An Empirical Analysis on Japan's Industrial Hollowing Out

By

SHIN, Saemee

THESIS

Submitted to

KDI School of Public Policy and Management

In Partial Fulfillment of the Requirements

For the Degree of

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Committee in charge:

Professor Lee, Siwook, Supervisor 

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Professor Lee, Changkeun 

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ABSTRACT

The purpose of this study is to investigate the role of domestic factors in hollowing out of Japan's manufacturing industry. During the three lost decades, Japan's manufacturing, an indicator of its economic health, suffered from the deterioration of international competitiveness. The rise in competition with emerging countries and domestic production costs forced Japanese manufacturers to operate overseas, hurting manufacturing value-added and employment. Among internal factors that caused Japan's industrial hollowing out, several episodes of yen appreciations have fostered not only economic recessions brought on by weakening exports but the deindustrialization of Japanese manufacturing since the late 1980s. This paper exploits aggregate time-series data from 1960 to 2021 to verify the increase in outward FDI and value of yen, a collapse of export-led growth along with Chinese economic expansion, and TFP growth has prompted deindustrialization in Japan. The paper also investigates the effect of sectoral exports, FDI outflows, and yen exchange rate fluctuations on the manufacturing share of GDP, using industry-specific data from 1970 to 2021.

Keywords: Japanese manufacturing, hollowing out, yen appreciation, service industry

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1. INTRODUCTION

The hollowing out phenomenon is a vital concern of national competitiveness and is strongly related to three main economic concepts in international business: deindustrialization, economic restructuring, and globalization (Simeon & Ikeda, 2011). The term refers to the process by which a country's industrial capacity is significantly reduced due to an increasingly weakening manufacturing sector (Modic & Trautlein, 1985; Schnorbus & Giese, 1987; Spilimbergo, 1998). Globalization increases interaction between countries while lowering barriers to the unrestricted flow of capital and investment, leading to an accelerated hollowing out (Robinson, 1983; Trowbridge, 1985).

The issue of hollowing out was first discussed in Japan at the end of the 1980s. Plaza Accord in September 1985, which gave rise to a structural transformation of the Japanese economy, was provoked by pressure from advanced countries, including the United States and Britain, on eliminating external trade imbalance in the 1980s. The yen continued to strengthen following the Plaza Accord, causing Japanese exporters to lose competitiveness. The sharp yen appreciation was detrimental to the Japanese economy, driving the manufacturing sector, the primary source of Japan's export earnings, into a recession. Japan's manufacturing production base increasingly relocated overseas, and domestic employment decreased. And such change in the economic environment significantly increased Japan's foreign direct investment (FDI henceforth).

Japan has suffered from changing FDI environment since the postwar era. From the 1960s to 1970s, Japan benefited from outward direct investment. Under such inferior economic conditions as soaring energy prices, inadequate land supply, and labor shortage, relocation of labor and energy-intensive industries to lower-cost destinations allowed public and private manufacturing investment to focus on producing high value-added products (Hirono, 1996).

Exports remained to thrive in the 1980s, and domestic manufacturing output rapidly increased despite the strong yen and growing FDI. However, following the bubble burst in the early 1990s, a recessionary economy with a low and negative growth rate has been witnessed for a more extended period. From 1980 to 2010, Manufacturing value-added declined from 27.2% to 20.8%, and the manufacturing share of total employed persons shrunk from 25% to 16.9%.

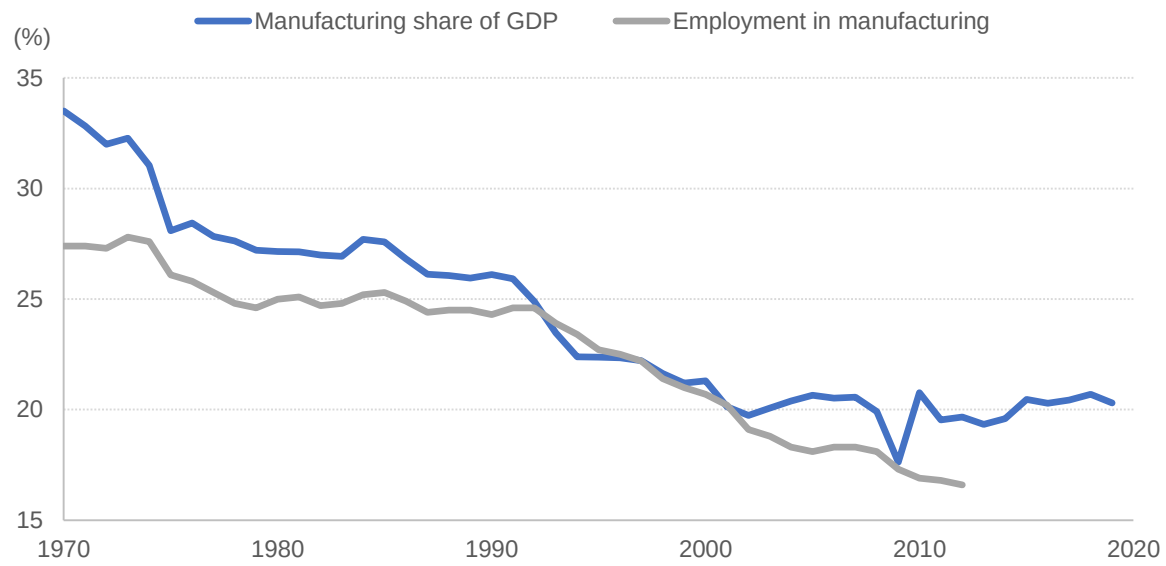

Figure 1. Changes in the manufacturing share of GDP and employment
Source: OECD Statistics, Federal Reserve Economic Data (FRED)

Such deterioration in manufacturing can be easily observed to various degrees across other industrialized countries, but what makes Japan's case unique is that the real effective exchange rate of the yen has exhibited greater volatility than other developed countries' currencies (Belke & Volz, 2020). *Endaka Fukyo*, Japan's economic recession induced by the relatively high value of the yen against other currencies, has consistently plagued Japanese policymakers and manufacturers. Since the collapse of the Bretton Woods system, the yen has undergone several great appreciations, including the late 1970s, after the 1985 Plaza Agreement, the early and late 1990s, and after the 2008 financial crisis. The Plaza Accord in 1985 especially triggered the trend of the strong yen and kept the real exchange rate for Japan highly overvalued.

The series of *Endaka* periods gave rise to concern about economic de-industrialization in Japan. The standard deviation of Japan's annual real effective exchange rate between 1980 and 2010 was 16.97, while it was 12.93 for the United States, 10.85 for the United Kingdom, and 5.28 for Germany, suggesting that the Japanese manufacturing industry has been hit hardest by the exchange rate (Belke & Volz, 2020).

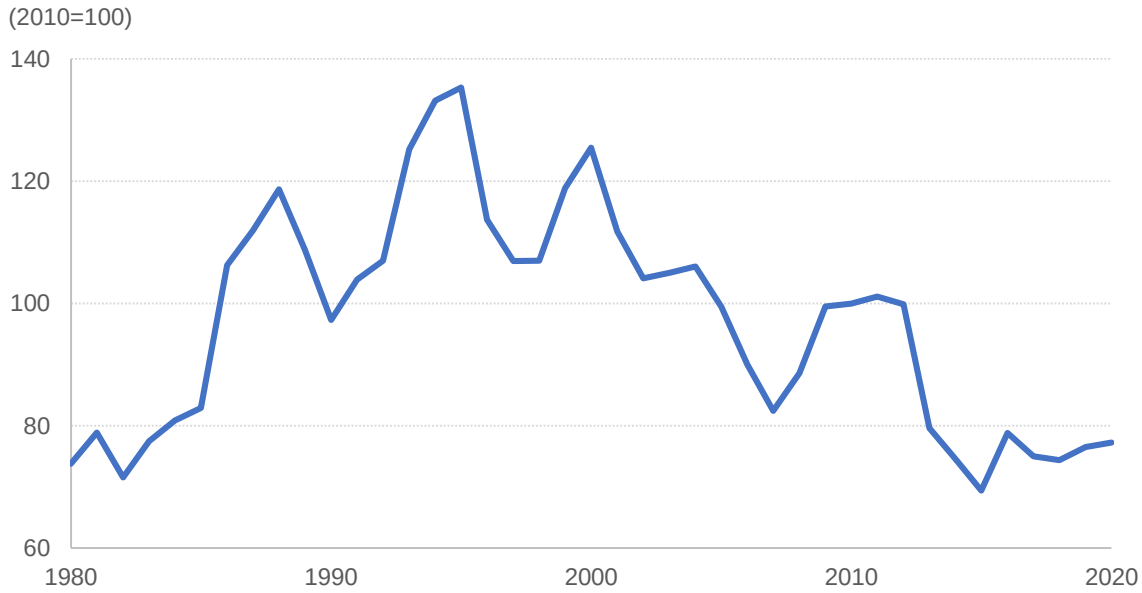

Figure 2. Real effective exchange rate of Japanese yen (2010=100)
Source: World Development Indicators (WDI)

