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Declining Capital Formation in Japan and the Role of Intangibles

―Empirical Studies using Industry-level Data—

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Abstract

The growth accounting using the JIP2021 database tells us that the contribution of capital accumulation to economic growth in the 2010s is very small. Following Gutierrez and Philippon（2017） and Crouzet and Eberly (2018), and based on the multiple Tobin's q theory, we examine whether the declining capital formation in tangibles is made up by an increase in intangible investment. Our study shows that capital formation in intangibles explains the about half of the investment gap between capital formation estimated by the multiple Tobin's q theory and real tangible investment. However, as intangible investment explains only half of the gap, we suggest that the government policies that increase intangible investment up to the levels of the major advanced countries will contribute to halting the declining capital formation in Japan.

Keywords: Growth accounting, Tobin's q, Investment gap, Intangible investment
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1. The Sluggish Japanese Economy and the Decline in Capital Accumulation

With the increase in consumption tax rates in October 2019 and the subsequent spread of the new coronavirus, the effects of Abenomics, which had been in place from Prime Minister Abe's re-emergence at the end of 2012, have ended. Figure 1 compares the economic expansion due to Abenomics with the other two economic expansions since entering the 21st century.[1] We can see that of the three periods of economic expansion, the Abenomics period had the lowest GDP growth. We also see that by demand component, the largest downturn occurred in private consumption. Thus it was the public capital formation that was increased by the second arrow (the flexible fiscal policy) and buoyed Abenomics。

（Place Figure 1 around here）

Now turning to the supply side, and looking at growth accounting using the JIP2021 database in Table 1, the aggregate TFP growth rate in the 2010s showed the highest growth of the last 25 years. By manufacturing and non-manufacturing industries, we observe that manufacturing had a higher TFP growth rate in the late 1990s and the 2000s, but in the non-manufacturing industries, it was significantly higher in the 2010s. This is because the TFP growth rate in the non-manufacturing sector in the late 1990s and the 2000s were negative.

Against the backdrop of slow economic growth, there has been a slowdown in the input of production factors such as labor and capital. The slowdown in labor input can be explained by the decline in the working age population that has continued since the mid-90s, but more serious is the slowdown in capital input. In the 2010s, capital input in the manufacturing sector grew by only 0.2%, and in the non-manufacturing sector, capital input also hardly grew at all. As Kim, Kwon and Fukao (2019) point out, the biggest factor in the downturn in economic growth since entering 2010 is the slowdown in capital accumulation.

（Place Table 1 around here）

From the perspective of demand-focused private sector economists, this stagnant capital accumulation could also be considered a result of a downturn in private consumption. However, according to supply-focused economists, companies are not looking at only

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[1] The peak of the economic expansion during Abenomics was determined to be October 2018 at the August 2020 Business Cycle Dating Committee. Thus, this expansion started from the fourth quarter of 2012 and ended the second quarter of 2018.

domestic markets. Given sales in overseas growth markets, investment behavior is not necessarily limited to the domestic market. Though the discussions tend to be limited to the manufacturing sector, there are also Japanese companies in the service sector that are actively expanding abroad, such as Uniqlo and Muji.

Actually, this decrease in capital accumulation is occurring not only in Japan but throughout the developed countries. The rate of change in labor productivity is the sum of the rate of change of TFP, and the rate of change of the capital service per manhour multiplied by the rate of capital allocation. Thus, a lackluster capital accumulation rate leads to a stagnation of labor productivity through the sluggish capital/labour ratio. In Figure 2 we use the 2021 version of the JIP and the EUKLEMS/INTANProd databases, and compare the capital service per manhour of Japan and Western developed countries. We see that these measures in Japan and major European countries have been flat after the Global Financial Crisis. However, in the manufacturing sector in Japan, labor input has fallen at a faster rate than capital, which results in a small increase in the capital service per manhour. At the same time, in the non-manufacturing sector, labor input is growing at a faster rate than the capital accumulation ratio which has been flat, and so the capital service per manhour has fallen. One of the reasons for the low labor productivity in Japan's non-manufacturing sector this stagnant capital service per manhour.

(Place Figure 2 around here)

Unlike Japan and major European countries, the capital service per manhour in the US had risen steadily until the Global Financial Crisis (GFC), and in 2010 reached about 1.3 times the rate in 2000. However, it has been more or less flat since then. After the GFC in the United States, economic growth and productivity slowed and this was called an era of "secular stagnation". Some studies have reported that this was due in part to the slowdown in the capital accumulation rate[2].

Gutierrez and Philippon (2017) and Crouzet and Eberly (2018) both show that actual capital investment in recent years is understated, and is less than the amount of capital investment explained by Tobin's q. Factors that cause this are: the existence of intangible asset investments, the fact that foreign revenues from globalization are reflected in Tobin's q, several market regulations, increased market concentration, and the effect of short-term

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[2]"Secular stagnation" was originally coined by Alvin Hansen to describe the US economic stagnation in the 1930s. However, the phrase attracted attention when Lawrence Summers revived it in 2013 to describe the gradual recovery from the GFC.

investors.

The understanding of the issue, and the analytical methods are almost identical in both papers . The only minor difference is that Gutierrez and Philippon (2017) have taken up many factors behind the decline in capital investment, while Crouzet and Eberly (2018) focus more on intangible assets and the role that monopoly power plays in the market. The empirical analysis in this chapter will rely primarily on Crouzet and Eberly (2018) as we focus on the role of intangible asset investment.

Before this, we will in the next section, follow Crouzet and Eberly (2018) and examine the investment function of tangible assets when we consider both tangible and intangible assets. Through this examination, we show that the observable tangible asset investment ratio is understated compared to the observed investment amount explained by Tobin's q.

