	699,180	2,150,000	18,736,712
2015	91,514	622,037	2,053,000	16,311,947
2016	92,883	635,820	1,989,000	15,799,459

Source: (World Bank, 2019) and (Knoema, 2019a & 2019b)*

Table 3 shows the Revealed Comparative Advantage results of High Technology Exports for the period 2007-2016.

Table 3. High Technology Exports - Revealed Comparative Advantage for the period 2007-2016

Revealed Comparative Advantage for the period 2007-2016	
RCA - Value	
Years	Japan
2007	1.35
2008	1.37
2009	1.36
2010	1.40
2011	1.49
2012	1.44
2013	1.33
2014	1.26
2015	1.17
2016	1.16

Source. (Author's calculation)

By calculating the Revealed Comparative Advantage for the period 2007-2016, we can certainly say that Japan enjoys a Revealed Comparative Advantage in High Technology Exports. From 2007 to 2012 the Revealed Comparative Advantage was rising, but afterwards started to decline, reaching its lowest value of 1.16 in 2016. It is interesting to see the RCA value of three different categories of Japan's high-tech products, especially, of (1) "Pharmaceutical products", (2) "Optical, photographic, cinematographic, measuring, checking, precision, medical or surgical", and (3) "Electrical machinery and equipment and parts thereof; sound recorders and reproducers, televisions" for the period 2007-2016, in order to determine on which of the chosen categories, among the chosen, Japan's Revealed Comparative Advantage is actually based.

Table 4 shows the exports of "Pharmaceutical products", "Optical, photographic, cinematographic, measuring, checking, precision, medical or surgical" and "Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television", of Japan and the World for the period 2007-2016.

Table 4. “Pharmaceutical products”, “Optical, photographic, cinematographic, measuring, checking, precision, medical or surgical”, “Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television”, of Japan and the World for the period 2007-2016

Year	Japan				World			
	Pharmaceutical products (billions of dollars)	Optical, photographic, cinematographic, measuring, checking, precision, medical or surgical (billions of dollars)	Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television (billions of dollars)	All products (billions of dollars)	Pharmaceutical products (thousands of billions of dollars)	Optical, photographic, cinematographic, measuring, checking, precision, medical or surgical (thousands of billions of dollars)	Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television (thousands of billions of dollars)	All products (thousands of billions of dollars)
2007	2,469	32,632	134,991	714,327	342,408	397,094	1,806,776	13,832,342
2008	2,960	34,317	138,579	781,412	398,952	439,600	1,918,129	15,978,251
2009	3,445	28,638	107,398	580,718	420,144	396,240	1,605,425	12,348,636
2010	3,608	39,608	131,394	769,773	443,254	476,240	1,962,020	15,094,313
2011	3,806	45,564	129,538	823,183	459,199	530,706	2,132,005	18,083,382
2012	3,391	45,639	125,888	798,620	469,486	553,052	2,164,117	18,388,298
2013	3,243	40,113	108,269	715,097	488,177	563,122	2,305,450	18,869,747
2014	2,922	40,369	104,055	690,217	512,500	574,836	2,373,098	18,866,492
2015	3,409	35,741	95,606	624,873	495,858	540,443	2,302,745	16,424,646
2016	4,064	35,856	98,151	644,932	493,872	535,704	2,282,760	15,878,996

Source: (ITC 2019a, 2019b)

Table 5 shows the Revealed Comparative Advantage results of Pharmaceutical products, “Optical, photographic, cinematographic, measuring, checking, precision, medical or surgical”, and “Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television”, of Japan and the World for the period 2007-2016.

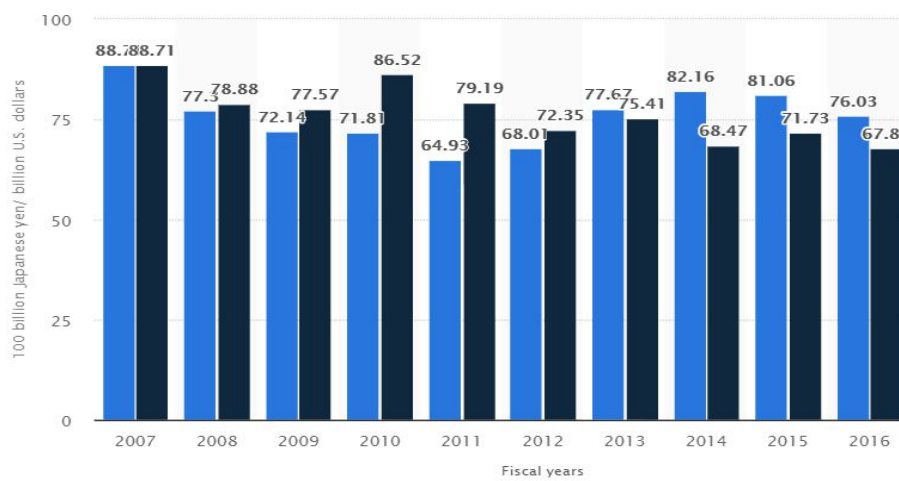
Table 5. High Technology Exports - Revealed Comparative Advantage for the period 2007-2016 (Pharmaceutical, Optical, Electrical machinery)