Another root cause of Japan's industrial hollowing out is the emergence of China as a global manufacturing hub. While Japan's hollowing out in the 1980s was prompted by rapid yen appreciation, the hollowing out that occurred later in the 2000s was attributed to the weakening competitiveness of the manufacturing sector and overseas relocation of production bases for high value-added products, caused mainly by China's economic rise following its WTO accession and export growth. Among emerging countries that expanded their international presence as single markets and production bases, China stood out in the global economy for its cheap labor and abundant resources, which ultimately incurred Japan's industrial hollowing out. Besides, South Korea and China started to make progress in

intermediate goods production, which Japan used to maintain a sole competitive advantage, and they moved forward with industrial infrastructures backed by the international division of labor.

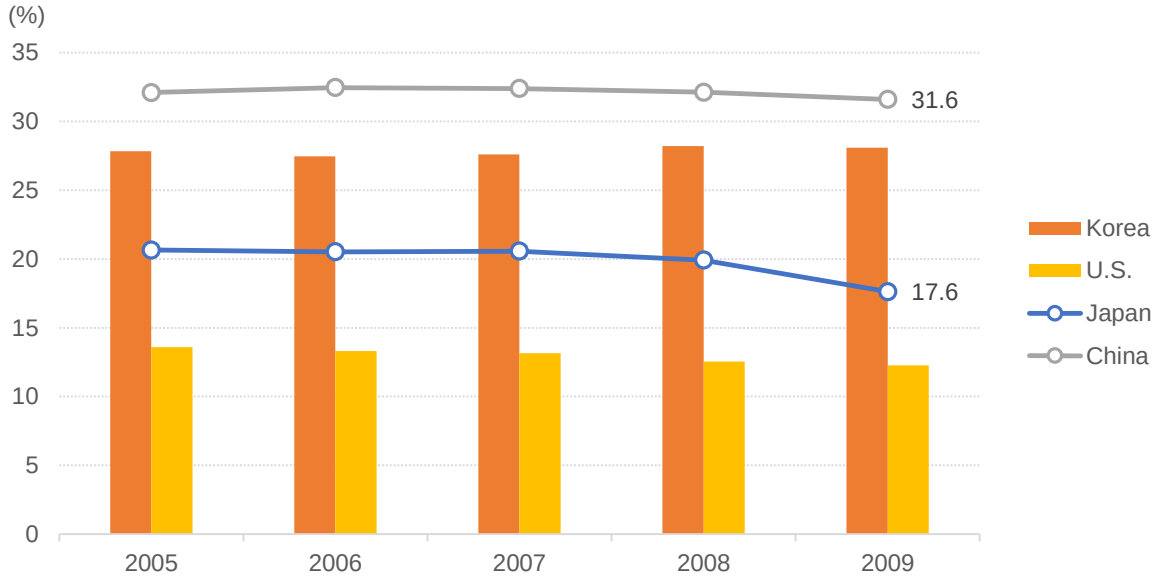

Figure 3. Manufacturing value-added by countries
Source: OECD Statistics

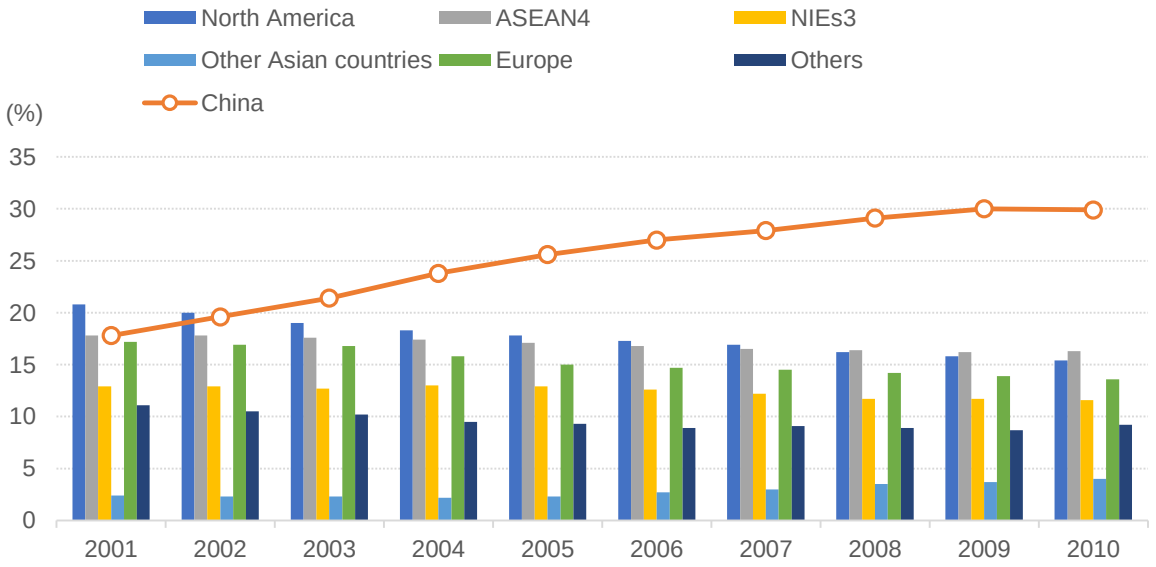

Figure 4. Distribution of Japanese manufacturing subsidiaries by country
Source: *Survey on Overseas Business Activities* - Ministry of Economy, Trade and Industry (METI)

With such challenges, Japan encountered economic stagnation that afflicted

employment and technological clusters. Relocation of production bases, mainly led by large corporations that made investments abroad, eventually led to the shutdown of Japan's productive business establishments. Only 44% of existing establishments in 1990 operated up to 2003, and few businesses were initiated in the same period. Consequently, the total establishments decreased by 33%. Even firms with high labor productivity within their respective industries encountered poor survival rates. Only 47% of them, which showed the fastest declines in each 50 manufacturing sectors in 1990, stayed until 2003 (Fukao, 2010). In the end, hollowing out is considered to lead only to the survival of the service industry and, thus, the fundamental weakening of the manufacturing that traditionally fostered economic development.

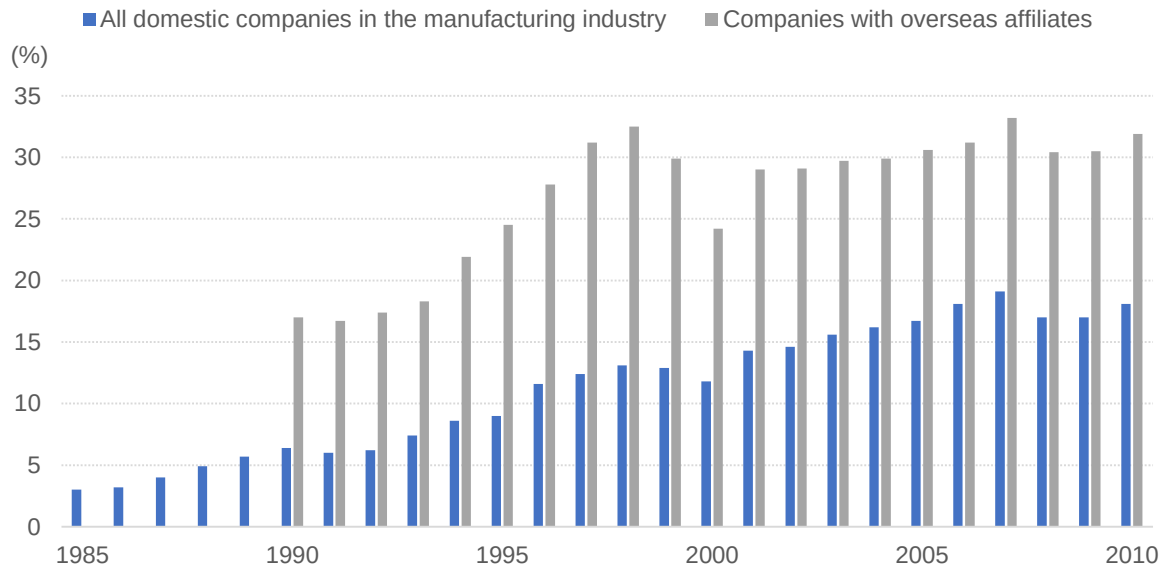

Figure 5. Overseas production ratio in the manufacturing industry
Source: *Survey on Overseas Business Activities* - METI

The outline of this paper is as follows. A review of literature on the domestic factors behind the hollowing out process in Japan is in the next section. Section 3 consists of two parts. First, it draws implications on the relationship between different factors and their potentially deindustrializing effect by formulating OLS regression with annual aggregate data that range

from 1960 to 2021. The second part of section 3 measures the long-term impacts of exports, outward FDI, and yen exchange rate movements by sector using industry-specific data from 1970 to 2021. Section 4 summarizes and concludes the paper, including policy implications.

