On the Measurement of Digitalization
-The Case of Japan-

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1. Motivation (1)

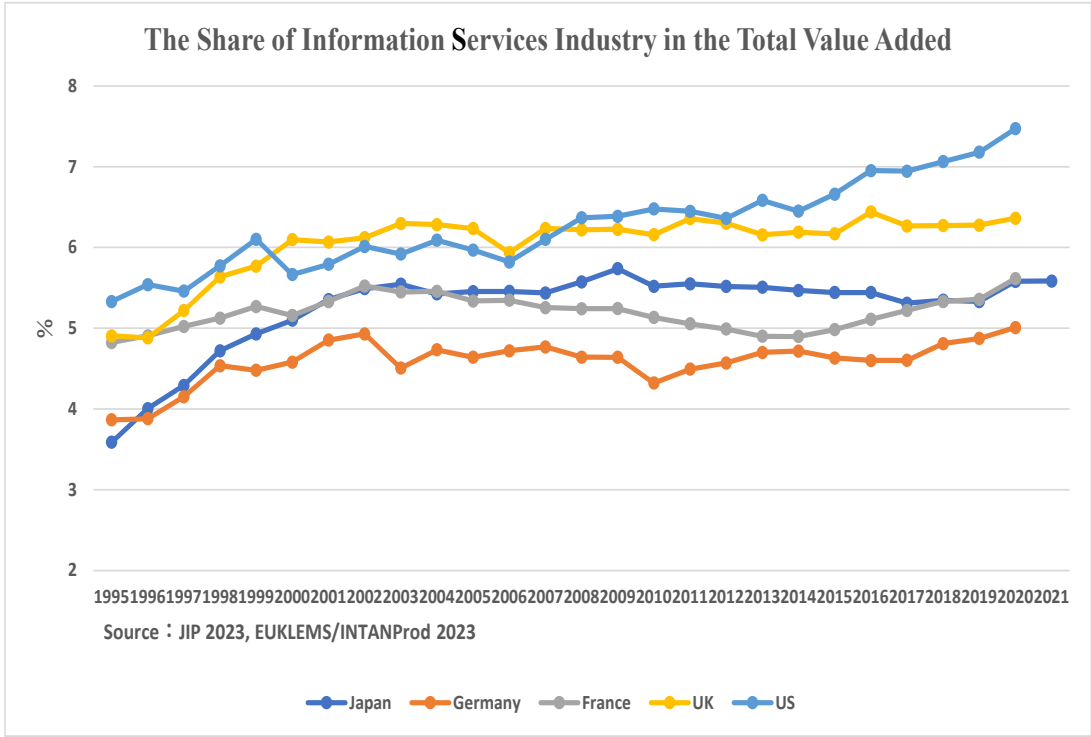
- **One of the reasons for turmoil in Japanese society during the COVID-19 Pandemic was the lack of digitalization.**
- **As the Japanese people do not have ID numbers like social security that Americans have the government was not able to immediately support people who lost their jobs due to the lockdown.**
- **In 2021, the Suga Cabinet founded a new Digital Agency in the Japanese government to promote the digitalization of Japan.**

1. Motivation (2)

- **However, as the government does not disclose the measures of digitalization, we do not know what digitalization targets the government is aiming to reach.**
- **In this presentation, we show several measures of digitalization using published data.**

2. A Simple Measure of Digitalization

- **The simplest measure of digitalization is the share of information industry in the total value added.**
- **Although the share in Japan increased in the late 1990s, it has been essentially stagnant in the 2010s.**
- **While in the US, the share has constantly grown.**