In Section 3, we explain the data required for our empirical analysis. We cannot measure Tobin's q utilizing stock market valuation because we are performing an empirical analysis using a productivity database by industry. For this reason, the remuneration allocated to capital is considered to be profit in the corporate sector, and this value divided by the cost of capital will be used as a proxy variable for Tobin's q. On the investment side, we explain tangible and intangible asset investment. The former utilizes only existing statistics, but much of the latter is made up of our own estimates. Japan's intangible asset investment data has traditionally been published in appendices in the JIP database. In Section 3, we would like to provide a detailed description of this revised intangible asset investment estimation method.

In Section 4 we estimate the capital investment function following Crouzet and Eberly (2018), based on the data described in Section 3. Their estimations are conducted in two stages. First, they conduct a panel regression of the industry-level tangible asset investment using the industry Tobin's q and take out the time dummy. They call this the investment gap, and it is interpreted as a portion of the unobservable capital investment that cannot be explained by the industry Tobin's q. Then, they consider the portion of that unobservable investment as intangible asset investment, and conduct a regression of the time dummy with the share of the intangible assets to see if the portion of the intangible asset investment is closing the investment gap. We conduct this empirical analysis using JIP2021 database.

The final section explains how to interpret the results of this analysis in the Japanese economy and how we can use upcoming company-level data to develop this analysis in the future.

2. Tobin's q and Multiple Assets

The standardized theory of capital formation was established by Hayashi (1982). He showed that Tobin’s q is a critical variable for explaining corporate investment behavior using firm level optimization. A number of theoretical and empirical studies have been developed based on this work.

Wildasin (1984) extended Hayashi’s work to a multiple assets case. He showed that the aggregate Tobin’s q is expressed as a weighted average of Tobin’s q in each asset. Following his study, Asako et al. (1989) and Hayashi and Inoue (1991) measured Tobin’s q of multiple assets. However, the assets they studied cover only tangible assets.[3]

Our study applies investment theory with multiple assets developed by Wildasin (1984) to the issue of intangibles. There are three approaches of empirical studies about this issue. The first type of study is represented by Peters and Taylor (2017) who measure Tobin’s q by including several types of intangibles, and examine the effect of this Tobin’s q on investment behavior. In Japan, Miyagawa et al. (2015) also measure Tobin’s q including intangibles and show that this Tobin’s q is close to 1. This implies that the stock market values intangibles, even though intangibles are not explicitly reported on the balance sheet.

The second approach focuses on the adjustment costs of investment. Basu et al. (2003), Brynjolfsson, Rock, and Syverson (2021) and Miyagawa, Tonogi, and Ishikawa (2021) recognized this adjustment cost of investment to be the accumulation of intangibles and estimated intangibles from investment behavior. As these estimated intangibles are alternative measures of intangibles using primary statistics, the TFP movements using these measures are different from the TFP measured from the standard growth accounting.

The above two approaches aim to find the role of intangibles on firm value and growth accounting. However, the purpose of the last approach taken by Gutierrez and Philippon（2017） and Crouzet and Eberly (2018) is to examine how much intangible investment complements the decline of tangible investment in recent years.

Their analytical framework starts from the firm value (V)、 which consists of tangible assets (K^T) and intangible assets (K^Z). Following Wildasin (1984), the firm value is expressed as follows:

$$(1) \quad V_{it} = q_{it}^T K_{it}^T + q_{it}^Z K_{it}^Z$$

In Equation (1), observable variables are assumed firm value (V) and tangible assets (K^T). Then, Tobin’s q is measured as $q_{it}^A = V_{it}/K_{it}^T$ from observable variables. However, this Tobin’s q is asymmetrical in the sense that although firm value in the numerator includes both values of tangible and intangible assets, there are only tangible assets in the denominator.

[3] Asako, Nakamura, and Tonogi (2020) summarize the empirical studies on capital formation of multiple assets.

Hence, as shown in Equation (2), the observable Tobin's q consists of Tobin's q of tangibles, and Tobin's q of intangibles produces the ratio of intangibles to tangibles.

$$(2)\quad q_{it}^{A} = \frac{V_{it}}{K_{it}^{T}} = q_{it}^{T} + q_{it}^{Z}\frac{K_{it}^{Z}}{K_{it}^{T}}$$

Even though we regress the tangible investment ratio (I_{it}^{T}/K_{it}^{T}) on observable Tobin's q (q_{it}^{A}), this Tobin's q is not an appropriate measure of investment opportunity for tangible assets. Therefore, Gutierrez and Philippon (2017) and Crouzet and Eberly (2018) proposed to estimate the following Equation (3).

$$(3)\quad I_{it}^{T}/K_{it}^{T} = \alpha_i + \mu_t + \beta q_{it}^{A} + \gamma' X_{it-1} + \varepsilon_{it}$$

In Equation (3), the time dummy expresses the gap between investment estimated from observable Tobin's q, and real tangible investment. The authors call this the "investment gap".

3. Data for the Estimations

3－1 The Data of Intangibles and the Overview of Intangible Investment in Japan

In the KLEMS type database, we have two types of intangibles. The first type is intangibles that are measured in National Accounts. In Japan, research and development expenditures, software investment, and expenditures in mineral exploitation and evaluation are measured in the Japanese SNA.[4]

The other type of intangibles is those categorized in Corrado, Hulten, and Sichel (2005, 2009) and are not measured in National Accounts. Expenditures in design, brand equity and organizational change and training costs are included in this category.

Intangible investment data in Japan (https://www.rieti.go.jp/en/database/JIP2021/index.html) is available from 1995 to 2018. It covers the two types of intangibles above. The first type of intangibles follows the data in the Japanese SNA. For the second type of intangibles, we measured intangible investment using primary statistics that are consistent with the measurements in US and EUKLEMS/INTANProd databases. In the second category, the depreciation rate is the same as Corrado, Hulten and Sichel (2005, 2009). There are 99 industries in this database which is the same as the JIP 2021 database and is more sophisticated

[4] Although expenditures for intellectual properties for artistic original are measured from the 2020 revision of the Japanese SNA, this revision is not reflected in JIP 2021 database.

than that in EUKLEMS/INTANProd database.