2. LITERATURE REVIEW

2.1. Overvalued Yen and Deindustrialization

The literature on deindustrialization has emphasized changes in specialization, technological advances, output, foreign trade, and investment and consumption patterns rather than real exchange rate movements (Rowthorn & Coutts, 2004). However, Japanese industries bore a heavy burden of overvalued real exchange rates, implying that monetary policy has played a vital role in generating prolonged stagnation in the case of Japan. A few studies, including Dekle (1996), Dekle et al. (2010), and Yamashita (2013, 2015), systematically verify that yen fluctuations have contributed to deindustrialization and foreign outsourcing in Japan. Obstfeld (2010) considers the yen real effective exchange rate has an adverse effect on Japan's real GDP growth rate. Japan's ability to compete with the U.S. was significantly weakened when the yen appreciations that appeared in 1985 and 1995 contributed to the rise in production costs of Japanese industries (Dekle, 1996; Dekle et al., 2010). Moreover, BOJ (2011) argues that the relatively appreciated yen against levels before the Lehman shock revitalized the movement of production bases overseas since 2008.

Yamashita (2013, 2015) views strong yen and FDI outflows as determinants of Japan’s deindustrialization and points out that weaker yen may prompt reshoring. However, the effects of appreciation and depreciation of currency value may not be symmetrical. Exchange rate appreciation may cause foreign outsourcing and offshoring, forfeiting manufacturing capacities and jobs in the home country. On the contrary, devaluation taking place afterward may not

necessarily lead to reshoring, given that foreign investments have been completed in the long term, which will not be reversed. Sunk cost hysteresis in international trade (Krugman 1988; Baldwin & Krugman 1989; Baldwin 1990; Baldwin & Lyons 1994) describe these hysteresis effects of international trade. According to the empirical investigation conducted by Giovannetti and Samiei (1995) on manufacturing exports in the U.S., Germany, and Japan, the case of hysteresis turns out to exist only in Japan.

2.2. Impact of FDI on Home and Host Countries

2.2.1. The Impact of Inward FDI on Host Countries

Simeon and Ikeda (2011) cover three areas of literature on hollowing out: general deindustrialization process and FDI outcomes of home and host countries. Generally, inflows of FDI stimulate the host country's economy, as observed in the case of the UK, whose overall industrial performance was improved due to Japanese FDI (Dunning, 1984). Inward FDI also promotes technical improvements, total factor productivity (TFP henceforth), employment, and the spread of ideas and technologies (Radulescu 1996; Hirono 1996; Barrell & Pain, 1997 and 1999). In addition to those findings, some studies demonstrated a positive relationship between exports and inward FDI. Pain and Wakelin (1998) state that inward FDI benefits trade outcomes in general and that net inflows of foreign investment into the UK significantly improved its export performance. Indeed, many state governments primarily consider inward FDI to foster economic development (Liou, 1993).

2.2.2. Productivity Effects of Outward FDI on Home Country

Outward direct investment in the manufacturing sector is one of the most solid indicators of hollowing out in general, but the effects can be ambiguous for the home country. Barrell and

Pain (1997) support the hypothesis that outward FDI harms net trade performance. BOJ (1989) states that expansion of outward FDI resulted in structural reform in the long term with a rapid and temporary increase in the physical movement of capital goods and parts to manufacturing bases in other countries. Indeed, Japanese outward direct investment recorded a sharp increase to avoid further the yen's strong appreciation after 1985. After surpassing $10 billion in 1985 with a starting point of $12.2 billion, it peaked at $33.4 billion in 1987 and $67.5 billion in 1989. The total investment amount for five years from 1986 to 1990 was $227.2 billion, which was 2.7 times higher than the accumulated amount of $83.6 billion for the previous 35 years from 1951 to 1985. Besides, Japanese multinationals grew by 290% in 1992 compared to 1985, and the physical restructuring rose 14% from 1982 to 2002 (Ryan & Toubal, 2017).

Nonetheless, international outsourcing may improve the competitiveness of domestic operations, and it plays an essential role in both regional and global level value chains (Baldwin, 2006; Yamashita & Fukao, 2010). According to Baldwin (2006), Japanese companies partly retained manufacturing work nationwide while strengthening external competitiveness by offshoring labor-intensive business processes to low-cost foreign locations in close geographical proximity such as South and Northeast Asia since the mid-1980s. Other studies also argue that outward FDI brings about firm-level benefits, although it may not directly profit the national economy. For instance, according to a survey of 164 Japanese small and medium-sized companies conducted by Lu and Beamish (2001), the positive impact of globalization originated primarily from the extent of their FDI activity. Relocation of physical manufacturing processes overseas permits low wage rates, few labor laws, cheap loans, affordable land, few environmental rules, and huge economies of scale with over a million workers dedicated to producing a single kind of product. In this respect, firms can avoid regulations, currency fluctuation, and high-priced land and wages with the freedom and flexibility to move their internal business processes to different locations. This physical restructuring allows offshoring

companies to focus more on other business concerns. Thus, the motivation of FDI activities determines the potential consequence of outward investments on the home economy (Dreyfack & Port, 1986; Terasaki & Yamauchi, 1996). This paper uses fifty years of data on the manufacturing share of outward FDI to explore its effect on the manufacturing industry and the overall economy of Japan.

2.3. Hollowing Out and Home Country's Labor Market

Employment is frequently discussed in connection with the hollowing out, but empirically, the impact of deindustrialization on domestic manufacturing employment is ambiguous. The discussion lies essentially in whether transferring manufacturing production bases overseas harms domestic employment and technology levels or should be regarded as a part of globalization. In general, outward FDI is perceived to hurt home country employment. Manufacturing jobs decrease as companies increasingly shift physical manufacturing processes to lower-cost destinations, causing shrinking middle-class and consequent income inequality (Davis & Huston, 1992; Iganski & Payne, 1999). In the US, outward FDI turned out to lower the domestic employment rate since US manufacturing firms relocate overseas in search of less-skilled, labor-abundant countries for their labor-intensive production (Blomstrom, Fors, & Lipsey, 1997). On the contrary, Yamashita and Fukao (2010) find no proof that bringing physical manufacturing processes overseas hurt Japan's domestic employment from 1991 through 2002. Using firm-level data from 1982 to 2001, Ryan and Toubal (2017) provide a comparative analysis of employment between companies with and without overseas branches to investigate the impacts of foreign operations on the domestic labor market. The study finds limited evidence that Japanese multinational companies' moving internal business functions to other locations since 1991 did influence the industrial hollowing-out phenomenon of Japan's economy, including job losses and wage erosion.

