# The Causes of Japan's Economic Slowdown: An Analysis Based on the Japan Industrial Productivity Database

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**Abstract**

Using the Japan Industrial Productivity Database (JIP) and the EU KLEMS database 2017, we compare the sources of economic growth of Japan, the United States, Germany, France, and the U.K. for the period 1995–2015 using growth accounting. We find that the reasons why Japan's economic growth during the 2005–2015 period was much slower than that of the other major economies are the decline in the working-age population and sluggish investment in capital services. Among the five countries, Japan was the only one whose growth rate of the capital stock was lower than the steady state growth rate. Another reason for the slowdown in Japan's economic growth in 2005–2015 was the decline in TFP growth, which was caused by a drop in productivity growth in a small number of industries, including electronic data processing machines, electricity, and wholesale trade.

With Japan's two lost decades (Fukao, 2018a), which started from around 1990, turning into three lost decades, what the economy needs most to escape from sluggish growth is to raise productivity. Against this background, the present study

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explores productivity developments in the Japanese economy and the causes of its long-term sluggish growth, and then considers policies necessary to overcome this sluggish growth.

In order to offer the correct prescription, it is necessary to accurately understand the disease. To this end, we will focus on macro- and industry-level productivity and its determinants using the most recent version of the Japan Industrial Productivity (JIP) Database, the JIP Database 2021, by the Research Institute of Economy, Trade and Industry and Hitotsubashi University.[2] Compared with the 2015 version of the JIP Database, the JIP Database 2021 has been completely revised and, reflecting changes in the 2008 SNA, for example treats research and development (R&D) expenditure as capital formation. This makes it possible to make comparisons using recent data from the EU KLEMS database (EU KLEMS 2017 Release, Revised July 2018), which already reflects the 2008 SNA.[3] We will therefore also conduct various comparisons between Japan and other major advanced economies.

This study is organized as follows. In the first main section, using growth accounting, we examine the sources of economic growth in recent years for Japan's economy as a whole and for the manufacturing and the non-manufacturing sector. Moreover, focusing on the market economy, we compare the sources of growth for the Japanese economy with the economies of the United States, the U.K., Germany, and France. The results indicate that the United States, France, and the U.K. experienced a more serious slowdown in total factor productivity (TFP) growth in 2005–2015 vis-à-vis 1995–2005 than Japan, and that the main reason for the extremely slow growth rate of Japan's market economy compared to the other major economies during 2005–2015 was not sluggish TFP growth but the slowdown in hours worked due to demographic trends as well as a substantial slowdown in capital accumulation.

The second section therefore considers why capital accumulation in Japan has been so slow from a variety of angles, including from the perspective of neoclassical growth theory. The third section examines whether Japan's investment in information and communication technology (ICT) and intangible assets has been particularly low by comparing it with the other major economies. In the fourth section, we then use the JIP Database to examine which industries in particular were responsible for the slowdown in Japan's TFP growth in 2005–2015 compared to the preceding decade. Finally, the fifth section summarizes the findings of this study and considers what policies are necessary for Japan to emerge from its long-term eco-

2 For the international comparison, we use the JIP Database 2018 (released on March 31, 2019), which covers the period 1994-2015. In order to additionally check the most recent developments in TFP and capital accumulation, we also use the JIP Database 2021 (released on April 6, 2021). The JIP Database 2021 extends the JIP Database 2018 by adding data for the years 2016 to 2018. The JIP Database 2018 can be downloaded at https://www.rieti.go.jp/en/database/JIP2018/index.html, while the JIP Database 2021 can be downloaded at https://www.rieti.go.jp/en/database/JIP2021/index.html.

3 The EU KLEMS data can be downloaded at http://www.euklems.net/index.html.

**Table 1: Sources of Japan's Economic Growth From the Supply Side, 1995-2005 and 2005-2015 (Annual Average Percent or Percentage Point Change Growth Rate)**

| | Market economy (excluding housing and activities not elsewhere classified) | | Manufacturing | | Non-manufacturing (Market ecnomy only: excluding housing and acitivites not elsewhere classified | |
|---|---|---|---|---|---|---|
| | 1995-2005 | 2005-2015 | 1995-2005 | 2005-2015 | 1995-2005 | 2005-2015 |
| **Real value added** | 1.04 | 0.15 | 1.35 | 0.77 | 0.92 | -0.09 |
| **Contribution from:** | | | | | | |
| Hours worked | -0.74 | -0.59 | -1.55 | -0.94 | -0.45 | -0.48 |
| Labour quality | 0.36 | 0.28 | 0.35 | 0.24 | 0.36 | 0.29 |
| Capital services | 0.65 | 0.10 | 0.52 | 0.13 | 0.71 | 0.08 |
| Total factor productivity | 0.77 | 0.38 | 2.04 | 1.34 | 0.30 | 0.02 |

*Source*: JIP Database 2018 (September 2019 Revision).
*Note*: GDP is based on the Laspeyres chain index, while labour and capital inputs are based on the Divisia index. The growth contribution of production factors is calculated based on their rolling two-year average costs shares.
Downloaded from: https://www.rieti.go.jp/en/database/JIP2018/index.html.

nomic stagnation.

## Sources of Economic Growth in Japan and Major Economies: An International Growth Accounting Comparison

Table 1 shows the growth accounting results for Japan using the JIP Database 2018. Since production-side statistics in Japan's National Accounts corresponding to the 2008 SNA are available only for 1994 onward, the JIP Database 2018 also covers only the period from 1994 onward. The following analysis therefore concentrates on the period from 1994 or 1995.

As shown by Fukao *et al.* (2007), under certain assumptions, such as constant returns to scale and perfectly competitive markets for factors of production, real gross domestic product (GDP) growth and real value-added growth in each industry can be decomposed into the contribution of labour input growth (which is equal to the sum of the contribution of increases in hours worked and the contribution of improvements in labour quality through the accumulation of education and skills), the contribution of capital services input growth, and the contribution of TFP growth, which is calculated as the residual. Table 1 presents such a decomposition for Japan's market economy (excluding housing and activities not elsewhere classified), manufacturing sector, and non-manufacturing sector (market economy only, excluding housing and activities not elsewhere classified).

The term "market economy" refers to the entirety of economic activity excluding the non-market economy (e.g., general government, education, nursing and medical care, imputed rent), where changes in product prices and real output as well as productivity growth are difficult to measure because suppliers are not compensated for their services, as in the case of government services, or services are not traded at market prices, as in the case of many medical services and imputed rent. Not only is it difficult to measure real output growth and TFP growth for the non-market economy, the way that real output is measured also differs across countries, making international comparisons difficult (for details, see Fukao *et al.*, 2017). Therefore, growth accounting for a particular country and international growth accounting comparisons are usually limited to the market economy. This applies to growth accounting studies based on the EU KLEMS database, which will be used later for international comparison,[4] as well our growth accounting for Japan, so that throughout this study we will focus on the market economy only.

Starting with the market economy as a whole, real value added growth rate (annual rate; the same applies to growth rates below) declined from 1.04 per cent in 1995–2005 to 0.15 per cent in 2005–2015.[5] During the same period, the growth rate of the economy overall including the non-market economy, i.e., GDP growth, fell from 1.11 per cent to 0.39 per cent. The fact that the growth rate of the economy overall is slightly higher than that of the market economy, and the decline in the growth rate is smaller, likely is due to the expansion of the non-market economy such as nursing care and medical care during this period.

The main reason for the slowdown in the growth of Japan's market economy in 2005–2015 vis-à-vis 1995–2005 is the slowdown in capital services input growth.

A second reason for the slowdown in economic growth is the slowdown in TFP growth. As will be discussed later, not only did TFP growth of the market economy turn negative during the period 2005–2010 (Table 3), which includes the global financial crisis, it also did not recover enough after 2010, and the TFP growth in 2005-2015 was less than that in 1995-2005.[6]

These two factors alone explain all of the 0.89 percentage point decline in the annual rate of growth of the market economy from the 1995–2005 period to the 2005–2015 period.

In addition, the contribution of labour quality improvements also declined slightly in the latter period. This reflects the fact that while many of the baby boomer generation retired during 2005–2015, many of the jobs created during the period were low-wage jobs taken up by women, whose labour force participation rose, and re-employed elderly workers (Fukao, 2018a). As we will see later, the contribution of labour quality improvements has declined substantially, especially since 2010. On the other hand, the increase in the employment rate of women and seniors counteracted the decline in hours worked due to demographic factors, i.e., the aging and shrinking of Japan's population, which as a result was less pronounced than it otherwise would have been.[7]

To examine this latter point in more de-

4 For a definition of the market economy in the EU KLEMS Productivity Accounts, see Jäger (2018). The EU KLEMS Productivity Accounts exclude the entire real estate industry, not just imputed rent, from the market economy.

5 We calculate the annual average growth rate of variable $X_t$ for the period from 0 to $T$ as $ln(X_T/X_0)/T$.

6 Though Japan has not suffered greatly from a housing collapse or toxic assets, its economy has been hit harder by the crisis than the United States or EU. Japan's contraction is almost entirely due to a steep fall in external demand. Fukao and Yuan (2009) use the World Input-Output Database (WIOD) to show that the fall in US demand has had an amplified effect on Japan because it not only reduces Japanese net exports to the US but also net exports of intermediate goods to Asian countries, where they would have been assembled for final export to the US.

7 Employment patterns of persons 65 and over in Japan reflect a combination of institutional factors and growing

**Table 2: Rate of Change in Japan's Working-Age Population (Aged 15–64) and Total Hours Worked in the Economy Overall and the Market Economy (Average Annual Rate, per cent)**

| | 1970-1975- | 1975-1980- | 1980-1985- | 1985-1990- | 1990-1995- | 1995-2000- | 2000-2005- | 2005-2010- | 2010-2015- | 2015-2020- | 2020-2025- | 2025-2030- | 2030-2035- | 2035-2040- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rates of change in working age population (aged 15-64) | 1.16 | 0.79 | 0.90 | 0.86 | 0.26 | -0.18 | -0.46 | -0.65 | -1.12 | -0.85 | -0.65 | -0.84 | -1.14 | -1.66 |
| Rate of change in total number of workers, economy overall | 0.59 | 0.97 | 0.79 | 1.03 | 0.79 | -0.18 | -0.35 | -0.22 | 0.35 | 1.40† | | | | |
| Rate of change in total hours worked, economy overall | -0.43 | 1.29 | 0.44 | 0.72 | -0.52 | -0.60 | -0.69 | -0.86 | -0.07 | 0.74† | | | | |
| Rate of change in total hours worked, market economy | -0.75 | 1.13 | 0.21 | 0.78 | -0.71 | -0.87 | -1.35 | -1.32 | -0.46 | 0.80† | | | | |

*Source*: Authors' calculations. Population data for 1970–2015 are obtained from the Statistics Bureau, Ministry of Internal Affairs and Communications (https://www.stat.go.jp/english/data/jinsui/2.html).

Population estimates for 2016–2040 are the medium-fertility, medium-mortality projections by the National Institute of Population and Social Security Research (http://www.ipss.go.jp/pp-zenkoku/e/zenkoku_e2017/pp_zenkoku2017e.asp). Data for the number of workers and hours worked are obtained from the JIP Database 2015 (https://www.rieti.go.jp/en/database/JIP2015/index.html) for 1970–1995, from the JIP Database 2018 for 1995–2015, and from the JIP Database 2021 (https://www.rieti.go.jp/en/database/JIP2021/index.html) for 2015–2018.

*Note*: Figures denoted with † are for 2015–2018.

tail, Table 2 presents the pace of decline in Japan's working-age population (those aged 15–64 years old),[8] changes in the total number of workers, and changes in total hours worked in the economy overall and in the market economy.

As can be seen in Table 2, total hours worked fell sharply from 1990 onward. This drop was mainly caused by the decline in the working-age population as well as the decline in the average hours worked per worker. The decline in the working-age population reflects Japan's low birthrate and population aging and was particularly large in the 2010s due to the retirement of the baby boomers. The decline is expected to continue in the coming decades.

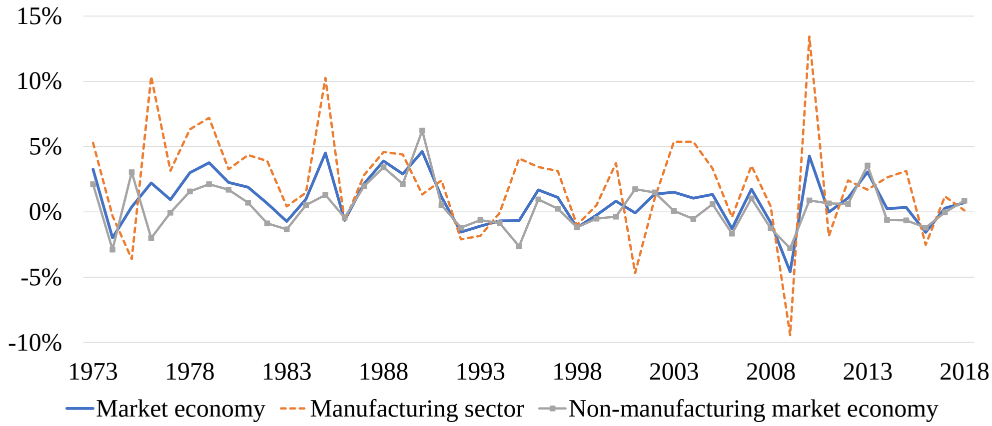
At the same time, the shrinking of the working age population has been partly offset by the growing labour participation of women and seniors, so that since 1985 the growth in the total number of workers has tended to be higher than that of the working age population.