The total amount of intangible investment in Japan in 2018 is JPY51 trillion (USD 378 billion).[5] As intangible investment in 1995 was JPY 43 trillion (USD 313 billion), it has increased by about 8 trillion of JPY. However, Japanese intangible investment peaked in 2008 (at JPY 55 trillion) and it does not grow since then, due to the Global Financial Crisis and the long-term stagnation in the 2010s (Figure 3). While software investment and R&D expenditures have increased, training costs and expenditures from organizational change have decreased.

(Place Figure 3 around here)

In Figure 4, we compare the Japanese intangible investment/GDP ratio with that of the US and major European countries. We divide the years 1995 to 2018 into two periods: one is before the Global Financial Crisis (from 1995 to 2008) and the other is after the Global Financial Crisis (from 2009 to 2018). In Japan, although the intangible investment/GDP ratio in the period after the GFC is slightly higher than that before the GFC, both ratios are less than 10%, like Germany. The intangible investment/GDP ratio in other advanced countries excluding Germany were over 10% in both periods. In addition, the ratios in the second period are higher than that in the first period. This shows that intangible investment has increased in spite of the sluggish economy after the GFC.

(Place Figure 4 around here)

In Table 2, we show the ratio of intangible investment to tangible investment in Japan, US, and major European countries. For all industries, the ratios in Japan and Germany are much lower than those in other countries. Although intangible investment surpassed tangible investment in the UK and the US after the GFC, the Japanese intangible investment is still half of the tangible investment in the same period. In the manufacturing sector, intangible investment exceeds tangible investment in all countries, because in the manufacturing sector R&D expenditures hold large shares of total investment. For instance, in 2018 in the US, R&D expenditures were larger than total tangible investment. In the US, intangible investment grew to almost the same level as tangible investment after the GFC.

(Place Table 2 around here)

[5] Exchange rate between the JPY and USD is ¥135/US dollar.

Finally, we compare the composition of intangibles between Japan and the US. The share of software has increased in both countries. The share of R&D expenditures in Japan is greater than that in the US. On the other hand, the shares of brand equity and organizational change in the US are much larger than those in Japan. As for training costs, in the US its share was 14% in 1995. Although it fell to 6% in 2008 and 2018, the share of training costs in Japan in the same years were 3%, much lower than in the US.

（Place Figure 5 around here）

3-2 Other Data for Estimations

To estimate Equation (3), we create datasets for the investment/capital stock ratio for tangibles $(\frac{I_{it}}{K_{it}})$ and Tobin's q. We obtain both data from the 2021 version of the JIP database and we find the former data from the capital account easily. Tobin's q is defined as a discounted value of profits in the future. When we assume the future profit rate is constant, Tobin's q is defined as the ratio of the current profit rate to cost of capital. We measure the industry-level profit rate by dividing capital compensation by capital stock.

On the other hand, the cost of capital (CC) is expressed as follows:

$$(4)\ \ CC_{it} = \frac{p^I_{it}}{(1-u_t)p^Y_{it}}\left(i - \frac{\Delta p^I_{it}}{p^I_{it}} + d_{it}\right)$$

where p^I is the price of investment goods, p^Y is the price of value added, i is the nominal interest rate and d is the depreciation rate. We also measure this cost of capital from the 2021 version of the JIP database. The statistical data for investment/capital stock ratio for tangibles and Tobin's q are summarized in Table 3.

（Place Table 3 around here）

4. Measurement of the Investment Gap and the Role of Intangibles

4-1 Measurement of the "Investment Gap""

Following Crouzet and Eberly (2018), we use a two-step approach to examine how intangible investment covers the decline in tangible investment. In the first step, we estimate Equation (3) to measure the "Investment Gap" In the second step, we examine how intangible investment covers the negative “Investment Gap”.

We estimate Equation (3) by using the industry-level data from 1996 to 2018 from the 2021 version of the JIP database. Figure 6 shows the “Investment Gap” measured from the estimation results.

(Place Figure 6 around here)

In Figure 6, the “Investment Gap” in 1996 is normalized as zero. We find that the “Investment Gap” in the total industries shows a negative trend until 2010, although it fluctuates with the business cycles. However, it turned to the positive trend in the 2010s and reached to -3% in 2010. We also measure “Investment Gap” in the manufacturing and service sectors. As shown in Figure 6, the negative gap in the service sector is larger than that in the manufacturing sector.

4-2. Do Intangibles Ease the Decline in Tangible Capital Formation?

Figure 6 implies that tangible investment in the 2000s and 2010s did not reach the investment level found by Tobin’s q. Gutierrez and Philippon (2017) and Crouzet and Eberly (2018) argued that this gap is explained by the increase in intangible investment. Hence, in the second step, we regress “Investment Gap” on the ratio of intangibles to tangibles.[6] Estimation results in all industries are summarized in Table 4

(Place Table 4 around here)

Table 4 shows that coefficients of the intangible/tangible ratio are negative and significant. These results imply that and increase in intangible investment contracts negative investment gap significantly. When we focus on R&D investment and software investment among intangibles, the coefficients of software investment are negative and significant. On the other hand, the coefficients of R&D investment are negative but not significant. These results show that software investment complements the decline in tangible investment because the increase in software investment is larger than that in R&D investment as shown in Figure 3. We also add the Herfindahl index and foreign direct investment to the original estimation as explanatory variables. However, these variables do not show expected signs and are not significant.

[6] We classify each industry in the JIP database into 15 sectors and estimate Equation (2) in each sector. We regress investment gap obtained in the first step on the ratio of intangibles to tangibles. The table including industry classification in the JIP database and 15 sectors which we defined in our paper is shown in the Appendix.

We also conduct estimations in the second step in the manufacturing sector and the service sector. Estimation results are summarized in Tables 5 and 6 for the manufacturing and the service sectors, respectively. Estimation results bin Table 5 are similar to those in Table 4. The coefficients of intangibles are negative and significant. When we specify items of intangibles, the coefficients of software investment are also negative and significant.