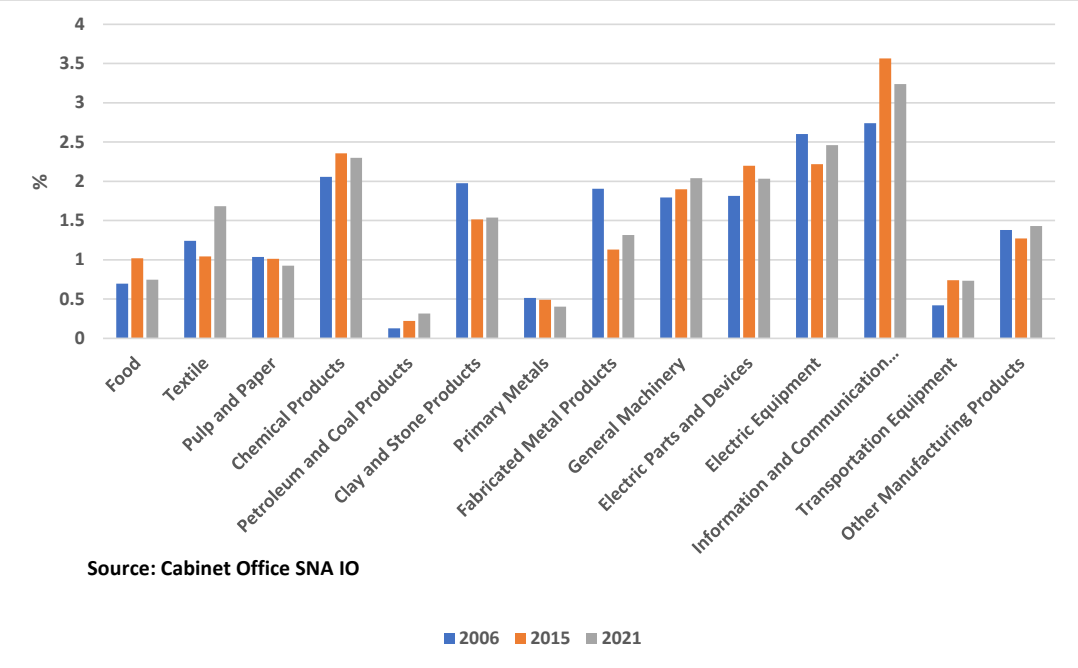


3. Digitalization Measured by IO Tables

- **The earliest measure of digitalization in Japan developed by Shinozaki (1995) was the ratio of input of information services to the total inputs using the IO tables.**
- **According to this digitalization measure using the SNA IO, digitalization has not increased at all from 2006 to 2021.**
- **Only machinery industries, information services and banking and insurance industries have made progress in the digitalization by this measure.**
- **In the wholesale and retail industries, the digitalization has actually decreased.**

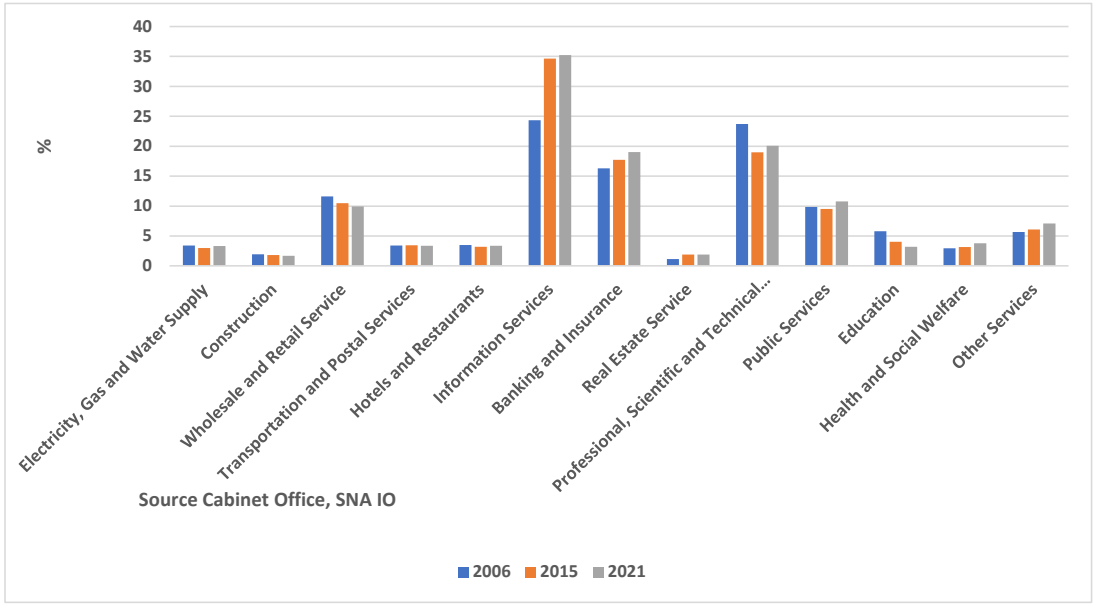
The Ratio of Input of the Information Services to Total Inputs