3. RESEARCH METHOD

3.1. Analysis with Aggregate Data, 1960-2021

3.1.1. Data Description and Methodology

Data are obtained primarily from World Development Indicators (WDI), OECD statistics, and the Federal Reserve Economic Data (FRED). The manufacturing sector's outward FDI and TFP growth rates are collected respectively from two sources: (1) Japan External Trade Organization (JETRO) and (2) Japan Industrial Productivity Database 2021 (JIP Database 2021) compiled by the Research Institute of Economy, Trade, and Industry (RIETI) and Hitotsubashi University. Explanatory variables were selected based on previous research on deindustrialization. The following model is estimated with data that span from 1960 to 2021:

Dependent Variables= Manufacturing share of GDP (GDPMAN) and employment (EMPMAN)

$$Dependent\ \ Variables = \beta_0 + \beta_1 FDI + \beta_2 EXR + \beta_3 EXPJP + \beta_4 EXPCN + \beta_5 TFPVA + \varepsilon \quad (1)$$

GDPMAN: Manufacturing, value added (% of GDP)

EMPMAN: Percent of employment in manufacturing

FDI: Foreign direct investment (FDI) in Japan, net outflows (% of GDP)

EXR: Japanese yen to U.S. dollar exchange rate (period average)

EXPJP: Japanese exports of goods and services (% of GDP)

EXPCN: Chinese exports of goods and services (% of GDP)

TFPVA: TFP growth rate in manufacturing (value-added basis)

Dependent Variables

Table 1 shows the trend of dependent variables over thirty years. In addition to the manufacturing share of GDP and employment, outward FDI is considered together to find a clear difference between dependent variables and hollowing out factors. The manufacturing share of GDP in the first column remained above 25% for the first ten years. However, it started to fall below 25% in the early 1990s and reached around 20% in 2002, indicating that manufacturing contribution to the Japanese economy steadily declined. Similarly, manufacturing employment in the second column remained constant at roughly 25% until the end of the bubble economy. Yet, in the post-bubble era, it gradually dropped to approximately 20% by the start of the new decade, which proves the labor force in the manufacturing sector shrank amid the hollowing out process. Lastly, Japan's outward FDI as a share of GDP exhibits the most drastic fluctuation among the three variables. FDI outflows remained relatively low until the mid-1980s, but they started to rise remarkably immediately after the Plaza Accord and unprecedented appreciation of the Japanese yen relative to the U.S. dollar. At the same time, the yen's appreciation throughout the bubble economy from 1988 to 1990 is also attributable to the rapid increase in outward FDI. Japan's FDI outflows flattened somewhat in the post-bubble period and then rose sharply again in the early 2000s, showing an overall upward trend despite several ups and downs.

Year	Manufacturing Share of GDP (%)	Manufacturing Share of Employment (%)	FDI Net Outflows (% of GDP)
1980	27.2	25.0	21.6
1981	27.1	25.1	40.1
1982	27.0	24.7	40.0
1983	26.9	24.8	29.1
1984	27.7	25.2	45.2
1985	27.6	25.3	46.0
1986	26.8	24.9	69.3
1987	26.1	24.4	79.4
1988	26.1	24.5	115.4
1989	25.9	24.5	151.4
1990	26.1	24.3	162.1

1991	25.9	24.6	88.3
1992	24.9	24.6	44.3
1993	23.5	23.9	31.2
1994	22.4	23.4	36.3
1995	22.4	22.7	40.8
1996	23.4	22.5	53.6
1997	23.4	22.2	53.4
1998	22.9	21.4	48.3
1999	22.5	21.0	52.3
2000	22.6	20.7	90.6
2001	21.3	20.2	81.5
2002	20.9	19.1	73.9
2003	21.1	18.8	76.3
2004	21.3	18.3	83.0
2005	21.6	18.1	106.9
2006	21.6	18.3	126.4
2007	22.1	18.3	159.4
2008	21.4	18.1	222.5
2009	19.1	17.3	139.3
2010	20.8	16.9	138.3

Table 1. The trends of hollowing out factors over three decades
Source: OECD Statistics, WDI, FRED, and Japan External Trade Organization (JETRO)

Overall, there appear to have been significant changes in the Japanese economy caused by hollowing out factors over thirty years. Manufacturing value added showed a substantial decrease with time, considering more manufactured goods were produced abroad as deindustrialization progressed. Likewise, since manufacturing operations continued relocating overseas, the manufacturing share of employment declined, while FDI net outflows, the main hollowing out factor, exhibited an increasing trend.

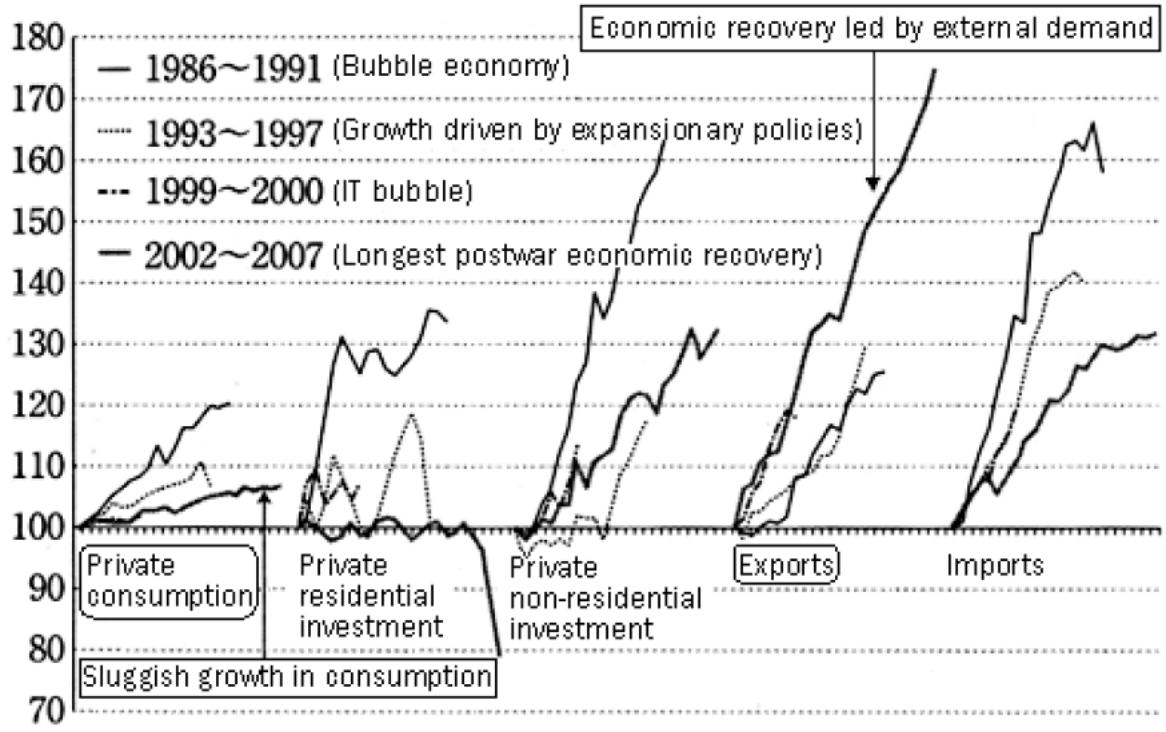

Figure 6. Economic history of Japan, 1986-2007
Source: *White Paper on International Economy and Trade 2009* - METI

Table 2. Comparison of means by periods, 1980-1999

Variables	Pre-bubble (1980-1989)	Post-bubble (1990-1999)	Significance
GDPMAN	26.84 (0.62)	23.25 (1.77)	***
EMPMAN	24.84 (0.31)	23.06 (1.30)	***
FDIMAN	0.55 (0.53)	1.76 (0.94)	***

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

As described in figure 6, Japan experienced four stages of economic change: Plaza Accord and bubble economy (1986-1991), growth driven by expansionary policies (1993-1997), IT bubble (1999-2000), and sustained economic recovery (2002-2007). Analysis of variance (ANOVA) in table 2 further investigates historical factors of hollowing out, focusing on two periods with the most evident causal relationship of hollowing out: pre-bubble in the 1980s when the yen strengthened after the Plaza Accord and post-bubble throughout the 1990s when Japan suffered a prolonged economic stagnation. In table 2, there exists a notable difference in the three variables between the analyzed periods. While manufacturing value-added in GDP and employment declined, outward FDI specific to the manufacturing sector

showed a significant upward trend during the presence of hollowing out, explaining the influence of factors that contributed to the hollowing out phenomenon. Table 7 in the appendix provides details of each ANOVA result.

Independent Variables

In Japan, FDI outflows are directly associated with the hollowing out and overall transfer of output bases abroad, contributing to weakened competitiveness of the manufacturing sector. Specifically, Japan's increased FDI in manufacturing raised concern over deindustrialization since manufacturing output has shown a persistent decrease. Meanwhile, the transfer of production bases overseas accompanied by yen appreciation has also brought about a downward trend in domestic employment and substantial loss of high-paid manufacturing jobs as the manufacturing sector declines. In this context, the Japanese yen to US dollar exchange rate is also added as an explanatory variable to examine the hypothesis that yen appreciation prompted FDI outflows and thus accelerated hollowing out.