（Place Tables 5 and 6 around here）

On the other hand, the movements in intangibles are not sensitive to the “Investment Gap” in the service sector. The reason why intangibles do not contribute to the decline in “Investment Gap” in the service sector is that there is a large negative investment gap in the service sector, even though intangible investment has increased.

We examine how much the “Investment Gap” is revised when we consider intangible investment, using the first estimation results in Table 4. Figure 7 shows the original investment gap and then the investment gap revised by intangible investment. We see the revised investment gap is less than the original investment gap. In 2018, 42% of the investment gap is explained by intangible investment. However, this figure is less than the two thirds in the US, which was measure by Crozet and Eberly (2018). The unexplained investment gap remains.

（Place Figure 7 around here）

5. Concluding Remarks

Our paper has two objectives. First, we show some features in intangible investment in Japan using the newly extended database in intangibles. We find that intangible investment has increased in the recent 23 years. Second, we examine how this increase has made up for the decline in tangible investment, following the study by Crouzet and Everly (2018).

Crouzet and Everly (2018) measure “Investment Gap”, which is the gap between investment expected by Tobin’s q and actual tangible investment. We also measure this “Investment Gap” in Japan and regress the movements of this gap on intangible investment. Our estimation results show that the increase in intangible investment, especially software investment, has helped make up for the decline in tangible investment. While this substitution effect works in the manufacturing sector, it does not work in the service sector.

Intangible investment in Japan explains only half of the investment gap, while Crouzet and Everly showed that intangible investment explains two thirds of the investment gap in the US. We believe that this difference is due to lower intangible investment in Japan than in the US. Hence, our research implies that the government policies that aim to lift intangible investment to the level of the major advanced countries slow the decline in capital formation in Japan.

We could expand our research into two possible directions. One direction is to search for additional factors that explain the "Investment Gap". Intangibles explain about half of the investment gap. Although we chose the index of market concentration (Herfindahl index) and foreign direct investment as additional factors, they do not explain this gap. We believe that the capital stock for overseas production of firms is a better index for explaining the investment gap than foreign direct investment. If we find some appropriate data capturing activities of Japanese firms in foreign countries, we will revise our estimation in the second step.

The other direction we could take this is to use firm-level data instead of industry-level data. However, we use only R&D investment data at the firm level, and we use the rich dataset for intangibles at the industry-level data. It is difficult to measure intangibles other than R&D at the firm level. If we obtain data which can help us to measure intangibles at the firm level, we will endeavor to apply our study to the firm level data.

Appendix: Industry Classifications in the JIP Database and Using the 2nd Step Estimations

Industry classification in the JIP database	Industry classification in the second step estimation
Livestock products	
Seafood products	
Flour and grain mill products	
Miscellaneous foods and related products	Food and beverages
Beverages	
Prepared animal foods and organic fertilizers	
Tobacco	
Textile products (except chemical fibers)	
Chemical fibers	
Pulp, paper, and coated and glazed paper	Textile, pulp and paper
Paper products	
Chemical fertilizers	
Basic inorganic chemicals	
Basic organic chemicals	Chmistry
Organic chemicals	
Pharmaceutical products	
Miscellaneous chemical products	
Petroleum products	
Coal products	
Glass and its products	Coal, petoreum and stome and clay products
Cement and its products	
Pottery	
Miscellaneous ceramic, stone and clay products	
Pig iron and crude steel	
Miscellaneous iron and steel	
Smelting and refining of non-ferrous metals	Primary metal and metal products
Non-ferrous metal products	
Fabricated constructional and architectural metal products	
Miscellaneous fabricated metal products	
General-purpose machinery	
Production machinery	General machineries
Office and service industry machines	
Miscellaneous business oriented machinery	
Ordnance	
Semiconductor devices and integrated circuits	
Miscellaneous electronic components and devices	
Electrical devices and parts	
Household electric appliances	
Electronic equipment and electric measuring instruments	Electric machineries
Miscellaneous electrical machinery equipment	
Image and audio equipment	
Communication equipment	
Electronic data processing machines, digital and analog computer equipment and accessories	
Motor vehicles (including motor vehicles bodies)	
Motor vehicle parts and accessories	Transportation equipment
Other transportation equipment	

Industry classification in the JIP database	Industry classification in the second step estimation
Printing	
Lumber and wood products	
Furniture and fixtures	
Plastic products	Other manufacturing industries
Rubber products	
Leather and leather products	
Watches and clocks	
Miscellaneous manufacturing industries	
Electricity	
Gas, heat supply	
Waterworks	Electricity, gas and water supply
Water supply for industrial use	
Sewage disposal	
Waste disposal	
Construction	Business services
Civil engineering	
Wholesale	Personal services
Retail	
Railway	
Road transportation	
Water transportation	Transportation and postal services
Air transportation	
Other transportation and packing	
Mail	
Hotels	Personal services
Eating and drinking services	
Communications	
Broadcasting	
Information services	Information and telecommunication services
Image information, sound information and character information production	
Finance	Regulated services
Insurance	
Housing	
Real estate	Business services
Research	
Advertising	Information and telecommunication services
Rental of office equipment and goods	
Automobile maintenance services	Business services
Other services for businesses	
Public administration	
Education	
Medical service, health and hygiene	Regulated services
Social insurance and social welfare	
Nursing care	
Entertainment	
Laundry, beauty and bath services	Personal services
Other services for individuals	

Chmistry-> chemistry (chemicals ではないですか)。

Coal, petoreum and stome and clay products -> Coal, petroleum and stone and clay products.