The Manufacturing Sector



Source: Cabinet Office SNA IO

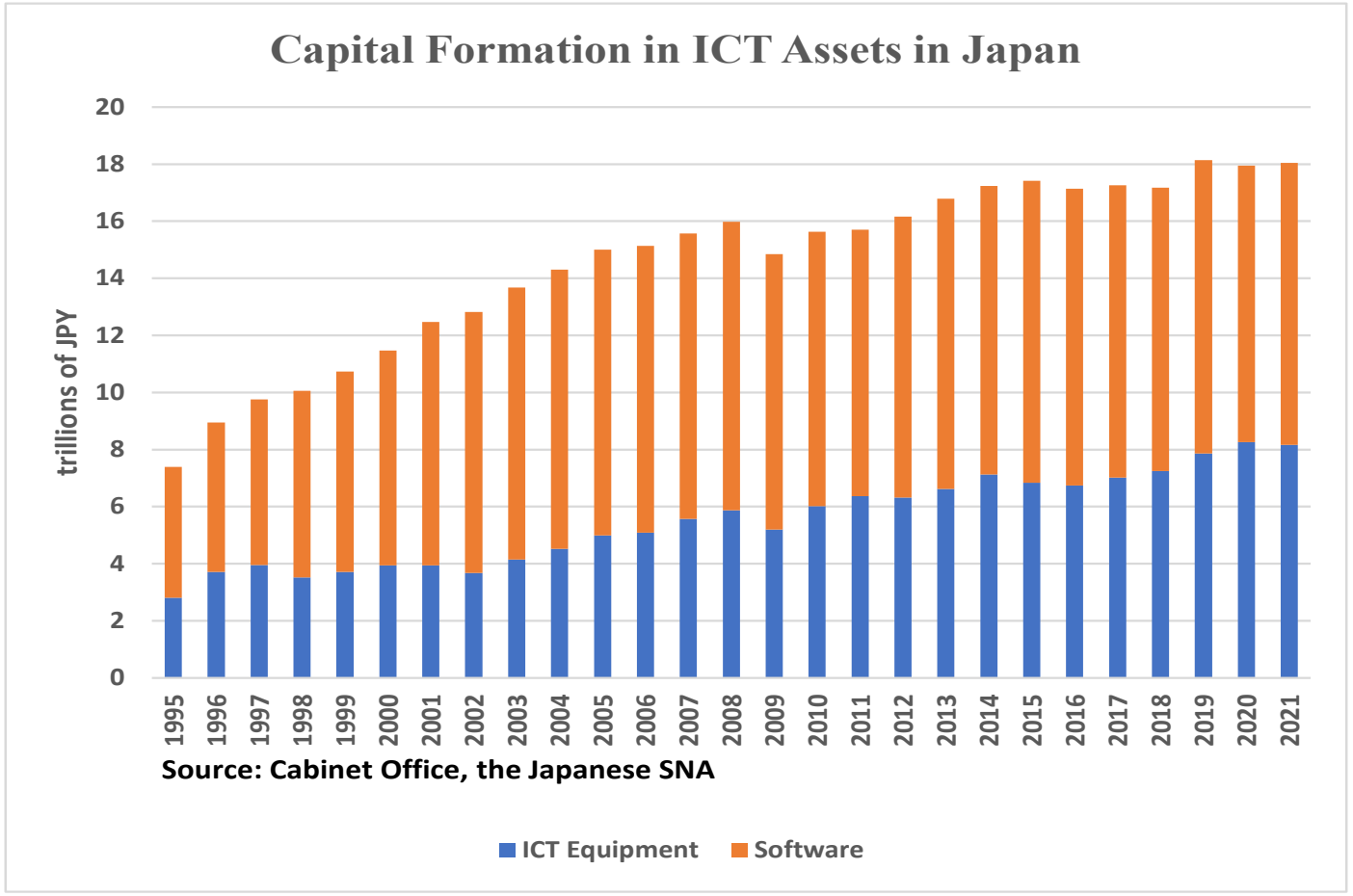
The Service Sector



Source Cabinet Office, SNA IO

4. Capital Formation in ICT Assets

- **Capital formation in ICT assets is a good measure of digitalization, as ICT assets consist of information and communication equipment and software.**
- **As the Japanese SNA has provided data on the capital formation of the above assets, we are able to measure the capital formation in ICT assets.**
- **Although capital formation in ICT equipment has increased constantly, software investment stagnated in the 2010s.**