Regarding the decline in hours worked per worker, two factors can be pointed out. The first, as highlighted by Hayashi and Prescott (2002), is the amendment of Japan's Labour Standards Act in 1987, introducing the 40-hour, five-day workweek. Hours worked gradually declined until the full implementation of the amendment in

life expectancy. Many major corporations and organization have a mandatory retirement age, which is often younger than the pensionable age, forcing many elderly workers to find work after reaching the mandatory retirement age. At the same time, due to rising life expectancy and growing fiscal pressure, the government has been gradually raising the pensionable age and is providing incentives for seniors to delay claiming their pension until age 70. These factors have led to an increase in part-time employment among seniors in recent years.

8 Figures from 2016 onward are based on the population projections of the National Institute of Population and Social Security Research.

**Chart 1: Total Factor Prodcutivity Growth in Japan, 1973–2018 (per cent)**




*Source:* Authors' calculations based on the JIP Database 2015 (1993 SNA) for 1973–1994 and the JIP Database 2021 (2008 SNA) for 1995–2018.
*Note:* The value for 1973 is the annual average growth rate of TFP in from 1970 to 1973.

1997. The second factor is the increase in part-time workers, which explains why average hours worked continued to decline even after the full implementation of the 40-hour week.

Returning to Table 1 and looking at the growth accounting results where the market economy is divided into the manufacturing and the non-manufacturing components, the main reasons for the slowdown in growth in 2005-2015 were the deceleration in capital services input growth and TFP growth. In the manufacturing sector, the negative growth contribution of the decline in hours worked became smaller in the 2005–2015 period. This is likely the result of the recovery of the manufacturing sector due to the depreciation of the yen (Fukao and Nishioka, 2021).

In summary, the results of the growth accounting analysis for Japan indicate that the main causes of the slowdown in economic growth from the 1995–2005 period to the 2005–2015 period were sluggish capital accumulation and the decline in TFP growth.

Many earlier studies, such as Hayashi and Prescott (2002), Fukao (2013), and Jorgenson, Nomura, and Samuels (2016), have pointed out that the slowdown in Japan's TFP growth occurred after the burst of the "bubble economy" in 1989–1990 and that the continued slow growth of TFP seems to be one of main proximate causes of Japan's lost decades from the 1990s. To examine whether Japan's TFP growth has improved in recent years, we plot the annual TFP growth rate of the market economy, the manufacturing sector, and the non-manufacturing market economy in Chart 1. The annual TFP growth rates for 1973–1994 are obtained from the JIP Database 2015, which is based on the 1993 SNA, while the growth rates for 1995–2018 are obtained from the JIP Database 2021, which is based on the 2008 SNA.[9]

Since the stagnation of capital deepening is the main cause of Japan's slow economic growth in recent years, we also plot annual

9 In Chart 1, the TFP growth rate for a certain year (for example, 2018) refers to the growth rate from the previous year (2017) to that year (2018).

data of the ratio of nominal gross capital formation to the nominal capital stock (referred to as the investment-capital stock ratio hereafter) in Chart 2. The chart depicts this ratio for total capital, ICT capital, and non-ICT capital. Data for 1970–1993 are based on the JIP Database 2015 (1993 SNA), in which non-ICT capital does not include R&D stock, and data for 1994–2018 are based on the JIP Database 2021 (2008 SNA), in which non-ICT capital includes R&D stock.[10]

Chart 1 shows that there was a sharp drop in TFP growth around 1990. Annual average TFP growth of the market economy declined from 1.8 per cent in 1973–1990 to 0.3 per cent in 1990–2018.[11] The decline occurred both in the manufacturing sector (from 3.5 per cent in 1973–1990 to 1.3 per cent in 1990–2018) and the non-manufacturing market economy (from 1.0 per cent in 1973–1990 to -0.1 per cent in 1990–2018).

During the three lost decades, 1990–2018, there were substantial changes in TFP growth. The 1990s were characterized by large macroeconomic shocks, such as the burst of "bubble economy" (1990–1993), the Asian financial crisis (1997–1998), and Japan's domestic financial crisis (also 1997–1998), which probably are a major reason for the sluggish TFP growth. Specifically, in 1990–2000, the annual average rate of TFP growth in the market economy overall was -0.1 per cent, that in the manufacturing sector 1.2 per cent, and that in the non-manufacturing market economy -0.6 per cent. The fact that the non-manufacturing market economy performed much worse during this decade than the manufacturing sector likely reflects that small and medium-sized enterprises (SMEs), which are more vulnerable to financial distress, make up a larger share, and more firms had invested in real estate, so that the non-manufacturing market economy was hit more seriously by the burst of the "bubble economy" and the Asian and Japanese financial crises.

By 2000, Japan had more or less resolved the non-performing loan problem in its banking sector and firms had repaired their damaged balance sheets. As a result, TFP growth in 2000–2007 recovered to 0.8 per cent in the market economy overall, 1.9 per cent in the manufacturing sector, and 0.4 per cent in the non-manufacturing market economy. However, even during this relatively stable period, Japan's TFP growth was much lower than before 1990.[12]

Since the 1990s, certain core character-

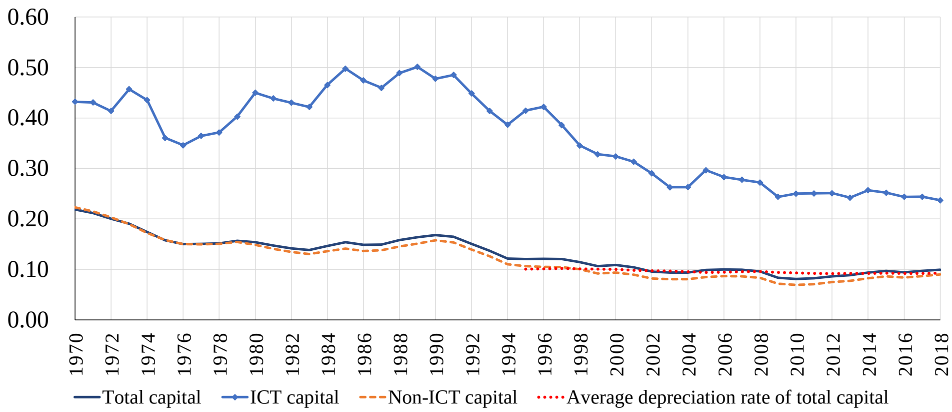
10 The definition of ICT capital goods in the JIP Database 2015 is broader than in the JIP Database 2021. For example, non-digital copiers and non-digital cameras are included in ICT capital goods in the 2015 version but not in 2021 version. On the other hand, in-house software investment is not included in ICT capital formation in the 2015 version but is included in the 2021 version.

11 The annual average TFP growth rate in 1973–1990 refers to the TFP growth from 1973 to 1990, which is calculated as the average of the annual TFP growth rates for 1974 to 1990. Growth rates for all other periods were calculated in a similar manner.

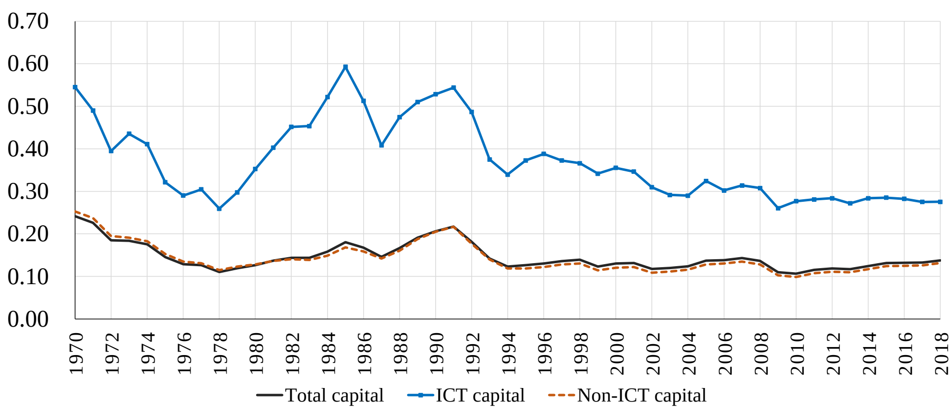
12 In addition to low TFP growth, Japan also suffers from another structural problem: insufficient demand (sometimes also referred to as the "excess saving problem"). For more on the problem of insufficient demand, see Fukao *et al.* (2016) and Fukao and Settsu (forthcoming). We should also note that low TFP growth might be in part caused by insufficient demand.

**Chart 2: Nominal Gross Capital Formation/Nominal Capital Stock: 1970–2018**

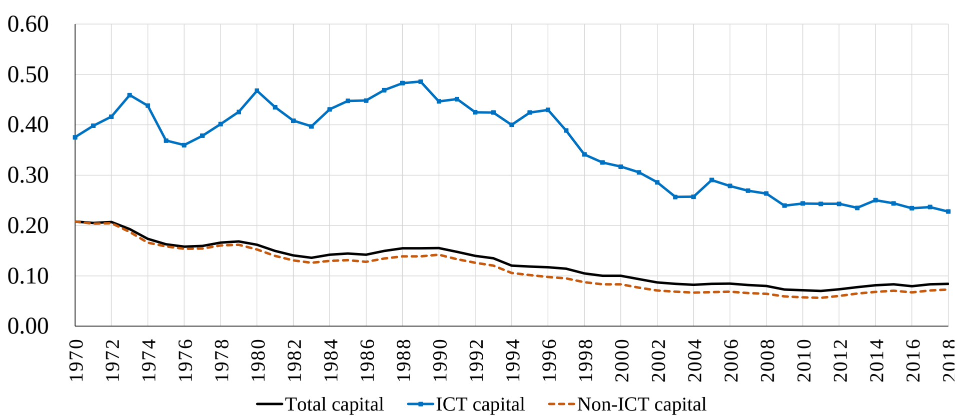
**Panel A: Market Economy**




**Panel B: Manufacturing Sector**




**Panel C: Non-manufacturing Market Economy**




*Source:* Authors' calculations based on the capital formation matrix of the JIP Database 2015 for 1970–1993 and the JIP Database 2021 for 1994–2018. Non-ICT capital data for 1994–2018 include the R&D stock.

istics of Japanese firms, such as close customer–supplier relationships and the lifetime employment system, have become obstacles to TFP growth in an environment shaped by globalization and slow/negative growth in the working age population. The reasons are as follows.[13]

First, from the 1990s, firms have increased the number of part-time workers in order to maintain the flexibility of employment levels. Given the decline of the working age population and economic stagnation, most firms cannot expect their need for employees to steadily increase, as was the case during the high-speed growth era (1955–1970). At the same time, areas in which individual firms have a competitive advantage over their rivals have been changing quickly and Japan's comparative advantage as a whole has also been evolving over time. Given the high job security provided under traditional employment practices, increasing the reliance on part-time workers has been almost the only way for firms to keep both the level and the mix of employment flexible.

Second, the structural causes of Japan's lackluster economic growth, such as the slow economic metabolism (entry and exit of firms),[14] sluggish investment in information and communication technology (ICT) at SMEs and the ineffective use of ICT, as well as insufficient investment in intangibles (training, new methods, brands) are closely related with labour issues. An example of the ineffective use of ICT is that firms often choose to purchase custom software rather than packaged software in order to avoid changes in corporate structure, employment adjustment, and training of workers. And since ICT engineers prefer to work for large firms due to the greater job security,[15] SMEs face difficulties in hiring such workers (Fukao *et al.* 2016). Meanwhile, many firms do not or cannot expand their reliance on outsourcing of ICT services because they are reluctant to adjust their employment levels (e.g., through layoffs).

Third, close customer–supplier relationships have weakened, and this change resulted in SMEs being left behind in terms of new technologies and internationalization. Since the mid-1990s, large Japanese firms, especially in the manufacturing sector, have been restructuring their business. As part of these restructuring measures, firms only partly filled positions left by retiring workers, replaced full-time workers with part-time workers, streamlined buyer-supplier relationships by making them more flexible and international, and relocated production abroad (Paprzycki and Fukao, 2008, Fukao *et al.* 2016, Fukao 2018a). It appears that these measures, such as the closure of factories in Japan by large R&D intensive firms and looser relationships with suppliers have

13 For more details about these issues, see Fukao (2012, 2018a), Fukao *et al.* (2016), and Fukao and Settsu (forthcoming).