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Figure 1 Growth Accounting in Japan

	1995-2000		
	Macroeconomy	Manufacturing sector	Non-manufacturing sector
	1995-2000		
Real GDP Growth	1.34%	1.68%	1.22%
Contribution of Labor Input Growth	0.03%	-0.99%	0.35%
Contribution of Hours Worked Growth	-0.39%	-1.37%	-0.09%
Contribution of Labor Quality Growth	0.42%	0.38%	0.44%
Contribution of Capital Input Growth	0.98%	0.72%	1.06%
Contribution of Capital Quantity Growth	0.72%	0.40%	0.77%
Contribution of Capital Quality Growth	0.26%	0.32%	0.29%
TFP Growth	0.33%	1.96%	-0.19%
	2000-2010		
Real GDP Growth	0.30%	0.92%	0.11%
Contribution of Labor Input Growth	-0.14%	-1.17%	0.15%
Contribution of Hours Worked Growth	-0.53%	-1.54%	-0.24%
Contribution of Labor Quality Growth	0.39%	0.36%	0.39%
Contribution of Capital Input Growth	0.22%	0.30%	0.19%
Contribution of Capital Quantity Growth	0.15%	0.17%	0.14%
Contribution of Capital Quality Growth	0.07%	0.13%	0.05%
TFP Growth	0.23%	1.80%	-0.23%
	2010-2018		
Real GDP Growth	0.83%	1.04%	0.77%
Contribution of Labor Input Growth	0.18%	-0.01%	0.23%
Contribution of Hours Worked Growth	0.17%	-0.08%	0.23%
Contribution of Labor Quality Growth	0.01%	0.08%	0.00%
Contribution of Capital Input Growth	0.13%	0.20%	0.11%
Contribution of Capital Quantity Growth	0.11%	0.16%	0.10%
Contribution of Capital Quality Growth	0.01%	0.04%	0.00%
TFP Growth	0.52%	0.85%	0.43%

Source: The 2021 version of the JIP database

Table 2 The Ratio of Intangible Investment to Tangible Investment in Advanced Countries

		Japan	France	Germany	UK	US
1995-2008	All industries	47.2%	75.2%	45.1%	85.6%	78.2%
	Manufacturing sector	113.5%	270.0%	154.5%	209.2%	199.8%
	Non-manufacturing sector	34.8%	58.0%	29.3%	74.6%	66.9%
2009-2018	All industries	55.6%	78.3%	55.0%	101.5%	108.9%
	Manufacturing sector	126.3%	342.0%	199.3%	368.9%	231.4%
	Non-manufacturing sector	41.2%	62.3%	35.9%	88.9%	97.9%

Source: The 2021 version of the JIP Database and EUKLEMS/INTANProd database
Note: We show the ratio in the US from 1997 to 2008.

Table 3 Summary of Statistics

	All Industries		Manufacturing		Service Sectors	
	q	I/K	q	I/K	q	I/K
mean	1.4340	10.4116	1.5502	10.0012	1.3606	11.2040
median	1.1058	9.0683	1.0550	9.1358	1.2138	9.1653
S.D.	1.5625	8.4847	2.0035	4.8885	0.7316	12.1302
Number of Observations	2371	2370	1296	1296	931	930

Source: The 2021 version of the JIP database

Table 4 Estimations in the Second Step (all industries)

	[1]	[2]	[3]	[4]
Intangible/Tangible	**-6.3568***		**-7.1306***	
	(2.9423)		(3.4056)	
R&D/Tangible		**-3.5139**		**-4.9995**
		(2.3399)		(2.9281)
Software/Tangible		**-33.2449****		**-29.1374*****
		(14.7694)		(9.0530)
HHI			**11.9184**	**12.7273**
			(14.3467)	(13.9518)
FDI/Total Investment			**0.1583**	**0.3643**
			(1.0912)	(1.0960)
Const.	-0.6215	-0.4703	-3.4723	-3.5465
	(0.8427)	(0.5641)	(3.5403)	(3.4221)
Industrial dummy	Yes	Yes	Yes	Yes
R-squared				
Within	0.0301	0.0409	0.0420	0.0491
Between	0.2430	0.1789	0.0709	0.0327
Overall	0.1757	0.1212	0.0479	0.0217
Number of Observations	308	308	300	300
Number of Groups	14	14	14	14

Note: *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively. Robust standard errors are in parentheses.

Table 5 Estimations in the Second Step (manufacturing sector)

	[1]	[2]	[3]	[4]
Intangible/Tangible	**-6.0247***		**-6.3078***	
	(2.9198)		(3.1941)	
R&D/Tangible		**-4.0229**		**-4.3154**
		(2.2845)		(2.6439)
Software/Tangible		**-25.7118****		**-27.7632*****
		(10.2531)		(7.9774)
HHI			**1.1336**	**2.4223**
			(7.5928)	(6.4933)
FDI/Total Investment			**0.4740**	**0.6382**
			(1.4083)	(1.4403)
Const.	1.7252	1.7328	1.4596	1.1536
	(1.2430)	(0.9147)	(2.1206)	(1.7493)
Industrial dummy	Yes	Yes	Yes	Yes
R-squared				
Within	0.0463	0.0547	0.0474	0.0569
Between	0.1282	0.0482	0.1137	0.0299
Overall	0.0644	0.0192	0.0571	0.0111
Number of Observations	198	198	198	198
Number of Groups	9	9	9	9

Note: *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively. Robust standard errors are in parentheses.

Table 6 Estimations in the Second Step (service sector）

	[1]	[2]	[3]	[4]
Intangible/Tangible	**-78.6949**		**-33.3271**	
	(73.7908)		(39.2674)	
R&D/Tangible		**-519.3976**		**-434.2004**
		(300.4651)		(436.0504)
Software/Tangible		**18.1127**		**16.4399**
		(61.7935)		(36.1973)
HHI			**22.7938**	**25.4405**
			(20.7544)	(19.2599)
FDI/Total Investment			**0.0598**	**0.4103**
			(0.8658)	(1.2251)
Const.	-2.5209	2.6732	-9.4939	-4.6859
	(2.6310)	(3.8647)	(5.2985)	(9.6541)
Industrial dummy	Yes	Yes	Yes	Yes
R-squared				
Within	0.0503	0.1020	0.0640	0.0902
Between	0.0305	0.2377	0.0856	0.2440
Overall	0.0112	0.1984	0.0647	0.1958
Number of Observations	110	110	110	110
Number of Groups	5	5	5	5

Note: *, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively. Robust standard errors are in parentheses.