Capital Formation in ICT Assets in Japan
trillions of JPY
20
18
16
14
12
10
8
6
4
2
0
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Source: Cabinet Office, the Japanese SNA
ICT Equipment
Software

5. On the Measurement of Software Expenditures that are not Accounted for as Capital Formation (1)

- **We understand that the capital formation in software in the 2010s appeared stagnant due in part to the fact that though there was an increase in the software expenditures such as cloud, online and AI services, they are not accounted for as capital formation.**
- **Many firms pay fees for the utilization of the above software. These fees are not considered to be expenses for the capital formation, but are accounted for as current information costs.**
- **As this software contributes to the production of firms that use it, we should categorize it as a production factor like we do physical leasing assets.**

5. On the Measurement of Software Expenditures that are not Accounted for as Capital Formation (2)

- **Using the SNA IO, we estimate the maximum value of software expenditures that are not accounted for as capital formation.**
- **Step 1: We focus on the two types of inputs in the information services: one is the input service from domestic information service firms and the other is the input service from the foreign information service firms.**
- **Step 2: As for the former input service, we take the input data of information services by industry from the SNA IO Tables.**

5. On the Measurement of Software Expenditures that are not Accounted for as Capital Formation (3)

- **Step 3: The input data is a kind of capital service that firms in the information services industry hold. The capital service corresponds to the capital stock of software. So, when we measure the change in the input data applying the depreciation rate (0.3159), this measure corresponds to capital formation in software.**
- **Step 4: We transform the change in the information service inputs into the amount of capital formation by using the following equation: $ECF_j = INF_j / 0.3159$. ECF_j is the measured capital formation from the input data in the industry j. INF_j is the change in information service inputs obtained from the SNA IO.**

5. On the Measurement of Software Expenditures that are not Accounted for as Capital Formation (4)

- **Step 5: When we recognize the change in the information services inputs to be capital formation by industry, this measure is also considered as capital formation in the information service industry.**
- **Step 6: To avoid this double counting, from the sum of 1) capital formation (OCF_{IS}) and 2) capital formation estimated from the information services inputs in the information services industries (ECF_{IS}), we deduct the sum of change in the information services inputs except those in the information services industry ($\sum_{j \neq IS} ECF_j$). This calculation is expressed as $DCF_{IS}=OCF_{IS} + ECF_{IS} - \sum_{j \neq IS} ECF_j$.**

5. On the Measurement of Software Expenditures that are not Accounted for as Capital Formation (5)

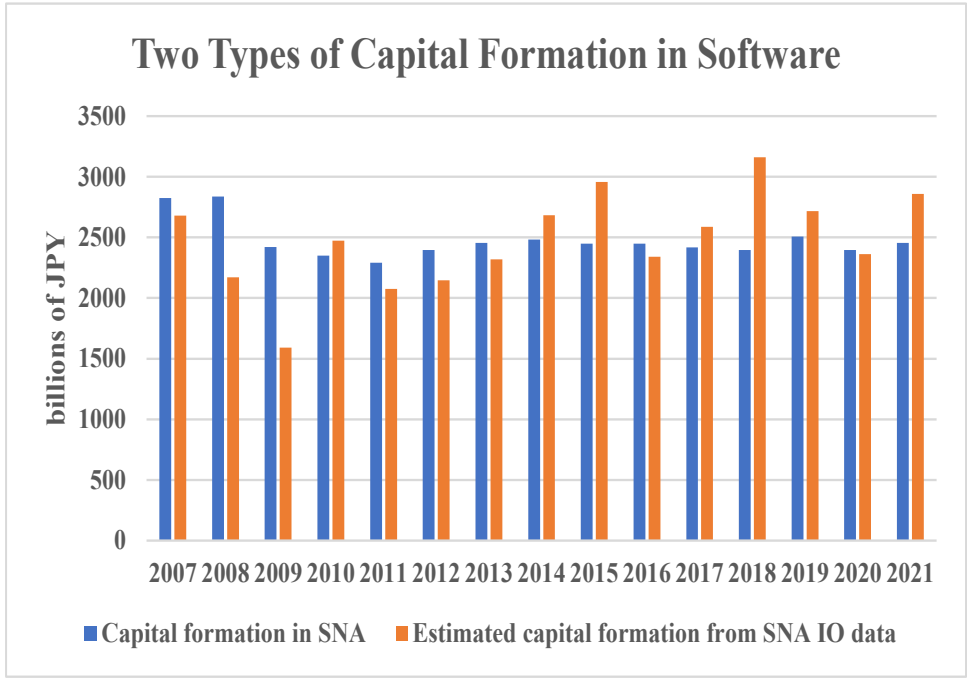
- **Step 7: As for the information services inputs by the foreign firms, we allocate the total net imports in the information services into each industry using the ratio of input in the information services in each industry to the total inputs for the information services in all industries.**
- **Step 8: We take the change of information input services and estimate the capital formation from net import data in the same way as estimations using the domestic input data.**
- **Step 9: When we sum the estimated capital formation from the domestic input data and that from net import data in the information services industry, we can estimate the total capital formation including the expenditures for the usage of the information services.**