14 On this issue, see Baily, Bosworth, and Doshi (2020).

15 Since the secondary labour market (i.e., for those who are not new graduates) is narrow and jobs of regular employees (seishain) at large firms are more secure than those at SMEs, new graduates in Japan have a strong incentive to obtain a job as a regular employee at a large firm.

reduced technology spillovers from large firms to SMEs (Belderbos *et al.*, 2013, Ikeuchi *et al.* 2015). These restructuring efforts of large firms continued in the 2000s, boosting their TFP growth. On the other hand, SMEs were left behind (Fukao, 2012, 2013, 2018a), resulting in much lower TFP growth that reflects lackluster R&D and a low degree of internationalization.

Next, the period 2007–2011 was again characterized by a deterioration in TFP growth, reflecting the global financial crisis of 2008–2009 and the Tohoku earthquake of March 2011. The TFP growth rate for the market economy overall was -0.3 per cent, that in the manufacturing sector 0.6 per cent, and that in the non-manufacturing market economy -0.6 per cent. TFP growth subsequently recovered in 2011–2018, registering 0.6 per cent in the market economy overall, 1.2 per cent in the manufacturing sector, and 0.4 per cent in the non-manufacturing market economy.

Chart 2 shows that the investment-capital stock ratio also declined after 1990. However, this decline occurred gradually, unlike the sharp drop in TFP after 1990.[16] Several reasons why the decline was gradual can be noted. First, the Bank of Japan adopted an accommodative monetary policy stance and gradually began to employ unconventional monetary policies. However, because of the zero lower bound on nominal interest rates, the effectiveness of additional monetary easing appears to have decreased over time. The Japanese government also sought to stimulate private investment through various policies such as investment tax credits and the provision of credit guarantees for SMEs. Second, as seen in Table 2, the working age population continued to decline during this period. This trend shifted downward the steady state growth rate of the economy and the steady state level of the investment-GDP ratio over time. Third, it appears that during the period from 1990 to the mid-2000s Japanese firms gradually realized that the long-run growth rate of the economy had substantially shifted downward and adjusted their investment accordingly.

Due to these factors, the period from 1990 to the mid-2000s can be regarded as a transition period from an ordinary developed economy with modest economic growth to an economy suffering from severe stagnation with a shrinking labour force, stagnant TFP, and very limited capital accumulation.

When the investment-capital ratio is lower than the depreciation rate, the real capital stock will decrease.[17]According to the JIP Database 2021, the average capital depreciation rate in the market economy during 2005–2018 was 29.6 per cent for ICT capital, 7.9 per cent for non-ICT capi-

16 According to the JIP Database 2021, the capital-labor ratio also gradually declined. Specifically, the annual average growth rate of the capital stock-labor input ratio in the market economy fell from 1.70 per cent in 1994-2000 to 1.23 per cent in 2000-2005, 0.77 per cent in 2005-2010, 0.15 per cent in 2010-2015, and 0.06 per cent in 2015-2018. The annual average growth rate of the capital service input-labor input ratio in the market economy in the corresponding periods was 2.86 per cent, 1.51 per cent, 1.28 per cent, 0.18 per cent, 0.19 per cent respectively.

17 Let $K_{i,j}$, $\Delta K_{i,j}$, $I_{i,j}$, $p_j$, $\delta_j$, and $\Omega$ denote the real stock of capital good $j$ in sector $i$, changes in $K_{i,j}$, real gross capital formation with respect to capital good $j$ in sector $i$, the price of capital good $j$, the depreciation

tal, and 9.3 per cent for capital goods overall.[18] Chart 2 shows that the investment-capital stock ratio of both ICT capital and non-ICT capital gradually declined after 1990 and approached the depreciation rate in both the manufacturing sector and the non-manufacturing market economy by the mid-2000s. This means that since the mid-2000s the real capital stock in Japan's market economy has almost stopped growing.[19] As a result, the 2005–2015 period as a whole was a period of extremely sluggish capital accumulation.

We should also note that this sluggish capital accumulation may have affected TFP growth. For instance, slow capital accumulation raises the average age of the capital stock and delays the introduction of new technologies, thus reducing TFP growth. Compared with 1990, the average age of equipment in 2017 had increased by 91.8 per cent at SMEs and 48.0 per cent at large firms (Small and Medium Enterprises Agency, 2019, Figure 1-1-12). On the other hand, since TFP growth is calculated as the residual, slower capital accumulation may have resulted in higher observed TFP growth.

Having looked at the source of growth in Japan in some detail, let us now compare developments in Japan with those in the United States, Germany, France, and the U.K. The results are presented in Table 3. For the United States, Germany, France, and the U.K., we use data from EU KLEMS 2017. Like the JIP Database 2018, which we use for the international comparison, EU KLEMS 2017 is based on the 2008 SNA and therefore can be said to be compiled based on almost identical standards.

The first interesting fact that emerges from this table is that since 2005 TFP growth has been sluggish not only in Japan but also in most of the other countries included in the comparison. As already mentioned, Japan's TFP growth declined in the 2005–2015 period relative to 1995—2005; however, what our results show is that, apart from Germany, TFP growth has fallen to an even greater extent in the other countries. As a result, Japan, which had the second lowest TFP growth rate (after Germany) in the 1995–2005 period, had the second highest TFP growth rate (again after Germany) in the 2005–2015 period. On the other hand, TFP growth fell substantially in the United States, France, and the U.K. during the 2005–2015 period relative

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rate of capital good $j$, and the set of the capital goods. The growth rate of the real capital stock (Laspeyres index) in sector $j$ can then be expressed by:

$$\frac{\sum_{j\in\Omega} p_j \Delta K_{i,j}}{\sum_{j\in\Omega} p_j K_{i,j}} = \frac{\sum_{j\in\Omega} p_j I_{i,j}}{\sum_{j\in\Omega} p_j K_{i,j}} - \frac{\sum_{j\in\Omega} p_j \delta_j K_{i,j}}{\sum_{j\in\Omega} p_j K_{i,j}}$$

The first term on the right-hand side denotes the nominal gross capital formation-nominal capital stock ratio in sector $i$, while the second term denotes the average capital depreciation rate in sector $i$.

18 These depreciation rates are based on the results of surveys on capital depreciation rates by the Cabinet Office.

19 We should note that capital depreciation rates differ slightly across sectors. Since R&D stock, which depreciates quickly, makes up a large share of the total non-ICT capital in the manufacturing sector, the average capital depreciation rate for non-ICT capital in this sector is higher than in the market economy. Similarly, since structures, which depreciate slowly, make up a large share of the total non-ICT capital in the non-manufacturing sector, the average capital depreciation rate for non-ICT capital in this sector is lower than in the market economy.

Table 3: **Sources of Growth in the Market Economy From The Supply-Side: Japan, United States, Germany, France, U.K. Comparison (Average Annual Rate of Change)**

| Japan | | | | | | |
|---|---|---|---|---|---|---|
| | 1995-2000 | 2000-2005 | 2005-2010 | 2010-2015 | **1995-2005** | **2005-2015** |
| **Real value added** | 1.19 | 0.89 | -0.51 | 0.82 | 1.04 | 0.15 |
| **Contribution of:** | | | | | | |
| Hours worked | -0.58 | -0.90 | -0.88 | -0.31 | -0.74 | -0.59 |
| Labour quality | 0.34 | 0.37 | 0.33 | 0.22 | 0.36 | 0.28 |
| Capital services | 0.92 | 0.39 | 0.17 | 0.02 | 0.65 | 0.10 |
| Total factor productivity | 0.51 | 1.03 | -0.13 | 0.89 | 0.77 | 0.38 |
| **United States** | | | | | | |
| | 1995-2000 | 2000-2005 | 2005-2010 | 2010-2015 | **1995-2005** | **2005-2015** |
| **Real value added** | 4.29 | 2.06 | -0.07 | 1.79 | 2.70 | 0.86 |
| **Contribution of:** | | | | | | |
| Hours worked | 0.69 | -0.52 | -1.00 | 0.87 | -0.18 | -0.07 |
| Labour quality | 0.13 | 0.24 | 0.24 | 0.13 | 0.21 | 0.18 |
| Capital services | 1.94 | 1.00 | 0.53 | 0.71 | 1.26 | 0.62 |
| Total factor productivity | 1.54 | 1.36 | 0.17 | 0.08 | 1.41 | 0.12 |
| **Germany** | | | | | | |
| | 1995-2000 | 2000-2005 | 2005-2010 | 2010-2015 | **1995-2005** | **2005-2015** |
| **Real value added** | 1.89 | 0.52 | 1.11 | 1.79 | 1.20 | 1.45 |
| **Contribution of:** | | | | | | |
| Hours worked | -0.21 | -0.84 | 0.17 | 0.45 | -0.53 | 0.31 |
| Labour quality | -0.09 | 0.32 | -0.06 | 0.16 | 0.12 | 0.05 |
| Capital services | 1.54 | 0.74 | 0.78 | 0.33 | 1.14 | 0.56 |
| Total factor productivity | 0.65 | 0.30 | 0.21 | 0.85 | 0.48 | 0.53 |
| **France** | | | | | | |
| | 1995-2000 | 2000-2005 | 2005-2010 | 2010-2015 | **1995-2005** | **2005-2015** |
| **Real value added** | 3.77 | 1.74 | 0.66 | 1.02 | 2.75 | 0.84 |
| **Contribution of:** | | | | | | |
| Hours worked | 0.88 | 0.17 | 0.23 | 0.13 | 0.52 | 0.18 |
| Labour quality | 0.30 | 0.38 | 0.28 | 0.62 | 0.34 | 0.45 |
| Capital services | 1.04 | 1.05 | 0.66 | 0.40 | 1.05 | 0.53 |
| Total factor productivity | 1.54 | 0.15 | -0.50 | -0.13 | 0.84 | -0.31 |
| **U.K.** | | | | | | |
| | 1995-2000 | 2000-2005 | 2005-2010 | 2010-2015 | **1995-2005** | **2005-2015** |
| **Real value added** | 3.86 | 2.62 | 0.11 | 2.17 | 3.09 | 1.14 |
| **Contribution of:** | | | | | | |
| Hours worked | 0.65 | -0.12 | -0.57 | 1.27 | 0.17 | 0.35 |
| Labour quality | 0.29 | 0.45 | 0.37 | 0.33 | 0.39 | 0.35 |
| Capital services | 1.46 | 0.90 | 0.24 | 0.55 | 1.11 | 0.40 |
| Total factor productivity | 4.46 | 1.39 | 0.06 | 0.02 | 1.42 | 0.04 |

*Source*: Authors' calculations based on the JIP Database 2018 (September 2019 Revision) for Japan and EU KLEMS 2017 (Revised July 2018) for the other countries. The EU KLEMS data were downloaded from http://www.euklems.net/index.html.

*Note*: To calculate the growth contribution of each production factor, factor cost shares are used for Japan, while for the other countries the ex post income shares are used. Due to data limitations in the EU KLEMS data, our growth accounting for the United States and the U.K. starts from 1998 and 1997, respectively.

to 1995-2005. The growth accounting for five-year intervals suggests that not only did TFP growth in these countries fall during 2005–2010, likely reflecting the global financial crisis, it also failed to improve during 2010–2015, which includes the recovery from the global financial crisis. As pointed out by Gordon (2012), Summers (2013), and others, there may have been a global slowdown in technological innovation, particularly in the United States, which might explain this decline in TFP growth. Another possible explanation of the low TFP growth in these countries is that after the global financial crisis these countries introduced unconventional monetary policies, which may have led to excess capital formation, reducing TFP growth in a similar manner as in Japan in the 1990s.

Although Japan's TFP growth rate during 2005–2015 was much lower than in the preceding decade, it was still higher than that for the United States, France, and the U.K. Nevertheless, the growth rate of Japan's market economy remained the lowest of the five countries. In addition to the decline in hours worked due to demographic factors, the reason for this is that the contribution of capital services input growth was remarkably low.

Therefore, to improve Japan's growth prospects, it will be necessary to tackle the other two sources of Japan's economic slowdown, namely, the slowdown in capital accumulation and TFP growth. It is unlikely that much can be done to substantially mitigate the decline in the number of hours worked brought about by the shrinking of Japan's working-age population shown in Table 2. For example, the working-age population is expected to decrease by 5.3 million between 2020 and 2030. It will be difficult to offset this decline simply by accepting more foreign workers or by further increasing the employment rate of women and persons 65 and over.[20]

## The Slowdown in Capital Accumulation in Japan

Let us consider the slowdown in capital accumulation in Japan. When a country's economic growth heavily relies on capital accumulation, the diminishing marginal returns to capital will cause the rate of return on capital to fall, which in turn will reduce capital accumulation and slow economic growth. However, if labour input increases, or if technological progress has the same effect as an increase in labour input, the diminishing marginal returns to capital will be counteracted and a high rate of capital accumulation may be maintained. We therefore examine whether the slowdown in capital accumulation in Japan in recent years is sufficiently severe to be explained by the shrinking of Japan's population and low TFP growth.