TFP growth rate in manufacturing is used as an indicator of productivity since higher productivity growth in manufacturing is widely recognized as a principal factor in deindustrialization. Manufacturing development increases consumer purchasing power and the level of demand for the economy. As manufacturing productivity improves and household income rises, national expenditure patterns shift from manufactured goods to services (e.g., Engel's Law). In this respect, productivity growth has prompted a fall in manufacturing employment and deindustrialization. If the hypotheses were correct, negative coefficients are expected for the three variables: FDI outflows, yen exchange rate, and TFP growth rate.

On the contrary, Japan's manufacturing performance and contribution to GDP have been responsible for 90% of Japan's exports - the driving force behind the Japanese economy, so a positive coefficient is expected for the value of exports. Since major Japanese exports

include manufactured goods, such as electronic equipment and cars, an increase in exports could also stimulate employment in the manufacturing sector. The effects could be ambivalent in the case of Chinese export growth. While the expansion of Chinese export fostered China's economic performance and allowed great opportunities for Japanese companies, at the same time, Chinese exporters have increasingly grown into competing with Japanese manufacturers.

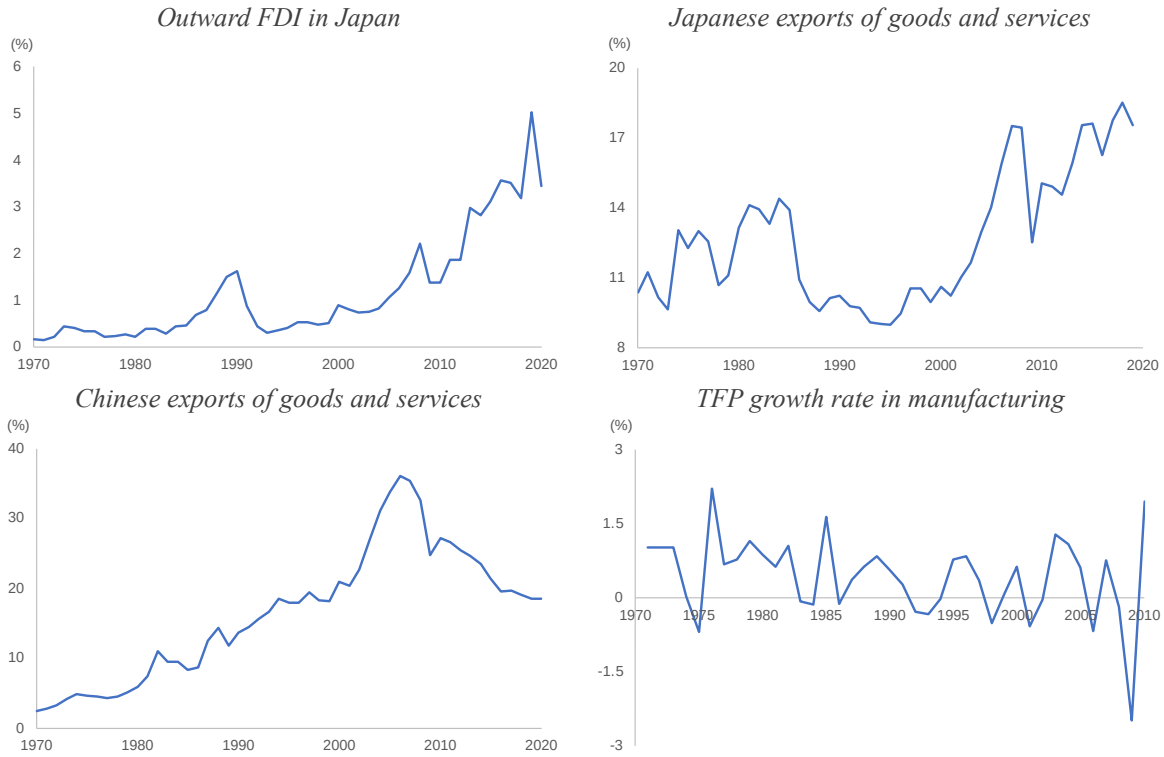

Figure 7. Time series of annual independent variables, 1970-2021
Source: JETRO, WDI, and Research Institute of Economy, Trade, and Industry (RIETI)

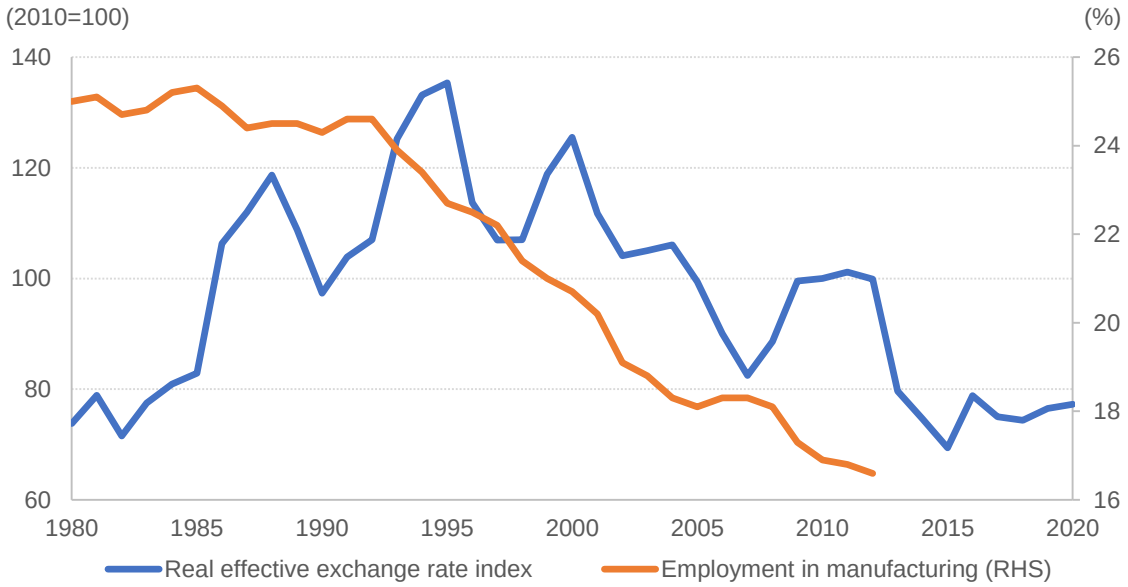

Figure 8. Real effective exchange rate and employment in the manufacturing sector
Source: WDI, FRED

Figure 7 graphically displays time series independent variables based on annual data. Figure 8 shows the movements of two correlated variables: the percent of manufacturing employment and the real effective exchange rate of the yen. Until the mid-1990s, the yen's real effective rate displayed a long-term upward trend except for the devaluation between 1988 and 1990. After peaking in 1995, the yen's REER showed a downward movement leaving out appreciation in 1998-2000 and 2007-2010. The manufacturing share of aggregate employment is generally decreased, although it temporarily remained stable from 1987 to 1992 and 2005 to 2007.

3.1.2. Results

Table 3 displays the results of an OLS estimation of the empirical model in equation (1). The share of manufacturing in GDP (GDPMAN) and employment (EMPMAN) represents dependent variables. Independent variables in equation (1) are considered simultaneously in the long run.

Table 3. OLS regression of hollowing out factors

VARIABLES	(1) GDPMAN	(2) EMPMAN
FDI	-4.302***	-8.782***
	(0.485)	(0.934)
EXR	-0.0486***	-0.0571***
	(0.00950)	(0.0133)
EXPJP	1.670***	0.973***
	(0.130)	(0.191)
EXPCN	-0.647***	-0.441***
	(0.0726)	(0.109)
TFPVA	0.131	-0.550
	(0.442)	(0.475)
Constant	25.97***	33.80***
	(3.244)	(5.038)
Observations	61	61
R-squared	0.897	0.852

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

FDI outflows have a negative and significant effect on the manufacturing share of GDP and employment. The yen exchange rate shows a negative coefficient and is statistically significant for both dependent variables, corresponding to prior expectation. A negative correlation observed between the TFP growth rate and manufacturing employment implies that higher productivity led to a lower share of manufacturing employment. Negative coefficients of Chinese exports suggest that competition with China prompted Japanese manufacturing deterioration and hollowing out. To sum up, the annual data analysis above based on OLS estimations indicates that higher exports relate to increased economic activity and a growing manufacturing sector, whereas the remaining variables have a high correlation to the hollowing-out phenomenon. Appreciations in the yen exchange rate particularly hurt the share of manufacturing in GDP and employment. It holds even when the yen undergoes prolonged real effective depreciation, proving hysteresis effects (Krugman & Baldwin 1987; Belke et al. 2013). Lastly, the high value of r-squared, a goodness-of-fit measure for linear regression

models, suggests the robustness of the empirical model.