5. On the Measurement of Software Expenditures that are not Accounted for as Capital Formation (6)

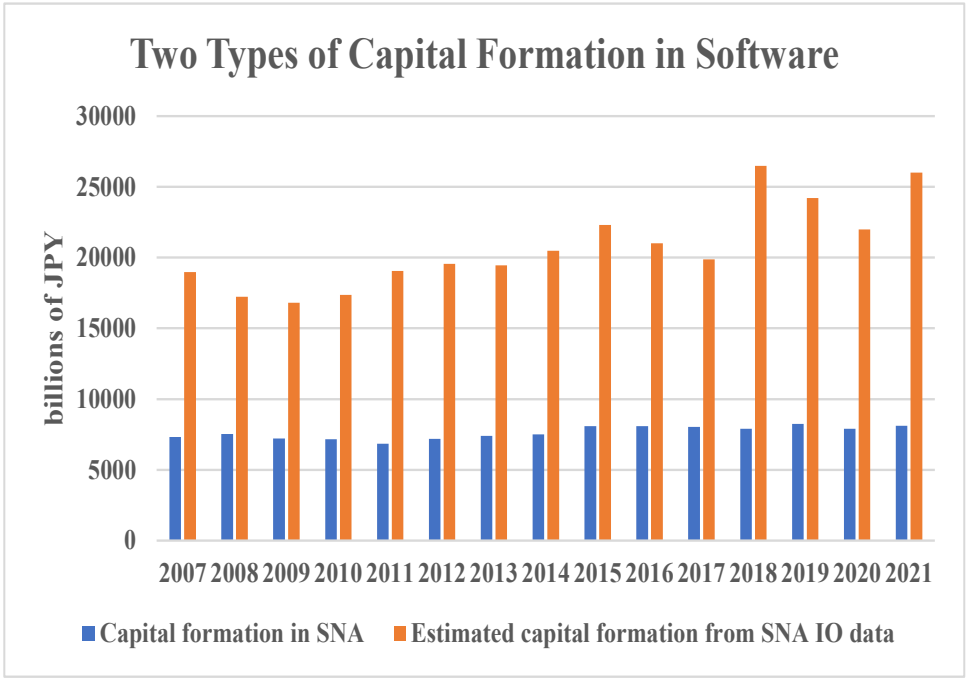
- In the next slide, we compare the capital formation in software measure in SNA with that estimated from the input data in the SNA IO.
- In the manufacturing sector, amounts of both types of capital formation are almost same. They have not increased since 2007.
- In the service sector, the estimated capital formation is much larger than the capital formation measured in SNA.
- In addition, the estimated capital formation has increased since 2007, while the capital formation in SNA has not increased.

5. On the Measurement of Software Expenditures that are not Accounted for as Capital Formation (7)

Manufacturing Sector



Service Sector



6. Preliminary Results

- **In Japan, the digitalization indices measured by the share of information services industry in the total value added, input ratio of information services, capital formation in software in SNA have not increased in the 21st century.**
- **However, when we estimate capital formation based on the expenditures for usage in information services, the estimated capital formation in the service sector has increased since 2007.**
- **The result shows that the data in capital formation in software in SNA do not capture the expenditures for information services such as cloud, online and AI services.**
- **We need more precise data on the information services to grasp the effects of digitalization policies.**

Thank you very much for your attentions !