Let us examine this question from the perspective of neoclassical growth theory. According to standard neoclassical growth theory, in an advanced economy that has accumulated sufficient capi-

20 The social costs associated with accepting sufficiently large numbers of unskilled workers from developing countries would be very high. Even in the case of skilled workers, since Japan has a relatively ethnically homogeneous population with a limited tradition of significant immigration, Japan would need substantial reforms of its education system, public consciousness, etc., in order to accept large numbers of immigrants without substantial social costs.

tal, assuming that technological progress is Harrod-neutral, under steady-state growth in which the marginal productivity of capital does not diminish (balanced growth), the rate of capital accumulation is equal to the rate of GDP growth (natural growth rate), which is defined as the sum of the rate of labour input growth and the Harrod-neutral rate of technological progress (Acemoglu, 2009, Chapter 2). According to neoclassical growth theory, if the rate of capital accumulation exceeds the natural growth rate, the rate of return on capital declines due to diminishing marginal returns, so that the rate of capital accumulation declines. When the rate of capital accumulation falls below the natural growth rate, capital becomes scarce, the rate of return on capital rises, and the rate of capital accumulation rises. Thus, there is a mechanism based on which the economy returns to a balanced growth path once it deviates from it.

Based on this neoclassical growth theory perspective, we calculate the natural growth rate (and the rate of capital accumulation in balanced growth, which equals the natural growth rate) for the five countries (Japan, United States, Germany, France, and U.K.) and compare it with the actual rate of increase in the capital stock. As in Tables 1 and 3, we exclude the non-market economy, for which TFP is difficult to measure, and examine TFP, labour input, and capital accumulation for the market economy only.

Assuming Harrod-neutral technological progress, the rate of technological progress equals the TFP growth rate divided by the income share of labour.[21] The natural growth rate in Table 4 (which in balanced growth is equal to the rate of increase in the capital stock) is calculated as the sum of the rate of Harrod-neutral technological progress calculated as described and the rate of change in labour input. The labour input growth rate in the table is the sum of changes in hours worked and labour quality improvements.

In Table 4, in row (e) for each country, the growth rate of the capital stock on a balanced growth path (which is equal to the natural growth rate) is calculated from the actual growth rate of labour input and TFP. According to this table, Japan's natural growth rate (for the market economy) was the lowest among the five countries, at 0.11 per cent per year during 2005–2015. Germany had the highest natural growth rate, followed by the U.K., France, and the United States. While Japan, as mentioned earlier, had the second highest TFP growth rate after Germany during this period of slowing TFP growth worldwide, Japan's natural growth rate was much lower than that of the other

21 As mentioned earlier, the growth accounting analysis for Japan uses information on cost shares rather than income shares. However, in the calculations in Table 4, for the comparison with the other countries, the labour income share is used for calculating Harrod-neutral technological progress. Since the cost share of labour in Japan, at 0.67 in 1995–2005 and 0.68 in 2005–2015, was higher than the income share (i.e., on average, firms' operating surplus was higher than their cost of capital), using cost shares results in a rate of Harrod-neutral technological progress for Japan that is lower than that shown in Table 4, and its natural growth rate is lower than in Table 4. If income shares are used in the growth accounting analysis for Japan in Tables 1 and 3, as in the EU KLEMS database, the TFP growth rate calculated as the residual will be somewhat smaller since the negative contribution of changes in labour input to growth will be smaller.

Table 4: **Natural Growth Rate and Capital Growth Rate for the Market Economy: Japan, United States, Germany, France, and U.K. 1995-2005 and 2005-2015 (Average Annual Per Cent Change)**

| | | Japan | | United States | | Germany | | France | | U.K. | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **1995-2005-** | **2005-2015-** | **1998-2005-** | **2005-2015-** | **1995-2005-** | **2005-2015-** | **1995-2005-** | **2005-2015-** | **1997-2005-** | **2005-2015-** |
| **Labour input growth** | $a$ | -0.69 | -0.58 | 0.05 | 0.18 | -0.57 | 0.52 | 1.22 | 0.86 | 0.81 | 0.99 |
| **TFP growth** | $b$ | 0.77 | 0.38 | 1.41 | 0.12 | 0.48 | 0.53 | 0.84 | -0.31 | 1.42 | 0.04 |
| **Labor income share (%)** | $c$ | 55.40 | 54.87 | 63.45 | 60.00 | 71.38 | 68.61 | 70.63 | 73.41 | 68.92 | 70.85 |
| **Harrod-neutral technological progress** | $d = b/c$ | 1.39 | 0.69 | 2.22 | 0.20 | 0.67 | 0.77 | 1.19 | -0.42 | 2.06 | 0.06 |
| **Natural growth rate = Growth rate of capital stock on balanced growth path** | $e = a + d$ | 0.70 | 0.11 | 2.27 | 0.38 | 0.10 | 1.30 | 2.41 | 0.44 | 2.87 | 1.04 |
| **Actual capital stock growth rate** | $f$ | 1.34 | 0.01 | 5.32 | 2.36 | 3.10 | 1.80 | 3.10 | 1.80 | 5.17 | 1.92 |
| **Actual capital stock growth rate minus growth rate on balanced growth path** | $g = f - e$ | 0.64 | -0.09 | 3.05 | 1.98 | 3.00 | 0.51 | 0.69 | 1.37 | 2.30 | 0.88 |

*Source*: See Table 3. Data for the market economy are used.

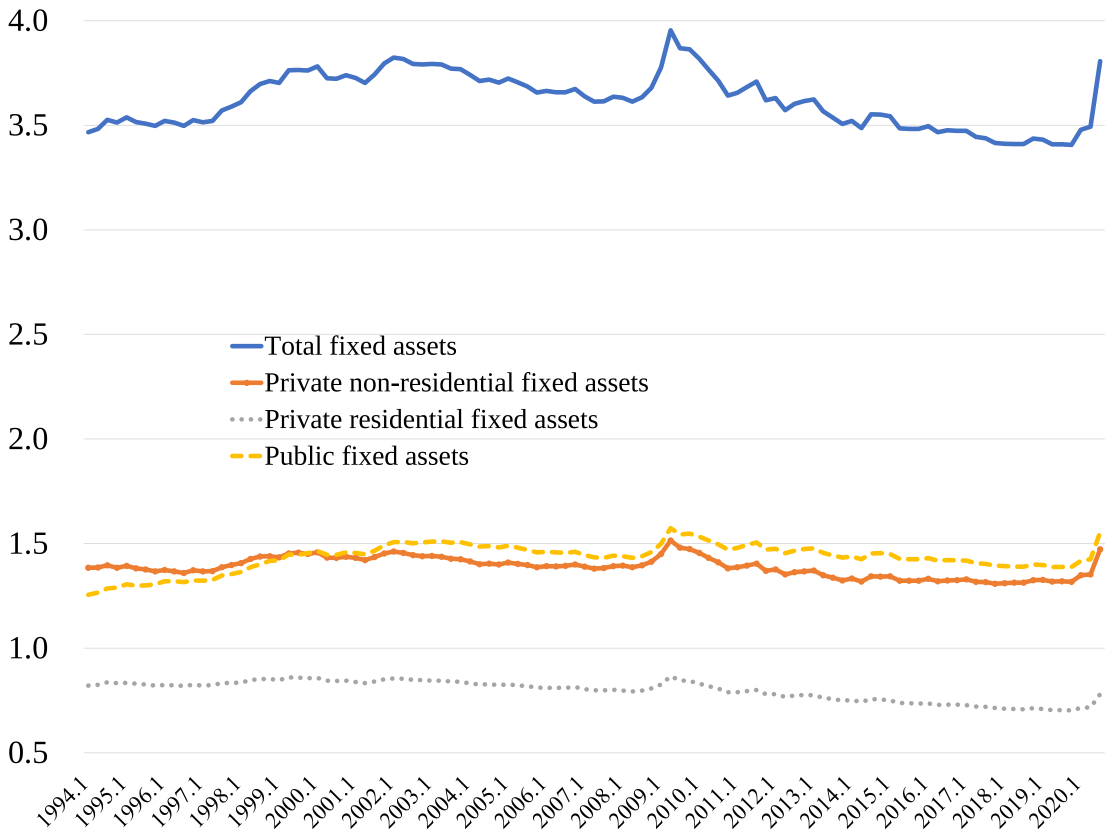
countries due to the decline in labour input reflecting demographic trends.

Next, we compare the actual capital stock growth rate (row (f)) with the natural growth rate of each country's market economy calculated as described above (row ((e)). Looking at the period 2005–2015, we find that unlike in other countries, where the capital stock growth rate was around 2 per cent, in Japan the actual capital stock growth rate during that period was only 0.01 per cent and thus below the natural growth rate, which itself was already lower than in the other countries.

While further research is needed to understand why Japan's capital accumulation between 2005 and 2015 was so much lower than in other major economies, possible reasons include the following: (1) While other major industrialized countries embarked on large-scale monetary easing after the global financial crisis to stimulate capital accumulation, in Japan there was little room to stimulate capital accumulation through further monetary easing, since the Bank of Japan had already been pursuing monetary easing for many years to bring the economy out of its long-term stagnation. (2) Until 2012, when Abenomics was launched,[22] the yen continued to appreciate against the United States dollar and other currencies reflecting monetary easing in other major economies, hurting the manufacturing sector. (3) Having transferred production overseas, large firms have tended to use their corporate savings to increase their investment and lending overseas rather than investing them at home; in addition, in recent years, they have also increasingly tended to spend profits on dividend payouts rather than investment (Fukao *et al.*, 2019).

22 Initially, Abenomics (2013–2020) consisted of three arrows: aggressive monetary policy, active fiscal policy, and a growth strategy (including measures to improve productivity).

**Chart 3: Developments in the Real Capital Stock-GDP Ratio for Japan: 1994Q1–2020Q3, Total Economy**




*Source:* The denominator for each variable is quarterly real GDP (seasonally adjusted, 2015 benchmark year) from the "Quarterly Estimates of GDP for Jul.-Sep. 2020 (The Second Preliminary Estimates)," Cabinet Office, Government of Japan. The numerators are the quarterly fixed capital stock series from the "Quarterly Estimates of Net Capital Stocks of Fixed Assets, Jul.-Sep. 2020" (2015 benchmark year; 2008 SNA), Cabinet Office, Government of Japan. The data were downloaded from: https://www.esri.cao.go.jp/en/sna/menu.html.

Against this background, let us examine developments in capital accumulation in Japan, including more recent years not covered in the JIP Database 2021, which only goes up to 2018. We therefore use data from the Cabinet Office to show developments in the ratio of the real fixed capital stock of various types of capital to real GDP (both denominator and numerator in 2015 prices) in Chart 3.

Chart 3 indicates that the real capital stock-output ratio for total fixed assets rose considerably from 1994, the first year for which data are available, to the early 2000s. However, since then it has been on a rapidly declining trend, with the exceptions of a spike around 2009, when real GDP fell precipitously due to the collapse in exports triggered by the global financial crisis, and another spike after the second quarter of 2020, when real GDP fell due to the outbreak of COVID-19. Breaking down total fixed assets into private non-residential fixed assets (including intellectual property products accumulated through research and development, etc.), public fixed assets, and private residential fixed assets, we find that whereas the ratios of public fixed assets and private residential fixed assets to GDP have continued to fall, the ratio of private non-residential fixed assets, which corresponds to the capital stock of the market economy, to GDP stopped falling in 2015. As mentioned in passing earlier, the share of the market economy in GDP has been declining due to the expansion of non-market sectors such as health care and nursing care. It seems that the capital stock of private non-residential fixed assets divided by the gross value added of the market economy excluding housing stopped declining from the mid-2010s until the outbreak of COVID-19.