Figure 1 Growth in Main Components of GDP during Japanese Economic Recoveries

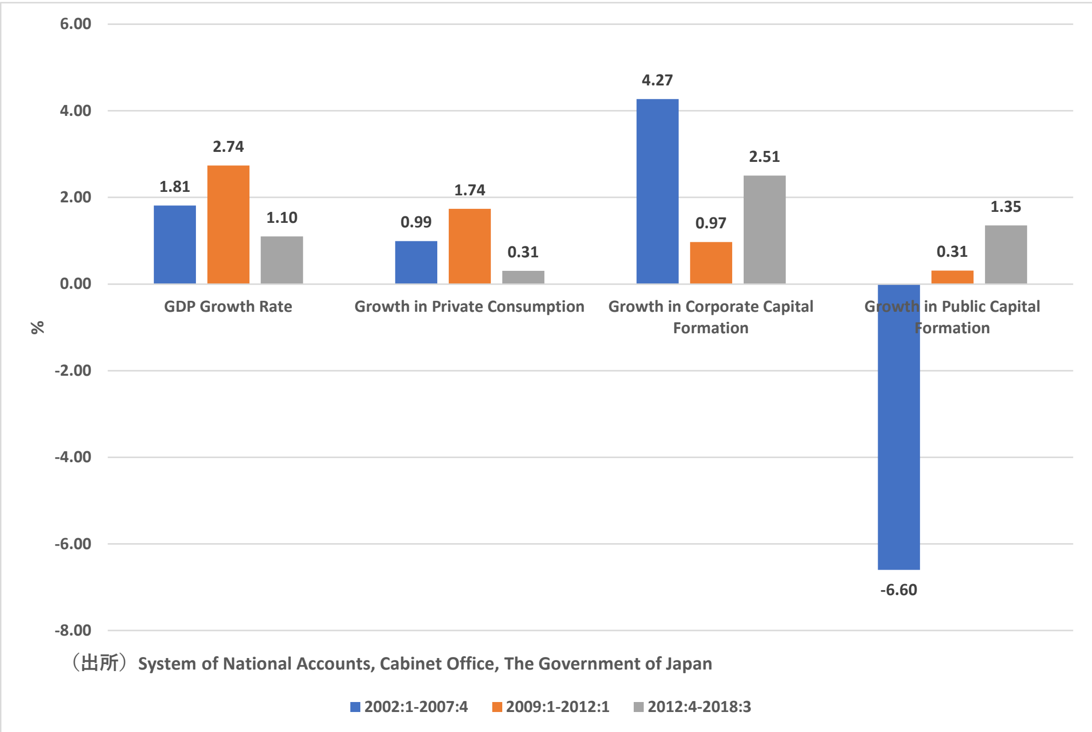
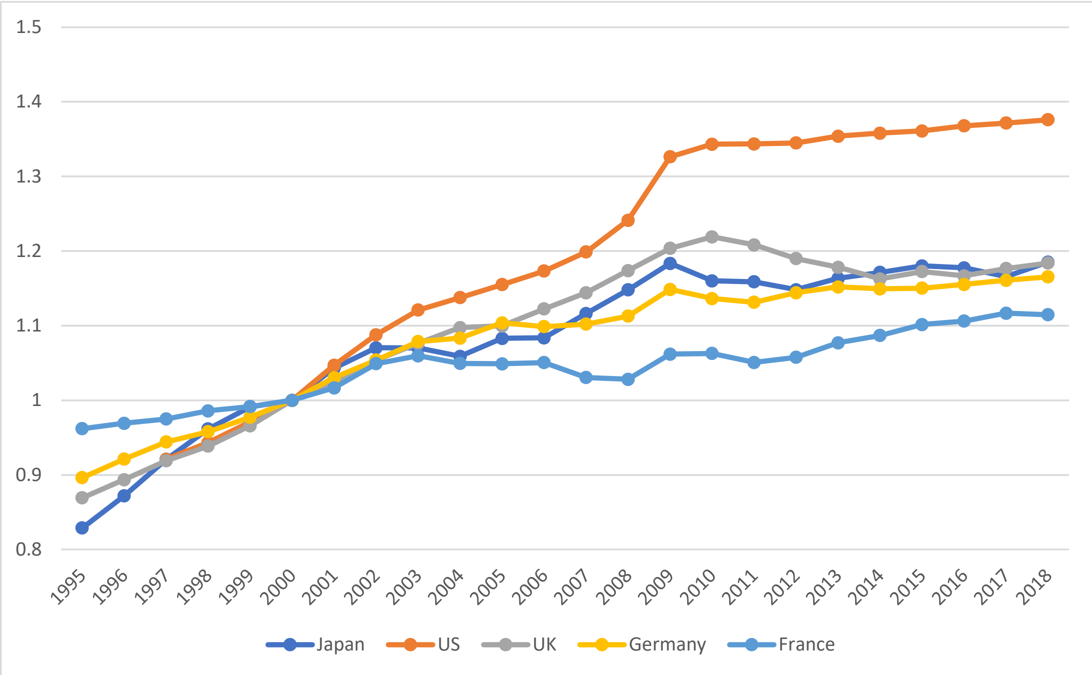