3.2. Analysis with Industry-Specific Data, 1970-2021

3.2.1. Data Description and Methodology

The following estimated model assesses the impact of industry-specific exports, FDI outflows, and yen exchange rate on manufacturing value-added, taking sector-wide real value-added and TFP growth rate into account simultaneously from a long-run perspective. The sector-specific dataset is obtained from RIETI, the Ministry of Finance Japan, and JETRO. The dataset covers seven industrial sectors: food (FOOD), textile (TEXT), chemicals (CHEM), metal (MTL), general machinery (GENMACHY), electrical equipment (ELECEQ), transport equipment (TRANSEQ), and manufacturing as a whole (MANALL).

$$GDPMAN = \beta_0 + \beta_1 RVA\_X_{t-1} + \beta_2 EXP\_X_{t-1} + \beta_3 FDI\_X_{t-1} + \beta_4 REER\_X_{t-1} + \beta_5 TFPVA_{t-1} + \varepsilon \quad (2)$$

RVA_X: Real value-added by industry X (million yen, 2000 price)

EXP_X: Value of exports by special classification of commodity

FDI_X: Outward FDI by industry X

REER_X: Industry-specific real effective exchange rates

TFPVA_X: TFP growth rate by industry X (value added basis)

In this section, the influence of the yen exchange rate on manufacturing output will be discussed in more detail, for which sector-specific real exchange rates will be applied to assess the effects of changes in currency valuation on manufacturing. Kato (2018) finds exchange

rates as the main factor that affects manufacturing firm-level exports. From January 2002 to October 2007, Japan underwent the most prolonged economic expansion stimulated by external demand. Exports, which grew at the fastest pace during that period, continued to rise against the backdrop of a weak yen stemming from low-interest rates, setting a record every year from 2004 to 2007. The ratio of exports to GDP also marked a record high of 17.1% in 2007. Comparing Japan, China, and Korea's export price competitiveness and performance, Sato et al. (2013) discovered that yen appreciation since 2007 has harmed Japan's electronics industry. Similarly, Thorbecke (2012) points out that the upward trend of yen from 2007 to 2011 was detrimental to electronics exports.

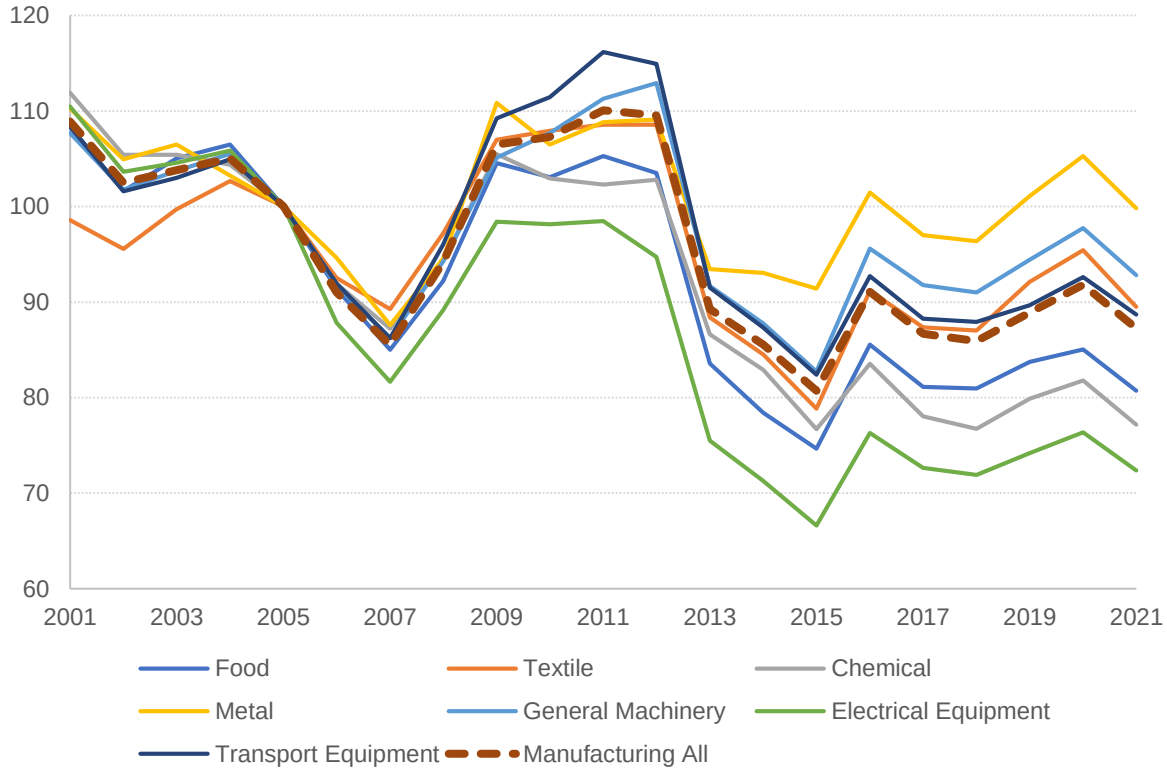

Figure 9. Industry-specific real effective exchange rates for Japan (2005 = 100)
Source: RIETI

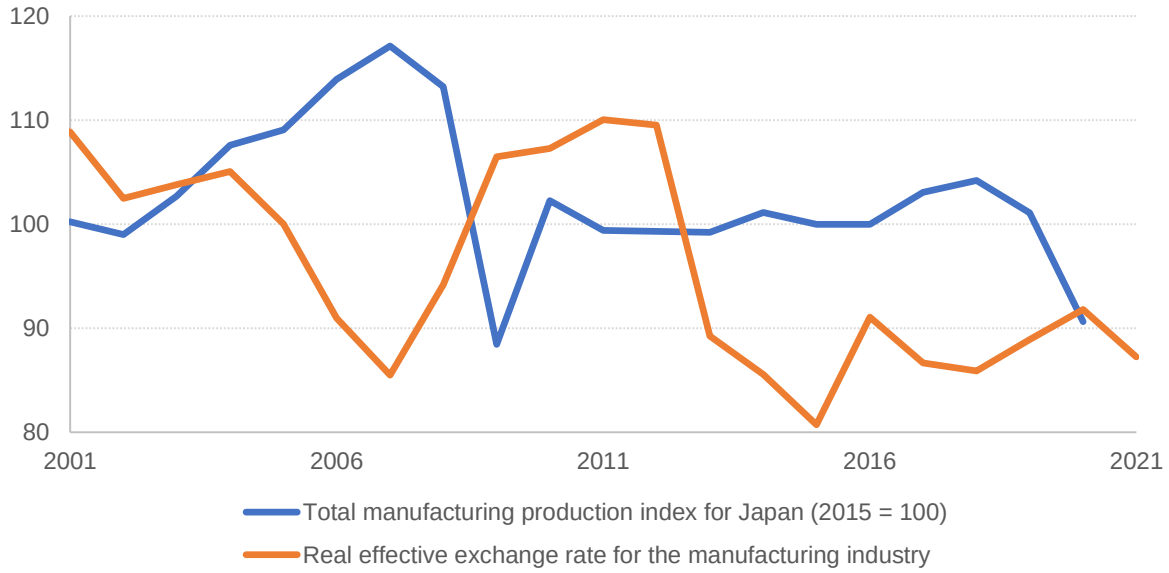

Figure 10. Manufacturing output and real effective exchange rate
Source: FRED, RIETI

Figure 9 shows trends in real effective exchange rates of selected manufacturing industries, among which 'manufacturing all' represents the average of different sectors. Figure 10 displays total manufacturing production for Japan and industry-specific real effective exchange rates for Japan's manufacturing industry. Both series moving in opposite directions imply that exchange rate fluctuations possibly hurt Japanese industrial production.