Next, let us examine why the capital-GDP ratio stopped increasing and started to decline around 2002–2003. As already discussed in the previous section, one explanation is that because of the drop in TFP growth after 1990, the gradual decline in the working age population, the persistent insufficient demand, and the zero interest rate constraint on monetary easing, the period from 1990 to the mid-2000s was a transition period from an economy with modest economic growth to one characterized by severe stagnation with very limited capital accumulation. In order to investigate the stagnation of capital accumulation in more detail, Chart 4 shows how the return on capital, the rental price of capital, and the capital-output ratio changed in the market economy, the manufacturing sector, and the non-manufacturing market economy during the period 1995–2018. Specifically, Chart 4 shows the annual data of the following four variables:

- Gross operating surplus/Nominal capital stock = (Nominal gross value added at factor costs − labour cost)/Nominal capital stock
- Rental price of capital = Capital cost/Nominal capital stock = Long-term interest rate + Capital depreciation rate − Capital gains[23]
- Excess return on capital = Gross operating surplus/Nominal capital stock - Rental price of capital
- Capital-output ratio = Real capital stock/Real value added (in 2011 prices)

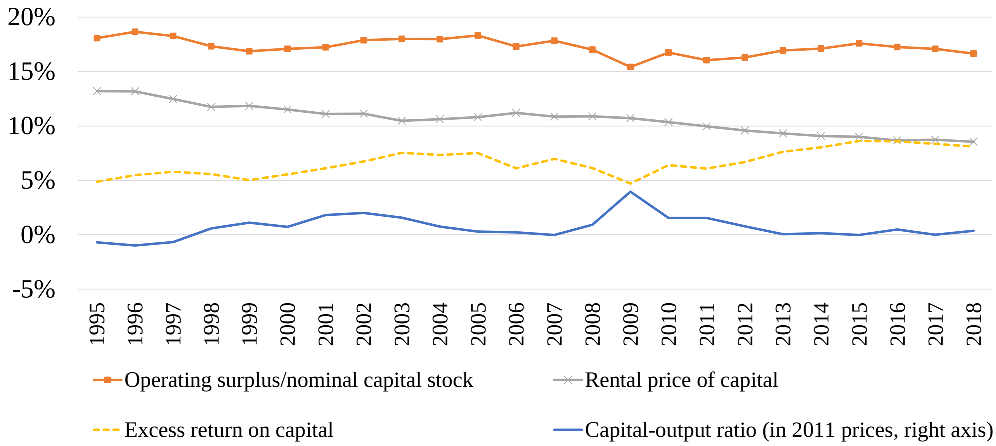
When the excess return on capital increases, firms will invest more and the capital-output ratio will increase. As already discussed in the previous section, the Bank of Japan increased monetary easing in the 1990 and early 2000s and succeeded in reducing the rental price of capital. While the ratio of the gross operating surplus to the nominal capital stock did not recover during the period 1995–2003, the decline in the rental price of capital raised the excess return on capital, mainly in the non-manufacturing market economy. This, in turn, appears to have contributed to the slowdown in the decline in the ratio of nominal gross capital formation to the nominal capital stock, but the decline in the rental price of capital was not sufficient to stop the decline or lead to an increase in the ratio of nominal gross capital formation to the nominal capital stock (Chart 2).

In 2006, the Bank of Japan terminated its quantitative-easy policy and zero-interest policy as the decline in the Consumer Price Index came to a halt, market interest rates started to increase, and

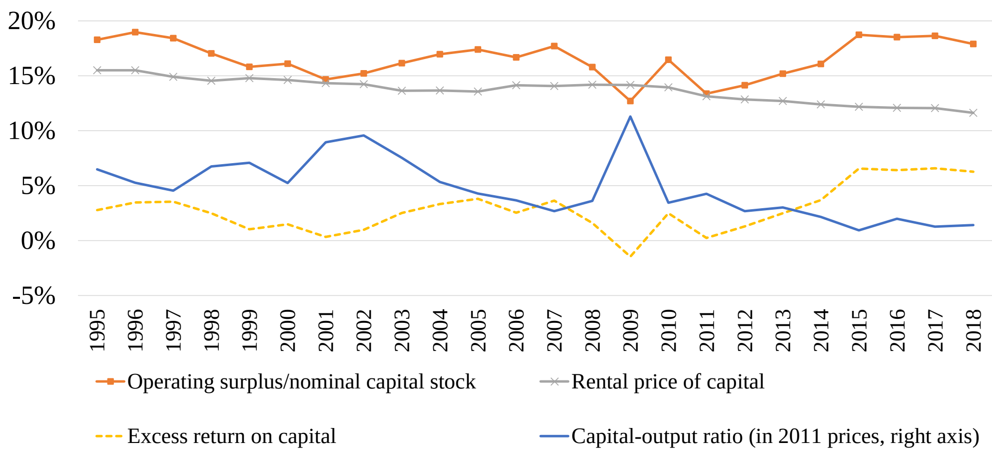
23 The cost of capital is adjusted for tax saving effects.

**Chart 4: Excess Return on Capital and Capital-Output Ratio in Japan, 1995-2015**

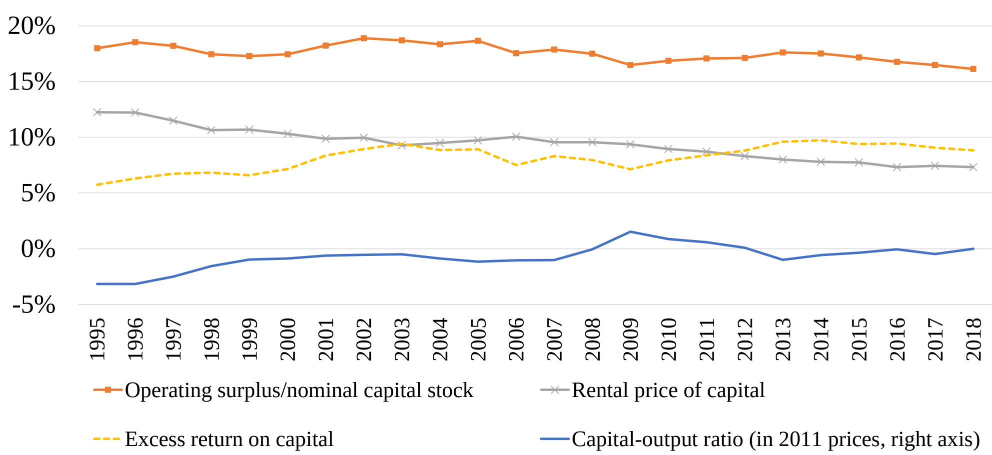
**Panel A: Market Economy**




**Panel B: Manufacturing Sector**




**Panel C: Non-manufacturing Market Economy**




*Source:* Authors' calculations based on the JIP Database 2021.

the decline in the rental price of capital also came to an end. The global financial crisis of 2008–2009 reduced the operating surplus-capital stock ratio and further reduced the excess return on capital.

From 2013, the Bank of Japan once again stepped up its unconventional monetary easing and increased investment in risk assets such as index-linked exchange-traded funds and Japan Real Estate Investment Trusts. This policy led to a substantial depreciation of the yen (Fukao and Nishioka 2021).[24] However, although the excess return increased substantially (Chart 4) under Abenomics, it did not lead to an increase in the ratio of nominal gross capital formation divided by the nominal capital stock (Chart 2).

Another potential explanation of Japan's slow capital accumulation is substitution between capital and labour. As already explained, the supply of non-regular female and senior workers increased substantially in recent years. This change may have made capital input more expensive relative to labour input and slowed down capital accumulation. To measure the input cost of one unit of labour services, we use the following wage rate index:

*Wage rate = Total labour costs/Total labour input index = Total labour costs/(labour quality index × Total hours worked)*

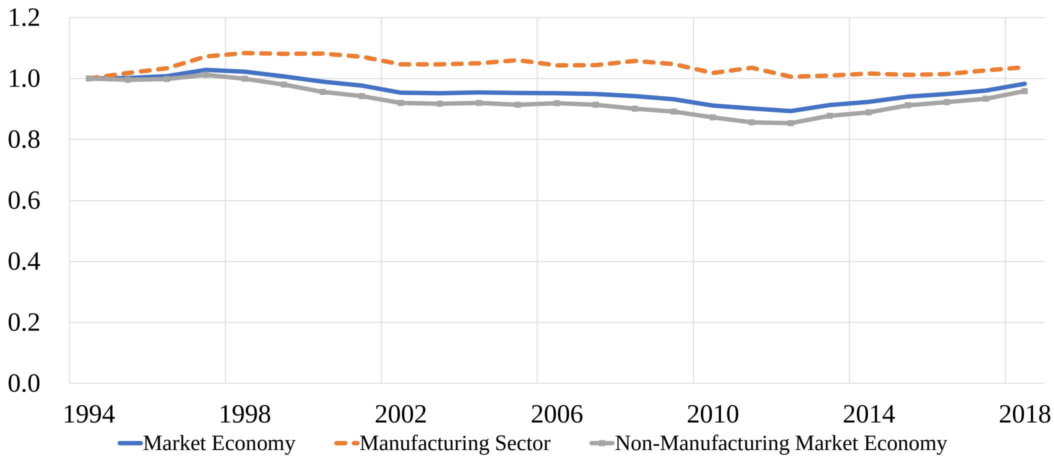
We obtain the data from the JIP Database 2021. Our wage rate index measures the labour costs incurred by firms (including social security expenses, accrued retirement benefits, etc., paid by employers) and takes account of changes in labour quality. As the rental price of capital, we use the same data as in Chart 4. Chart 5 shows developments in the wage rate and the wage-rental ratio (i.e., the ratio of the wage rate to the rental price of capital) during the period 1994–2018.

Reflecting Japan's very low or negative inflation and slow labour productivity growth, the nominal wage rate remained almost unchanged over the 24-year period. While the wage rate in the non-manufacturing sector declined somewhat until 2012, it subsequently recovered, essentially returning to the level at the beginning of the period. Meanwhile, as already seen in Chart 4, the rental price of capital followed a declining trend. Because of this decline in the denominator, the wage-rental ratio increased over time. In particular, it rose substantially until 2003–2004, mainly due to the decline in the rental price of capital as a result of unconventional monetary easing. The wage-rental ratio then stopped increasing during the period 2004–2011 because of the decline in the wage rate, the Bank of Japan's termination of its quantitative-easy policy and zero-interest rate policy, and capital losses on capital owned due to a decline in capital goods prices, which raised the rental price of capital slightly. From 2012, the wage-rental ratio started to once again increase quite rapidly. Reasons include wage increases brought about by Abenomics, increased unconventional monetary easing,

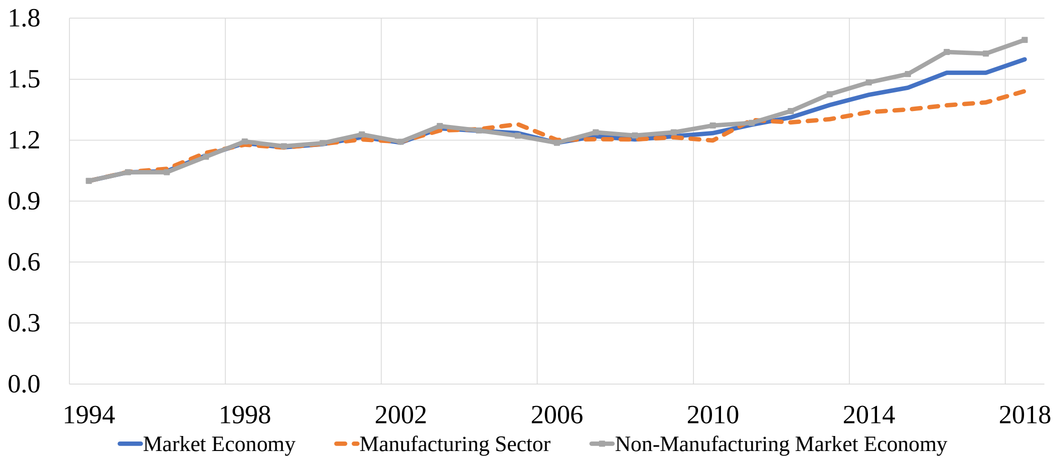
24 The depreciation of the yen also raised the prices of tradables, leading to an increase in the capital goods price index from 2012 to 2018. This change resulted in capital gains for capital owners and reduced rental price of capital.

**Chart 5: Wage Rate and Wage-Rental Ratio in Japan: 1994–2018, (1994 = 1)**

**Panel A: Wage Rate in Nominal Terms**




**Panel B: Wage-Rental Ratio (Wage Rate in Nominal Terms/Rental Price of Capital in Nominal Terms)**




*Source:* Authors' calculations based on the JIP Database 2021.

and capital gains on capital owned caused by the depreciation of the yen and increases in capital goods prices.

Since the wage-rental ratio increased substantially during 2012–2018, the slow capital accumulation during this period cannot be explained by the substitution of capital by labour.

To sum up the analysis above, the gradual slowdown in capital accumulation can probably be explained as the transition to a low growth economy as well as the increase in unconventional monetary easing. However, we cannot explain why Japan's capital stock growth rate during 2005–2015 was below the natural growth rate. We also cannot explain why capital accumulation did not accelerate substantially under Abenomics.

In the case of the United States, Gutiérrez and Philippon (2017) find that the rise in investment in intangibles appears to have reduced fixed investment relative to Tobin's Q. Miyagawa and Ishikawa (2021) arrive at a similar result for Japan. However, in Japan, the increase in Tobin's Q was modest and, as we will see in the next section, intangible investment excluding R&D and software is relatively small in comparison with the United States. It therefore seems that it cannot be argued that an increase in intangible investment (excluding R&D and software) substantially displaced other capital accumulation (including R&D and software) in Japan.