Figure 2 The Ratio of Capital Service per Manhour



Source: The 2021 version of JIP Database and EUKLEMS/INTANProd database

Figure 3 Intangible Investment in Japan

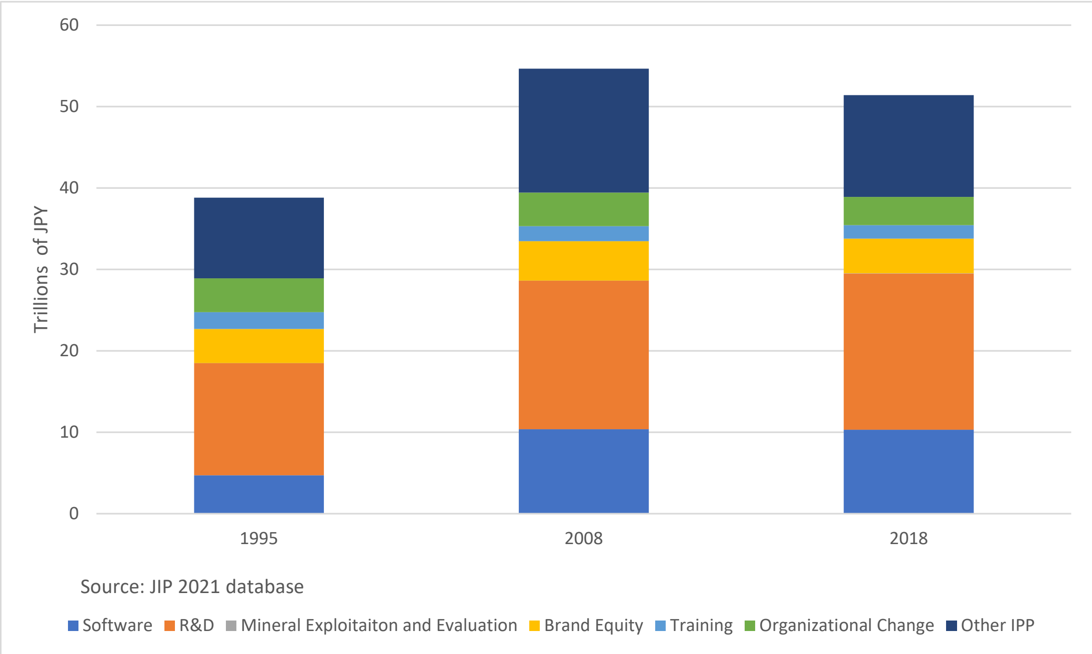


Figure 4 Intangible Investment/GDP Ratio in Major Advanced Countries

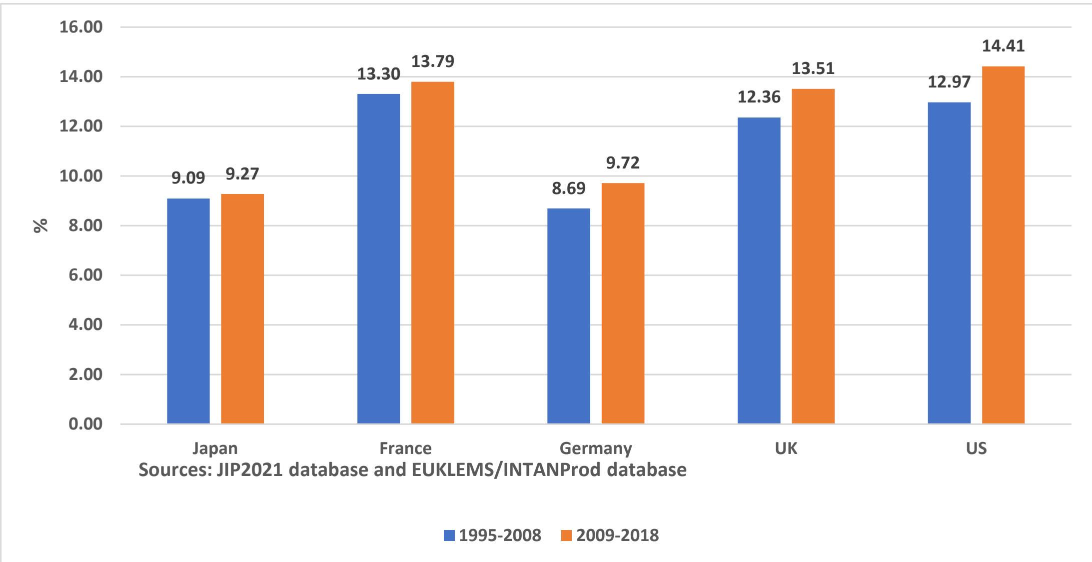