3.2.2. Results

Overall, the estimation results in table 5 are consistent with the hypothesis that in the Japanese economy, exchange rate appreciations are closely interrelated with the hollowing out phenomenon, including growing outward FDI and deteriorating GDP and exports. According to the estimation, the yen exchange rate by industry exercises significant adverse influences for Japan's industrial growth for all seven sectors and whole manufacturing. As indicated in table 4, REER in manufacturing has an inverse relationship with the manufacturing share of GDP, real value-added, and value of exports, demonstrating that currency appreciation deters industrial development and economic growth. This result is consistent with the findings of Sato

et al. (2013) and Thorbecke (2012), which empirically examined the relationship between the yen exchange rate and Japanese exports. The result also reveals that outward FDI by industry negatively affects manufacturing value-added in all cases. In the case of the electrical machinery industry, from 1990 to 2003, overseas production sharply increased, and there was a decrease in both domestic production and the balance of trade. It followed Japanese firms' growing shift of production base primarily to Southeast Asian states and China in search of lower wages and production costs in the 1990s. Although TFP growth provided the least explanatory power, there are some negative correlations between TFP growth and industrial outputs, including chemical, metal, general machinery, and electrical equipment. In the 1990s and early 2000s, TFP growth in the manufacturing industry stagnated, partly explained by the idling of capital stock due to the recession in this period. However, even considering the low level of the capacity utilization rate of capital, TFP growth in the manufacturing sector exhibited a rapidly declining trend.

Table 4. The statistical relationship between variables (manufacturing sector)

	GDP	RVA	EXP	FDI	REER	TFPVA
GDP	1.0000					
RVA	0.2527	1.0000				
EXP	0.6371	0.3826	1.0000			
FDI	-0.6087	-0.4199	-0.2206	1.0000		
REER	-0.6605	-0.1737	-0.3500	0.6815	1.0000	
TFPVA	0.0377	-0.2977	-0.1055	0.0859	0.0304	1.0000

Table 5. Estimation of causal effects of industry-specific explanatory variables

Food		*Textile*	
	(1)		(1)
VARIABLES	GDPMAN	VARIABLES	GDPMAN
lnRVA_FOOD	0.720**	lnRVA_TEXT	0.976**
	(0.307)		(0.399)
lnEXP_FOOD	0.196**	lnEXP_TEXT	0.150**
	(0.0791)		(0.0711)
lnFDI_FOOD	-1.543***	lnFDI_TEXT	-1.348***
	(0.190)		(0.451)

lnREER_FOOD	-1.102***
	(0.241)
TFPVA_FOOD	0.139
	(0.295)
Constant	22.65***
	(5.328)
Observations	52
R-squared	0.814

Chemical

	(1)
VARIABLES	GDPMAN
lnRVA_CHEM	0.625*
	(0.359)
lnEXP_CHEM	0.116
	(0.0693)
lnFDI_CHEM	-1.692***
	(0.297)
lnREER_CHEM	-1.034***
	(0.274)
TFPVA_CHEM	-0.444
	(0.653)
Constant	27.49***
	(4.909)
Observations	52
R-squared	0.769

General Machinery

	(1)
VARIABLES	GDPMAN
lnRVA_GENMACHY	0.438
	(0.376)
lnEXP_GENMACHY	0.184**
	(0.0696)
lnFDI_GENMACHY	-1.872***
	(0.276)
lnREER_GENMACHY	-1.118***
	(0.241)
TFPVA_GENMACHY	-0.800
	(1.769)
Constant	30.32***
	(5.875)
Observations	51
R-squared	0.806

Transport Equipment

	(1)

lnREER_TEXT	-1.344***
	(0.297)
TFPVA_TEXT	0.544
	(2.838)
Constant	18.70**
	(7.067)
Observations	52
R-squared	0.741

Metal

	(1)
VARIABLES	GDPMAN
lnRVA_MTL	0.698*
	(0.364)
lnEXP_MTL	0.165**
	(0.0721)
lnFDI_MTL	-1.799***
	(0.314)
lnREER_MTL	-1.388***
	(0.286)
TFPVA_MTL	-1.664**
	(0.801)
Constant	26.33***
	(5.561)
Observations	52
R-squared	0.774

Electrical Equipment

	(1)
VARIABLES	GDPMAN
lnRVA_ELECEQ	0.384
	(0.274)
lnEXP_ELECEQ	0.0672
	(0.0917)
lnFDI_ELECEQ	-1.750***
	(0.368)
lnREER_ELECEQ	-1.185***
	(0.404)
TFPVA_ELECEQ	-0.984
	(0.875)
Constant	32.55***
	(4.161)
Observations	52
R-squared	0.698

Manufacturing All

	(1)

VARIABLES	GDPMAN	VARIABLES	GDPMAN
lnRVA_TRANSEQ	0.781**	lnRVA_MANALL	0.0386
	(0.355)		(0.127)
lnEXP_TRANSEQ	0.0827	EXP_MANALL	0.210***
	(0.0728)		(0.0248)
lnFDI_TRANSEQ	-1.447***	lnFDI_MANALL	-1.386***
	(0.307)		(0.315)
lnREER_TRANSEQ	-0.964***	lnREER_MANALL	-0.574***
	(0.350)		(0.156)
TFPVA_TRANSEQ	1.192	TFPVA_MANALL	0.502**
	(2.528)		(0.219)
Constant	22.99***	Constant	16.81***
	(5.717)		(2.822)
Observations	51	Observations	52
R-squared	0.785	R-squared	0.770

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Summing up, analysis using sectoral data confirms that hysteresis effects of REER for Japan exist in an extensive range of manufacturing industries. Various factors have contributed to the deindustrialization process that has been witnessed in Japan in recent decades, and the yen exchange rate is not a single factor. However, the results indicate that the yen's impact on growth and employment in manufacturing was much longer and greater than expected. Given the significance and importance of manufacturing in Japan, new approaches are required to revitalize the economy, considering potentially damaging outcomes of rapid, large-scale exchange rate appreciations.

4. CONCLUSION

This paper analyzes factors associated with industrial hollowing-out in Japan and demonstrates a causal relationship between such factors and Japan's weakening manufacturing sector. As emphasized, the manufacturing share of GDP and employment have undergone a considerable

downturn while outward FDI has shown a substantial increase. The most dynamic hollowing out appeared from the mid-1980 to the 2000s when Plaza Accord and asset bubble consecutively occurred. The hollowing-out issue is still intensely debated in Japan, but there is some uncertainty about the nature of manufacturing hollowing-out impact. Some have maintained that excessive dependence on manufacturing exports prevents non-manufacturing sectors from growing and hinders manufacturing productivity (Chowdhury, 1987; Terasaki & Yamau-chi, 1996). They argue service industry needs to attract more workforce to achieve structural adjustments. Others say that the shrinking manufacturing industry will lower income levels and aggregate demand and prevent sustained economic growth.

As in other developed countries, the service sector in the overall Japanese economy has continuously grown in terms of employment and value-added shares. Service production accounted for more than 70% of Japan's real GDP as of 2018. Wholesale, retail, and real estate made up the highest proportion, while professional science, ICT, and medical and social welfare have shown the fastest growth. At the same time, 72% of total employed persons in Japan are engaged in the service industry over the same period. Employment in medical and social welfare increased most rapidly, accounting for the second-largest share of 12.5%, following 16.1% taken by wholesale and retail. Figure 12 in the appendix compares employment activity in both manufacturing and services from 2002 to recent years. While employment in manufacturing considerably dropped, the non-manufacturing share shows an upsurge. It also suggests that the service sector has absorbed a significant workforce despite the sharp decline in the proportion of Japan's working-age population aged 15-64.

While the service industry accounts for more than 70% of Japan's total production and employment, productivity growth in the service sectors has been sluggish since 2000 compared to other service-oriented countries like US and UK due to the rapid increase in employment in services compared to the sector's growth. In table 6, Japan's service productivity measured

using real value-added has decreased by 0.2% per year on average since 2000. On the other hand, the annual average in US and UK maintained a 1% improvement, although it recently showed a slight downturn, and France also recorded a 1% increase compared to 2010. Nevertheless, in figure 13 in the appendix, despite the low level of growth overall, labor productivity in non-manufacturing has not declined drastically relative to the manufacturing sector due to the steep rise in non-manufacturing output price compared to that of manufacturing. Moreover, the productivity gap between manufacturing and non-manufacturing sectors has narrowed since the service sector is becoming more important in Japan's domestic economy.