Gutiérrez and Philippon also point to concentration, globalization, and corporate governance issues (increased short-termism) as causes of the reduction in fixed investment in the United States. However, in Japan, there are few giant firms such as the Big Tech firms (Google, Amazon, Apple, etc.) that have a dominant position resulting in a high degree of market concentration. Moreover, using firm-level data from the Economic Census, Fukao *et al.* (2021) find that the average Herfindahl-Hirschman index and the four-firm concentration ratio in industries (both measured at the 4-digit industry level) declined during the period 2011–2015. Therefore, Japan's slow capital accumulation likely cannot be explained by market concentration.

Turning to globalization, Japanese manufacturing firms have actively relocated production abroad and in fiscal 2018 (from April 1, 2018 to March 31, 2019), for example, gross fixed capital investment, which does not include R&D, by Japanese manufacturing affiliates abroad amounted to 4.4 trillion yen, equivalent to 27.5 per cent of the total capital investment in Japan of all domestic manufacturing firms (Ministry of Economy, Trade and Industry (METI) 2020:12). Therefore, the hypothesis that the sluggish fixed investment in Japan is linked to globalization is a promising candidate. However, it should also be noted that in 2018, 60 per cent of total capital formation in Japan's market economy was in the non-manufacturing market economy (JIP Database 2021), and globalization in Japan's non-manufacturing sector is not substantial.

Finally, whether corporate governance issues could provide an explanation is an issue that we hope to examine using firm-level data in the future.

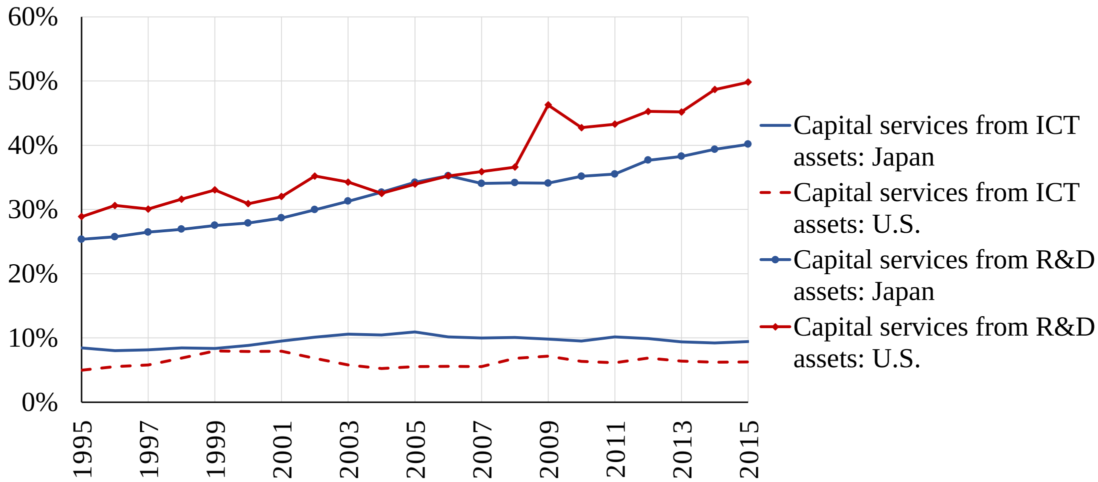
## Input of Information and Communication Technology and Intangible Assets

One of the reasons for Japan's sluggish productivity growth that has been frequently highlighted is weak investment in information and communication technology (ICT) and intangible assets (see Fukao *et al.*, 2009, and Fukao *et al.*, 2016). In this section, we examine this issue primarily through comparisons of ICT inputs and intangible asset investment between Japan and the United States.

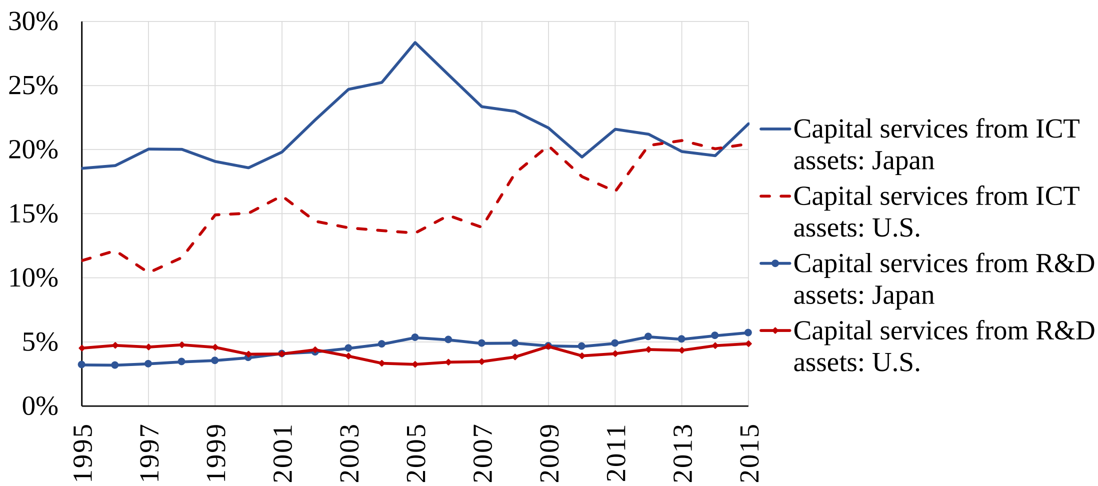
We start by comparing the share of ICT assets (including software), R&D assets, which form part of intangible assets, and other assets (total capital services input minus the services input of ICT and R&D assets) in total capital services input in the manufacturing and non-manufacturing market economy in Japan and the United States. In particular, we want to know whether the United States tends to have a higher share of ICT and R&D capital services input in total capital services input and whether Japan tends to have a higher

**Chart 6: Share of R&D and ICT Capital Services in Total Capital Services Input by Sector: Japan-U.S. Comparison, 1995–2015**

**Panel A: Manufacture Sector**




**Panel B: Non-Manufacturing Market Economy**




*Source:* See Table 3.

share of other assets.[25]

As shown in Chart 6, the share of R&D capital services in total capital services input is higher in the United States than in Japan in the manufacturing sector, but in the case of the non-manufacturing market economy, the shares in Japan and the United States are almost identical. On the other hand, the share of ICT capital services is higher in Japan than in the United

25 Capital services input by type of capital good for the United States was obtained based on EU KLEMS 2017 as follows: Capital services input = capital goods prices × (Nominal interest rate + capital depreciation rate + capital loss due to fall in price of capital goods) × Real capital stock, where for the nominal interest rate we use the annual average of 10-year Treasury yields, while for the capital depreciation rate, capital goods prices, and the real capital stock we use data from EU KLEMS 2017. In EU KLEMS 2017, capital goods for the United States are categorized into computing equipment, communications equipment, computer software and databases, transport equipment, and other machinery and equipment, total non-residential investment, residential structures, research and development, and other intellectual property protected assets. ICT assets are the total of the following three of these categories: computing equipment, communications equipment, and computer software and databases.

States both in the manufacturing and the non-manufacturing sector. However, in the non-manufacturing sector the gap has recently narrowed. These results suggest that the United States is not necessarily more ICT-intensive in its production activities than Japan. In addition, comparing the manufacturing and the non-manufacturing sector indicates that both in Japan and the United States the share of R&D capital services is higher in the manufacturing than the non-manufacturing sector;[26] on the other hand, the reverse is the case for the share of ICT capital services, which is higher in the non-manufacturing than the manufacturing sector.

Several comments are in order regarding the comparison between Japan and the United States based on Chart 6. First, in Japan, both the ratio of R&D expenditures to sales and the ratio of ICT capital services input to gross value added tend to be much lower for small and medium-sized enterprises (SMEs) than for large firms (see Yamaguchi *et al.*, 2019, for R&D and Fukao *et al.*, 2016, for ICT). Therefore, for SMEs, especially those in the non-manufacturing sector market economy, Japan likely lags behind the United States in the adoption of ICT (Fukao *et al.* 2012 and Fukao *et al.*, 2016).

Second, it has been pointed out that the prices of ICT assets and ICT services differ between Japan and the United States. As highlighted by Fukao *et al.* (2016), the prices of ICT assets and services tend to be higher in Japan. For example, since it is too costly for small firms to have their own ICT service division providing a full range of ICT services, having access to efficient vendors of ICT services is a key factor for procuring ICT inputs at a reasonable price; however, in Japan, the market for business process outsourcing (BPO), which includes outsourcing of ICT processes, is not well developed. According to METI (2014), the size of the BPO market in Japan was 663 billion yen in 2012, whereas in the United States it was 12 trillion yen in the same year.

Another factor which makes ICT inputs expensive for small firms is the difficulties they face in recruiting ICT experts, as already explained in the second section. And even in the case of packaged software, the price in Japan according to a survey by the Ministry of Economy, Trade and Industry (METI, 2013) in 2012 was 2.27 times higher than in the United States.[27] While price differentials at market prices likely have shrunk due to the depreciation of the yen since 2012, this depreciation is insufficient to offset such price differentials. While Chart 6 suggests that the share of ICT capital services is higher in Japan than the United States, in real terms the share may be lower once price differences are adjusted for.[28]

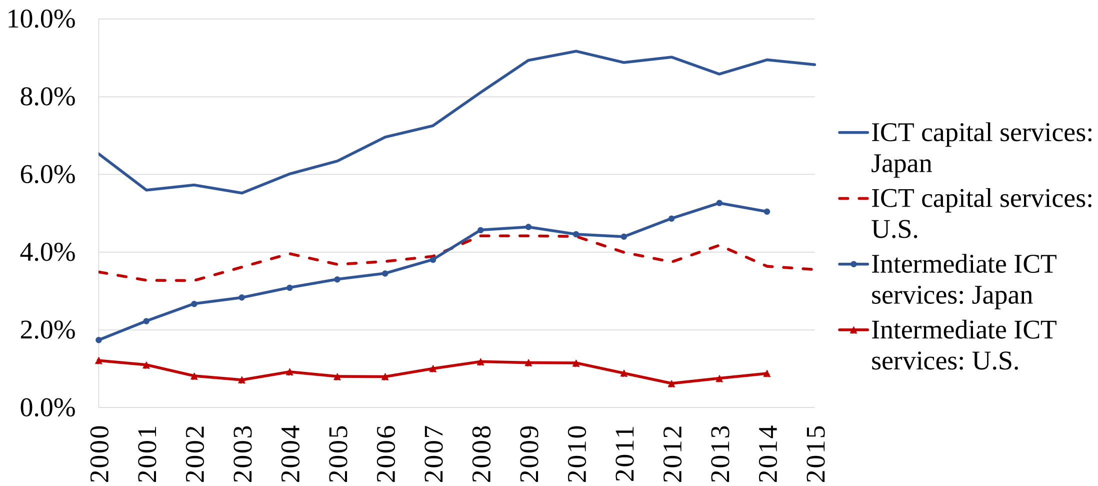
26 We should note that R&D does not play a major role in the non-manufacturing sector, except in ICT services.

27 It seems that packaged software suppliers employ a pricing-to-market strategy because of the lack of competitors and language barriers.

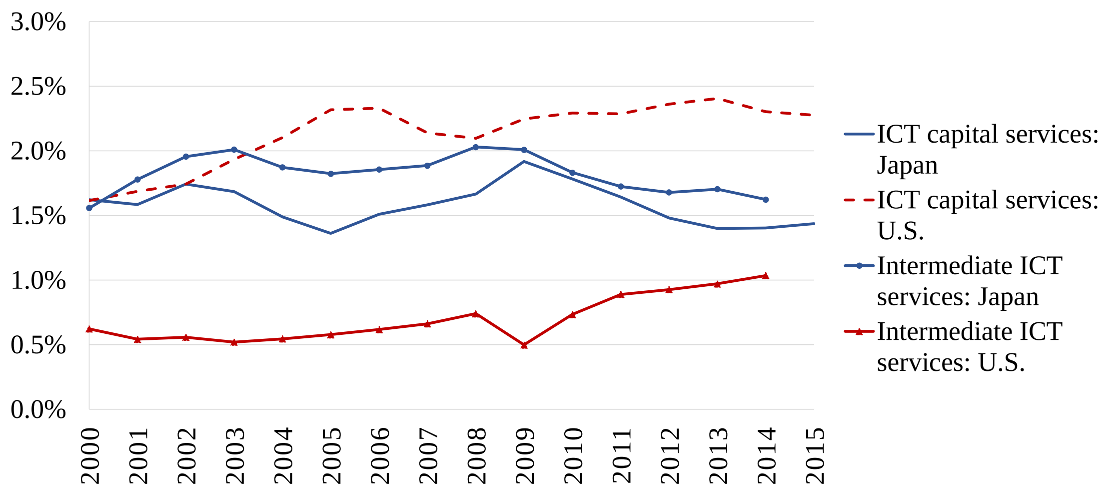
28 That is, if the elasticity of substitution between production factors is smaller than one, it is possible that the real price-adjusted input share of ICT capital services is lower in Japan than in the United States because the price of ICT capital is higher in Japan than in the United States, while the input share of ICT capital services in nominal terms is higher in Japan.