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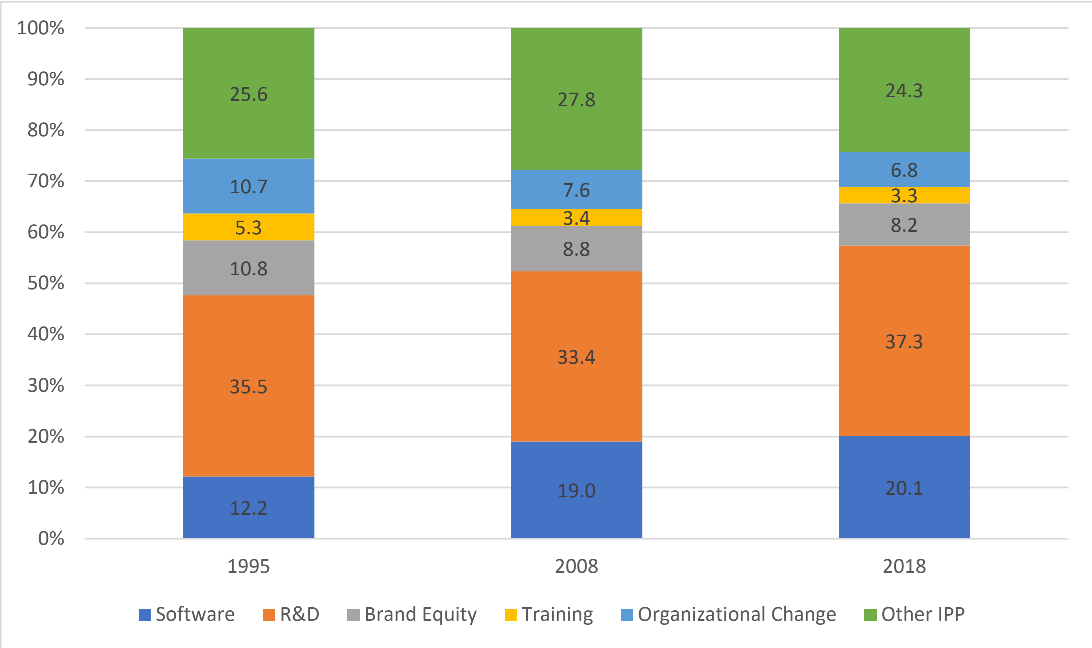
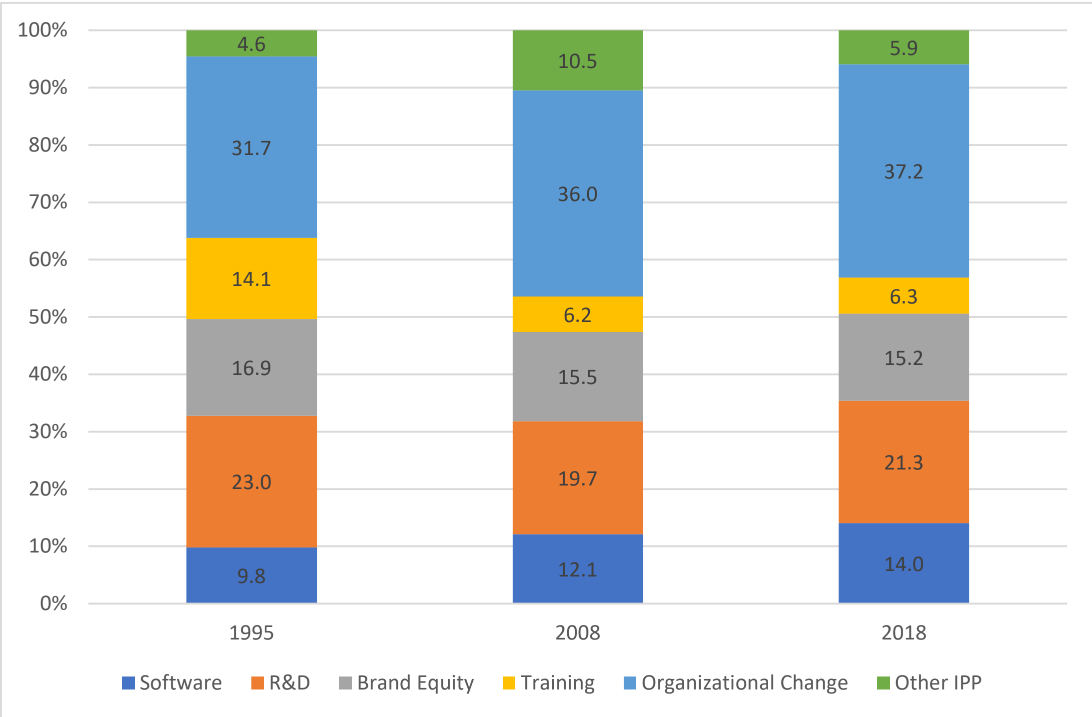
Figure 5 The Breakdown of Intangibles

(1) Japan



(2) The US



Source: The 2021 version of JIP Database and EUKLEMS/INTAN Prod database

Figure 6 Investment Gap in Japan

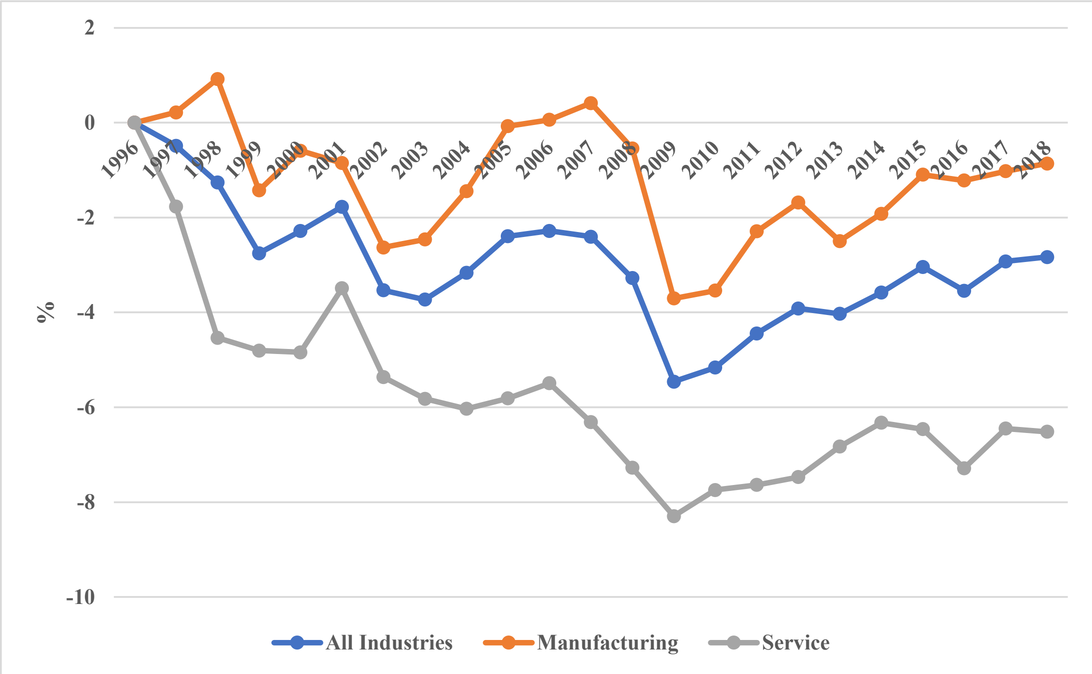


Figure 7 Investment Gap Revised for Intangibles