Revealed Comparative Advantage for the period 2007-2016			
RCA - Value			
Years	Japan		
	Pharmaceutical products	Optical, photographic, cinematographic, measuring, checking, precision, medical or surgical	Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television
2007	0.12	1.60	1.44
2008	0.12	1.59	1.47
2009	0.14	1.53	1.41
2010	0.13	1.64	1.31
2011	0.16	1.89	1.34
2012	0.16	1.90	1.34
2013	0.16	1.93	1.23
2014	0.14	1.93	1.2
2015	0.16	1.78	1.09
2016	0.19	1.66	1.06

Source: (Author's calculation)

By calculating the Revealed Comparative Advantage for the period 2007-2016, we can observe a paradox. Although, Japan enjoys a Revealed Comparative Advantage for “Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television”, its value was declining during 2007-2016. But, even though Japan does not have a Revealed Comparative Advantage for “Pharmaceutical products” its value was increasing course during the period 2007-2016. As far as “Optical, photographic, cinematographic, measuring, checking, precision, medical or surgical” products are concerned Japan has a Revealed Comparative Advantage for the period 2007-2016, with higher values than “Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television”. It would be interesting to see the total revenue of Sony, one of the largest Japanese corporations. Figure 2 shows Sony's total revenue from 2007 to 2016 (in 100 billion Japanese yen/billion U.S. dollars). Sony's business type divisions enable the company to concentrate its efforts and means is such a way as to boost innovation and product development (Meyer, 2018). As a leading worldwide provider of electronic and entertainment content, Sony is developing creations that enhance its innovative status (UKessays, 2018).

Figure 2. Sony's total revenue from 2007 to 2016



Source: (Statista, 2019)

Conclusions

In conclusion, we can say, first, that Japan has a Revealed Comparative Advantage regarding the period under review, which has, nonetheless, been decreasing from 2011 and afterwards. Second, from the selected categories of high-tech products it is easy to argue that the highest values of Revealed Comparative Advantage are those of “Optical, photographic, cinematographic, measuring, checking, precision, medical or surgical products”, followed by “Electrical machinery and equipment and parts sound recorders and reproducers, television” products, while there is no Revealed Comparative Advantage for “Pharmaceutical products”. Finally, if we take into consideration China’s notion of dominating the high-tech industries in the following decade under the “Made in China 2025” plan (Lee, 2019), it is important for Japan to strengthen its presence in high-tech product industries in order to maintain its competitiveness. The relationship between China and Japan is a noteworthy subject. There are many factors that influence that relation. It is interesting to refer to what Yuan (2018, pp: 2) argues:

“Over the last two decades, in particular China joined the World Trade Organization (WTO), its economy has registered an average of over nine percent in growth for the better part of this period until recently when it has slowed down to around 6.5%. At the same time, Japanese economy has stagnated since the 1990s and it is only in recent years that Japanese economy has shown signs of recovery. Within a decade of joining the WTO, China surpassed Japan in 2010 to

become the second largest economy in the world. China's dramatic economic growth means not only that the gap between China and Japan shrank within a considerably short period of time (within a decade) but also has left Japan far behind since 2010. This power shift is not confined to economic statistics only; Beijing has also significantly built up its military power and has extended its diplomatic influence in the region and beyond. Needless to say, this reversal of fortune has had an enormous psychological impact on bilateral relations even as it induces and further intensifies rivalry between the two Asian powers."

In a globalised world Japan should not only enhance its macroeconomic situation, but, as Parc (2018, pp: 445) notes:

"For Japan, Abenomics should not be focused solely on macroeconomic policies, but rather, it needs to enhance the fundamental sources of its competitiveness. this study shows that the problem of Japan's staggering economy since the asset bubble burst in the early 1990s is weak globalization that induces relatively low global competitiveness overall."

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