**Chart 7: ICT Capital Services Input and Intermediate ICT Services Input Divided by Value Added in Japan and the United States: Finance, Wholesale, and Retail, 2000–2015**

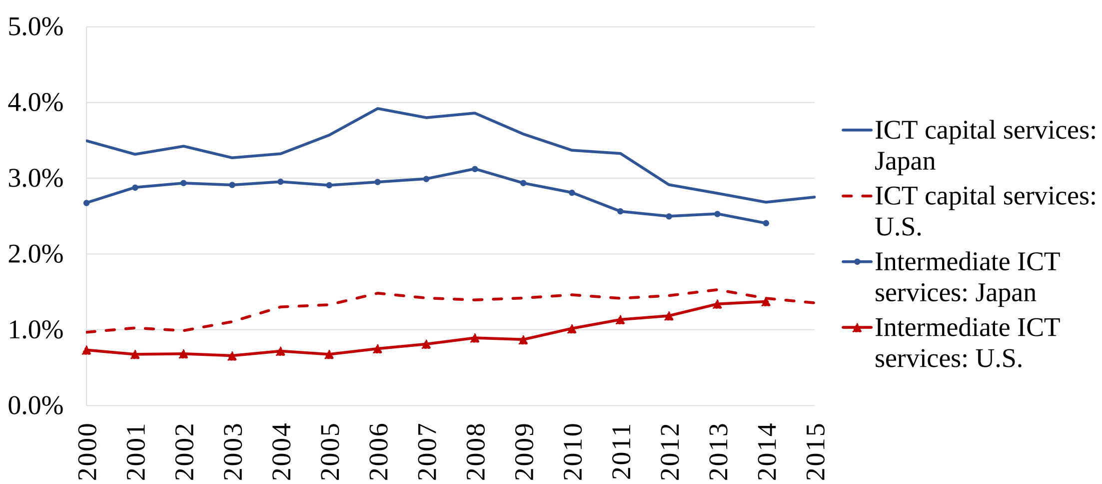
**Panel A: Finance**




**Panel B: Wholesale**




**Panel C: Retail**




*Source:* See Table 3 for the sources for ICT capital services and the denominator, value added. Intermediate ICT services were obtained from the 2016 release of the World Input-Output Database (WIOD; http://www.wiod.org/database/wiots16). Due to data limitations in the WIOD, this figure only covers the period from 2000.

**Table 5: Real Capital Stock Growth Rates: Japan-U.S. Comparison by Type of Assets and Sector (annual rate, per cent)**

| | Japan | | | |
|---|---|---|---|---|
| | 1995-2000 | 2000-2005 | 2005-2010 | 2010-2015 |
| **Total capital stock** | | | | |
| Market economy | 1.94 | 0.73 | 0.04 | -0.01 |
| Manufacturing | 1.15 | 0.62 | 0.39 | -0.16 |
| Services | 2.26 | 0.77 | -0.09 | 0.04 |
| **ICT capital stock** | | | | |
| Market economy | 10.14 | 5.34 | 2.18 | 1.12 |
| Manufacturing | 8.43 | 5.72 | 1.98 | 0.70 |
| Services | 10.62 | 5.24 | 2.24 | 1.23 |
| **R&D capital stock** | | | | |
| Market economy | 3.02 | 1.81 | 1.42 | 0.70 |
| Manufacturing | 2.80 | 1.84 | 1.77 | 0.88 |
| Services | 3.88 | 1.66 | 0.02 | -0.09 |
| | **U.S.** | | | |
| | 1995-2000 | 2000-2005 | 2005-2010 | 2010-2015 |
| **Total capital stock** | | | | |
| Market economy | 6.13 | 4.90 | 2.40 | 2.33 |
| Manufacturing | 4.39 | 2.24 | 1.73 | 1.69 |
| Services | 6.70 | 5.65 | 2.57 | 2.48 |
| **ICT capital stock** | | | | |
| Market economy | 15.12 | 6.48 | 5.82 | 3.89 |
| Manufacturing | 13.69 | 0.74 | 5.22 | 3.05 |
| Services | 15.34 | 7.21 | 5.88 | 3.97 |
| **R&D capital stock** | | | | |
| Market economy | 5.02 | 3.17 | 3.66 | 3.10 |
| Manufacturing | 5.11 | 3.81 | 4.13 | 3.04 |
| Services | 4.76 | 1.16 | 1.98 | 3.32 |

*Source*: See Table 3.

Chart 7 indicates that while in wholesale the value added ratio of ICT capital services is higher in the United States, in finance and retail it is about twice as high in Japan as the United States. The value added ratio of intermediate ICT services is about twice as high in Japan as in the United States in all three industries. Adding up the two ratios, we find that the sum of the ICT capital services and intermediate ICT services ratios is higher in the United States in the case of wholesale, but it is considerably higher in Japan than the United States in finance and retail. However, according to the survey of goods and services prices by METI cited earlier, ICT services are also much more expensive in Japan, with payroll processing fees and market research fees being 2.56 and 3.20 times higher, respectively. Therefore, as in the case of ICT assets, Japan may only appear to be more ICT-intensive due to such price differences.

Summarizing the analysis on ICT inputs, there is no evidence that Japan's ICT inputs are clearly lower than those of the United States, although the issue of price differences between Japan and the United States in terms of ICT capital services and intermediate ICT services needs to be borne in mind. However, as we saw in the previous section, Japan lags behind other major countries in terms of capital accumulation, and it may also be lagging behind in terms of the accumulation of R&D and ICT assets.

To examine this point, Table 5 compares the growth rates of real capital stock by type of assets and sector in Japan and the United States. The table shows that, as in the United States, the ICT capital stock and R&D capital stock in Japan have been growing at faster rates than the total capital stock. However, the growth rates of both the ICT and the R&D capital stock are much lower in Japan than in the United States.

Intangible assets can be broadly classified into innovative property based, for example, on past R&D expenditure, computerized assets such as software, and economic competencies such as investment in advertising and branding, organizational structure, and off-the-job training of workers. Since we have already examined R&D expenditures and software purchases, let us make an international comparison of economic competencies. Chart 8 compares ratio of investment in economic competencies to gross value added by sector for the same five countries as above. The chart indicates that investment in economic competencies in Japan is also extremely low compared to the other major economies.

Japan's accumulation of ICT and R&D capital has been very slow in recent years. However, we found that the share of ICT and R&D investment in total investment is not particularly low when compared with the United States. Moreover, the value added ratio of the sum of the ICT capital services and intermediate ICT services ratios is higher in the United States in the case of wholesale, but it is considerably higher in Japan than the United States in finance and retail. We also noted, however, that ICT service prices are substantially higher in Japan than the United States, so that the real input of ICP capital services in Japan might be smaller than that in the United States. To sum up, what is concerning for Japan's future growth is not that the technologies employed by firms are not ICT- or R&D-intensive, but that firms do not invest in general to begin with, that ICT services are expensive, and that SMEs have been left behind in terms of investment in ICT and R&D.

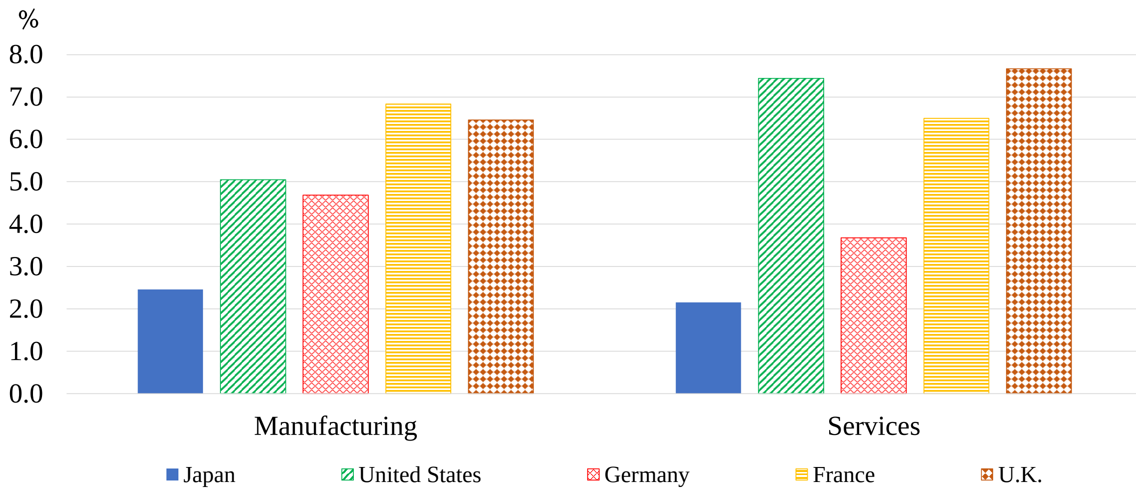
## In Which Industries did TFP Growth Fall?

As shown in Table 1 in the second section, TFP growth in Japan's manufacturing and non-manufacturing sectors decelerated in 2005–2015 from already low growth in the preceding 10-year period from 1995–2005. To examine this slowdown in TFP growth, this section, using detailed industry-level data from the JIP Database 2018, examines which industries in particular were responsible for this decline in TFP growth. It should be noted that while Japan experienced a sharp fall in TFP growth around 1990, we cannot examine the reasons for this here, since the JIP Database 2018 covers only the period from 1994 onward.[29]

Chart 9 shows Harberger diagrams (Harberger, 1998) for the manufacturing sector for the periods 1995–2005 and 2005–2015.

29 A detailed analysis of the slowdown in TFP growth around 1990 using long-term data from the JIP Database 2015 covering the period 1970–2012 can be found in Fukao (2018b) for the manufacturing sector and Fukao (2018c, d) for the non-manufacturing sector.

**Chart 8: Investment in Economic Competencies to Gross Value Added by Sector: International Comparison, 1995-2015**




*Source:* Authors' calculations based on data from the JIP Database 2015 and INTAN-Invest (http://www.intaninvest.net).
*Note:* Japan data are for 1995-2012 period. Both investment in economic competencies and gross value added are in nominal terms.

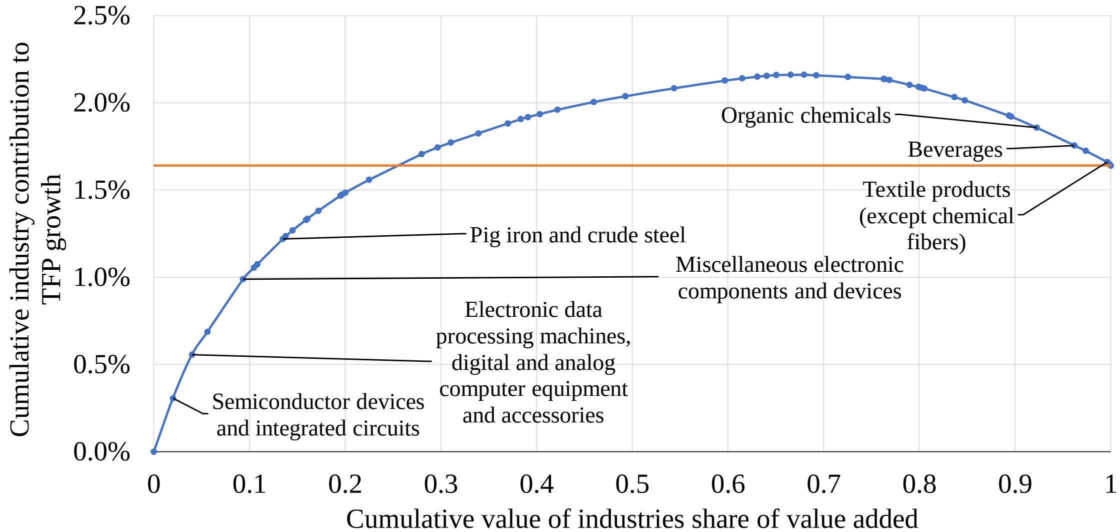
The vertical axes represent the cumulative industry contributions to aggregate TFP growth of the manufacturing sector (annual average, on a value added basis), while the horizontal axes depict the cumulative value of industries' share in the value added (average of each of the 10-year periods) of the manufacturing sector overall. The contribution of each industry was calculated by multiplying the TFP growth of that industry on a value-added basis by its share in the value added of the manufacturing sector overall. Industries are lined up by descending order of their TFP growth rate. Therefore, the slope of each line segment shows the TFP growth of that industry. We provide the names of industries that make a large positive or negative contribution to TFP growth in the manufacturing sector at the right end of the line segment.