Country[1)]	Period		
	2000-2018	2000-2010	2010-2018
US (79.2)	0.98	1.29	0.55
UK (79.9)	0.86	0.96	0.73
France (79.6)	0.38	-0.16	1.05
Germany (71.4)	0.08	-0.31	0.57
Japan (70.6)	-0.16	-0.07	-0.28

Table 6. Percentage change in value-added per capita of service industries in major countries
Source: World Bank
Note: 1) Average annual growth rate within the period

Japanese government views insufficient investment in information and communication technology (ICT) as the primary reason for the lack of productivity improvement in the service industry (Cabinet Office, 2017). ICT investment per capita is declining in the service industry due to the steep increase in employment in services. ICT investment is concentrated in information and communication (27.6%) and finance and insurance (15.5%), while it remains relatively stagnant in wholesale and retail (12.8%) and medical and welfare industries (4.9%). ICT investment is also low in the food, lodging, and personal service, which have a high employment share. Against this backdrop, the government of Japan recommends that the service industry actively introduce innovative technologies in line with the 4th industrial

revolution. With accelerating deindustrialization and a shrinking labor force, service sector productivity is critical to Japan's economic growth.

APPENDIX

Table 7. Single Factor ANOVA

ANOVA (GDPMAN)

Source of Variation	SS	df	MS	F	P-value	F crit
Treatments	64.435281	1	64.435281	36.675880	0.000010	4.4138734
Residual	31.623919	18	1.7568844			
Total	96.059199	19				

ANOVA (EMPMAN)

Source of Variation	SS	df	MS	F	P-value	F crit
Treatments	15.842	1	15.842	17.637061	0.0005386	4.4138734
Residual	16.168	18	0.8982222			
Total	32.01	19				

ANOVA (FDIMAN)

Source of Variation	SS	df	MS	F	P-value	F crit
Treatments	7.2882525	1	7.2882525	12.407331	0.0024326	4.4138734
Residual	10.573470	18	0.5874150			
Total	17.861723	19				

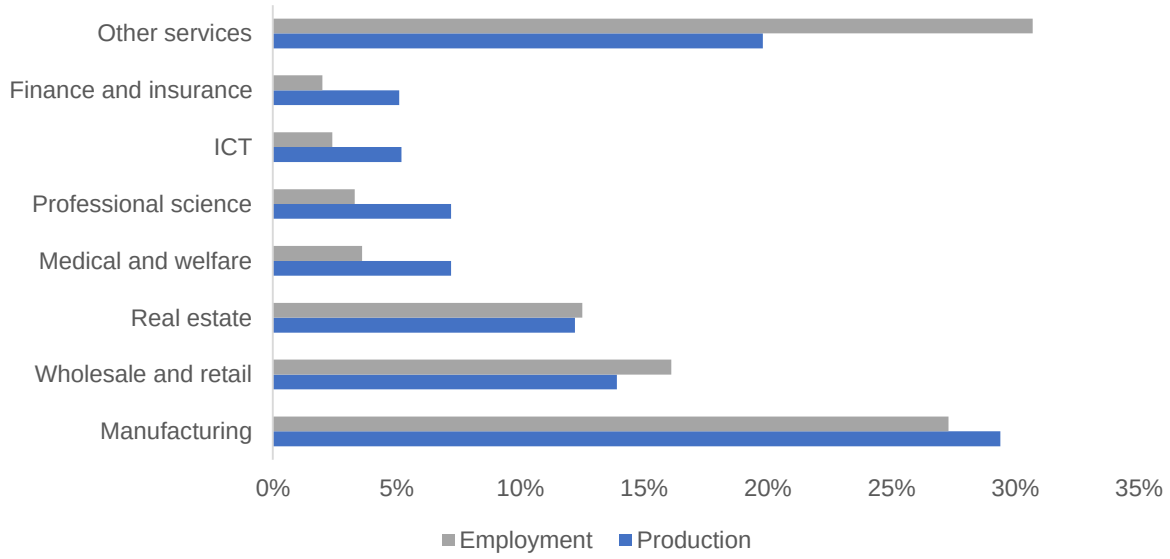

Figure 11. The proportion of production and employment by industry, 2018
Source: Ministry of Health, Labor and Welfare

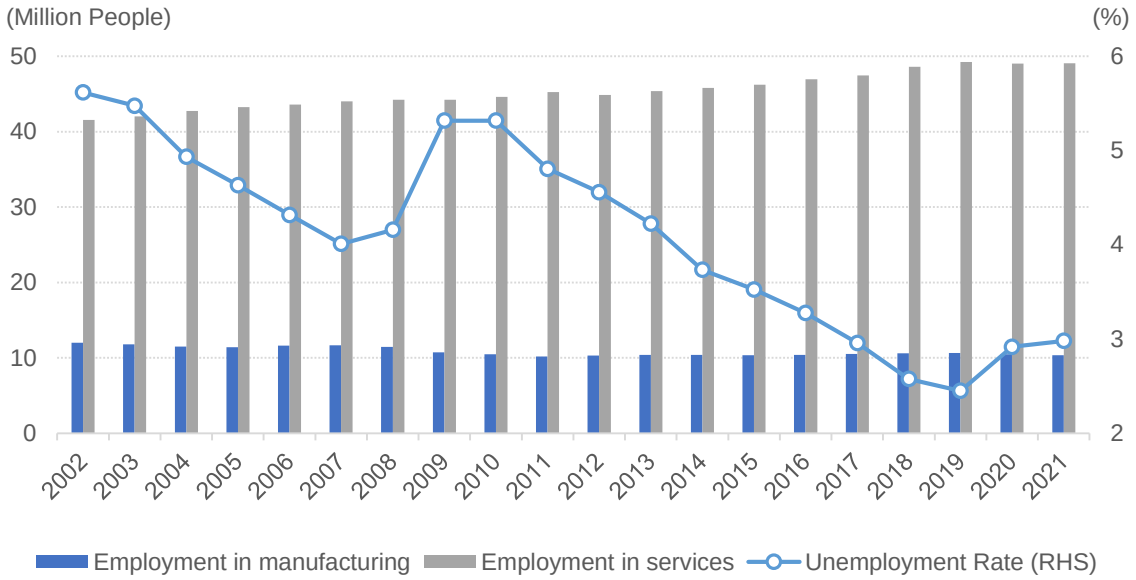

Figure 12. Employment by economic activity (millions of persons) and unemployment rate in Japan
Source: FRED

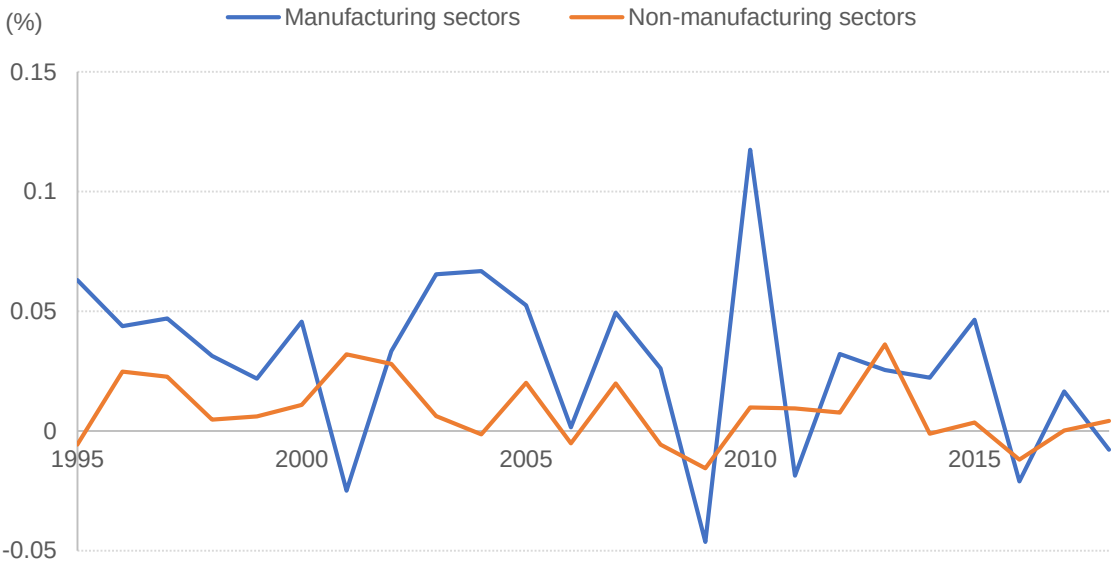

Figure 13. Labor productivity growth rate in manufacturing and non-manufacturing sector (value-added/total hours worked), 1995-2018
Source: *Japan Industrial Productivity Database 2021 (JIP Database 2021)* - RIETI and Hitotsubashi University

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