Chart 9 indicates that the (annual average) TFP growth rate of the manufacturing sector overall declined from 1.6 per cent in 1995–2005 to 1.2 per cent in 2005–2015.[30] The value added weight of sectors with positive TFP growth was 67 per cent in 1995–2005 and 64 per cent in 2005–2015. The top three sectors in terms of their TFP growth contribution were (1) semiconductor devices and integrated circuits, (2) miscellaneous electronic components and devices, and (3) electronic data processing machines, digital and analog computer equipment and accessories in 1995–2005, and (1) pharmaceutical products, (2) semiconductor devices and integrated circuits, and (3) miscellaneous electronic components and devices in 2005–2015. In each period, these three sectors together contributed almost half of the TFP growth of the manufacturing sector overall. In other words, ICT hardware-producing industries were the main driver of TFP growth in the manufacturing sector.

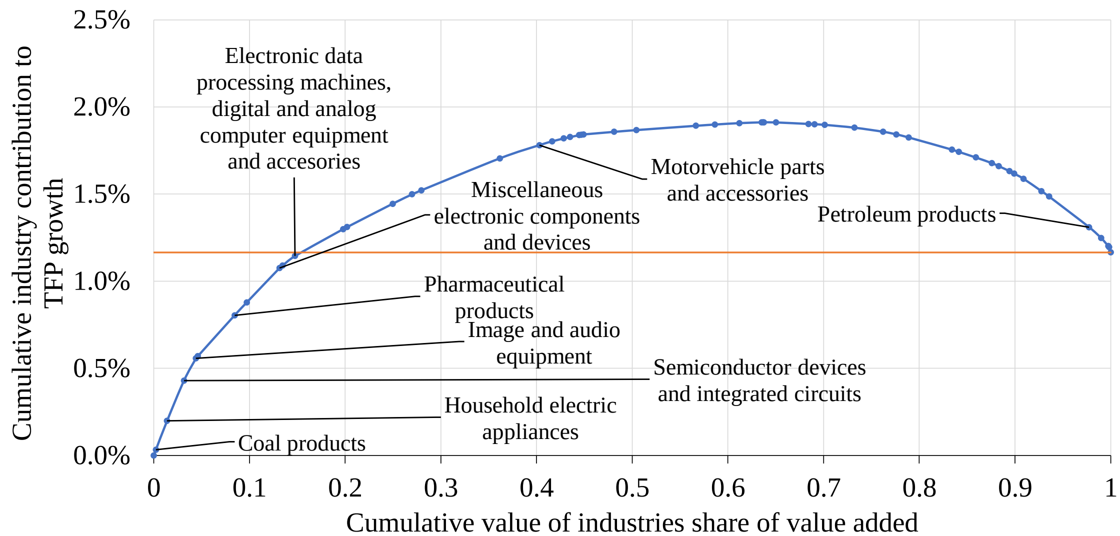
30 Because of aggregation error, these values are not identical to our growth accounting result in Table 1.

**Chart 9: Harberger Diagram: Manufacturing Sector in Japan, 1995-2005 and 2005-2015 (Annual Rate, Percentage Points)**

**Panel A: 1995-2005**




**Panel B: 2005-2015**



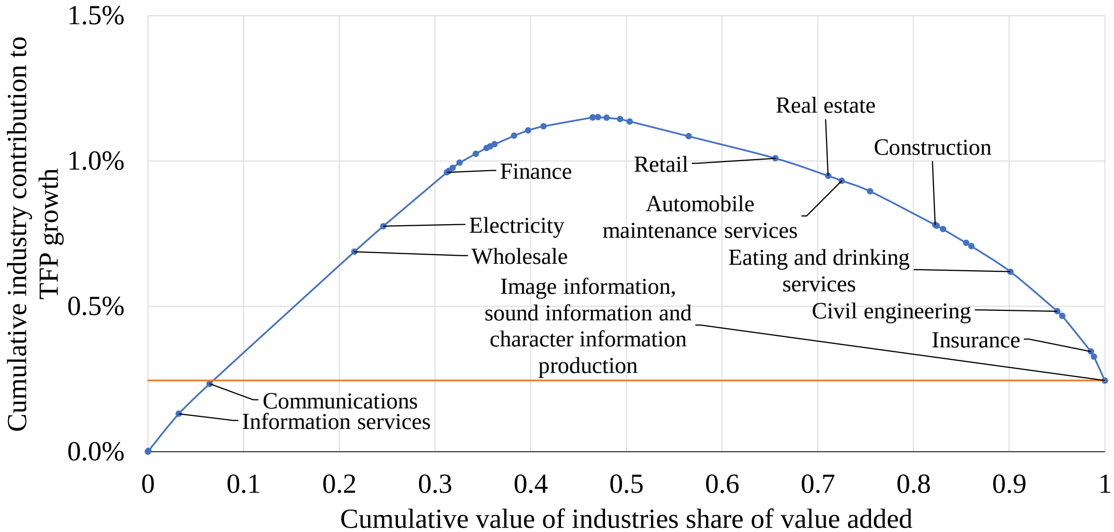

*Source:* Authors' calculations based on the JIP Database 2018.

The value added share of ICT hardware-producing industries (industry classification numbers 40–48 in the JIP Database 2018) in the manufacturing sector overall declined from 19 per cent in 1995 to 18 per cent in 2005 and 15 per cent in 2015. Moreover, their value added share in the economy overall declined from 5 per cent in 1995 to 4 per cent in 2005 and 3 per cent in 2015. This decline likely was one reason for the slowdown in Japan's overall TFP growth. However, compared with the United States during the period 2004–2013, the decline in Japan's ICT hardware-producing industries appears modest (Byrne, Fernald, and Reinsdorf, 2016).

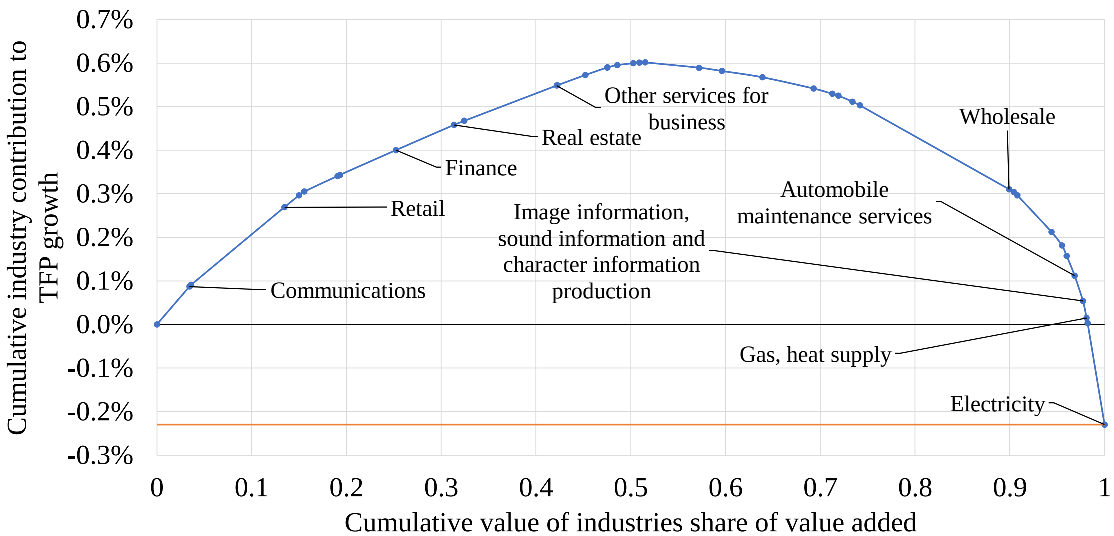
Chart 9 also shows that the industries that made a large negative contribution are mainly those in which Japan has lost

**Chart 10: Harberger Diagram: Non-Manufacturing Sector in Japan, 1995-2005 and 2005-2015 (Annual Rate, Percentage Points)**

**Panel A: 1995-2005**




**Panel B: 2005-2015**




its comparative advantage, such as textile products (except chemical fibers) and petroleum products.

Next, Chart 10 shows each industry's contribution to TFP growth in the non-manufacturing market economy as a whole for the periods 1995–2005 and 2005–2015.

As in the case of manufacturing, in both periods most of the TFP growth in the service sector was produced by a small number of industries. In 1995–2005, the combined contribution of the four industries with the largest contributions, wholesale trade, finance, information services, and communications, reached 0.9 percentage points per year. Similarly, during 2005–2015, the sum of the five industries with the largest contributions, retail trade, communications, other services for businesses, real estate, and finance, reached 0.46 percentage points per year.

Chart 10 indicates that TFP growth in

the non-manufacturing sector as a whole (market economy, services plus agriculture, forestry, fisheries, mining, construction, and utilities) fell from 0.2 per cent per annum in 1995–2005 to -0.2 per cent per annum in 2005–2015, and this decline can be attributed mainly to the slowdown in TFP growth in a small number of industries. The contribution of the wholesale, electricity, and information services industries fell by 0.6, 0.3, and 0.1 percentage points, respectively. On the other hand, the contributions of the retail trade, civil engineering, insurance, and real estate industries increased, but not enough to reverse the decline in TFP growth for the non-manufacturing market economy as a whole.

The sharp decline in TFP growth in the wholesale industry and the sharp increase in TFP growth in the retail industry likely reflect structural changes in the wholesale and retail sector such as the development of private brands by major retailers and the increase in online sales. Meanwhile, the sharp fall in TFP growth in the electricity industry likely reflects the fact that all nuclear power plants were shut down in the wake of the Tohoku earthquake in 2011.

## Conclusion

Using the Japan Industrial Productivity (JIP) Database 2018 and 2021 and the EU KLEMS database 2017, we examined the sources of growth of the Japanese economy from a supply-side perspective and conducted comparisons with major industrialized economies. The main results of our analysis are as follows.

- The slowdown in Japan's economic growth in the 2005–2015 period compared to the 1995–2005 period was much more pronounced than that in the other major industrialized countries, reflecting not only the decline in the working-age population but also sluggish growth in capital services input.
- Among the major industrialized countries, only Japan's capital stock growth rate was lower than the natural growth rate calculated based on standard neoclassical growth theory.
- Comparing the composition of factor inputs in Japan and the United States, we found that although inputs of ICT and R&D capital services and intermediate ICT services in Japan are not particularly low compared to the input of other capital, capital investment in general has been extremely weak. Moreover, investment in economic competencies (worker training and organizational structure), which are thought to be complementary to ICT and R&D capital, has been much smaller than in other countries.
- In addition to demographic factors and sluggish capital investment, another reason for the slowdown in Japan's economic growth in 2005–2015 compared to the preceding decade was the decline in TFP growth, which was caused by a drop in productivity growth in a small number of industries such as electricity and wholesale trade.

The gradual slowdown in capital accumulation in the 1990s and the 2000s can probably be explained as the transition to a low growth economy as well as by the acceleration in the decline of the working age population and the increase in unconventional monetary easing. However, we cannot explain why Japan's actual capital stock growth rate during 2005–2015 was below the natural growth rate. We also cannot explain why capital accumulation did not accelerate substantially under Abenomics, a period when the rental price of capital declined and the wage-rental ratio increased.

A particularly unexpected result of our analysis is that economic growth in the United States and the other major industrialized countries after the global financial crisis was driven not by TFP growth but by increased capital input. From the 1990s, when Japan's prolonged stagnation began, to the early 2000s, authorities tried to maintain economic growth by promoting private investment through monetary easing and public investment. It appears as though the United States economy after the global financial crisis resembles Japan's economy during the 1990s.

However, it is also possible that although it has not yet resulted in higher TFP growth, the emergence of new technologies is generating vigorous investment. Fierce competition among companies trying to lead the so-called Fourth Industrial Revolution that is currently underway is triggering investment in R&D and ICT. For example, the total global R&D investment of Apple, Amazon, Microsoft, Intel, and Google in 2016 was approximately 7.2 trillion yen. This is more than half of the 13.3 trillion yen R&D investment by all Japanese firms together (according to the 2017 Survey of Research and Development).

In order for Japan, which has already fallen behind in the ICT revolution, to avoid the mistake of falling behind in the Fourth Industrial Revolution as well, Japan needs to promote investment in human capital to support large-scale investment in new technologies such as electric vehicles, automated driving, robots, the internet of things, artificial intelligence, fintech, and big data. Moreover, in order for Japanese firms to redirect their enormous internal reserves to investment, the government needs to reduce policy uncertainty and proactively reform laws and institutions that inhibit new innovation. It is no exaggeration to say that the first requirement for Japan to ride the Fourth Industrial Revolution, which presents a major opportunity for the economy to escape from long-term stagnation, is to make new investments.

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