Secular Stagnation of Labor Productivity and Real Wages in Japan:
An Empirical Analysis Based on the JIP Database 2021

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1. Introduction

Real wages in Japan have barely risen over the past two decades. While the Kishida administration has made wage increases an important policy issue (Cabinet Office 2022), to achieve this, it is necessary to understand why Japan's real wages have stagnated in the first place. This paper examines this issue.

Simply put, real wages equal labor productivity multiplied by the labor share of income. Given this, we first use the JIP Database to provide an overview of how labor productivity and the labor share have evolved over the period 1970–2018, both in the economy overall and at the sectoral level. While in the United States and in many European countries, the labor income share declined substantially in the 2010s (Grossman and Oberfield 2021, Fukao and Perugini 2021), the labor income share in Japan did not decline substantially since the 1990s, as we will show below. The stagnation of real wages in Japan since the 2000s was due to sluggish developments in labor productivity. Note that, strictly speaking, developments in real wages are also influenced by a range of other factors such as changes in the terms of trade. We will examine this issue as well.

From a growth accounting perspective, labor productivity growth is driven by capital deepening, increases in the quality of labor, and increases in total factor productivity (TFP). According to the JIP Database 2021, Japan experienced a decline in labor quality in 2015–2018, perhaps for the first time in postwar history. In addition to this, as shown in Fukao, Kim, and Kwon (2021a), sluggish TFP growth in the 2000s and stagnation in capital services input in the 2010s were the main causes of the sluggish labor productivity growth. This paper will also consider the reasons for the stagnation in labor quality growth and capital deepening.

In what is known as the "dual structure hypothesis," there has been a large gap in labor productivity and wages between large and small firms in Japan from before World War II (see, for example, Nakamura and Odaka 2003). This means that if the productivity of SMEs could be brought closer to that of large firms, average wages could be increased. As shown in Fukao et al. (2014) and Fukao (2018), the labor productivity gap between large and small firms widened during the 1990s and 2000s, and this likely contributed to the stagnation of real wages during this period. In this paper, we examine recent developments in wage differences across firms of different size and examine the reasons for these differences in labor productivity using level accounting to consider how such differences in labor productivity and wages contributed to wage stagnation.

This paper is based primarily on the most recent version of the JIP Database (JIP Database 2021), which covers the period up to 2018. This means that, unfortunately, it is difficult to examine the impact of the COVID-19 pandemic and the global increase in resource prices increases due to Russia's invasion of Ukraine on wages from a productivity perspective.

The paper is organized as follows. In the next section, we use the JIP Database to look at developments in real wages, the labor share of income, and labor productivity from 1970 to 2018. We also use growth accounting to explore the causes of the recent stagnation in labor productivity. The section also considers the causes of the stagnation in labor quality improvements and capital deepening, which are responsible for the stagnation in labor productivity. Section 3 then examines developments in wage differences across firms of different size and uses level accounting to examine the causes of the observed differences in labor productivity. Finally, Section 4 summarizes the findings of this paper.

2. Causes of the long-term stagnation of real wages: Decomposition

Simplifying somewhat, the following equation holds:

Real wages (labor costs per hour worked)
= Labor share of income × Labor productivity (real GDP per hour worked) (1)

If real wages rise without an increase in labor productivity, the labor share of income (ratio of labor income to gross value added) will rise. This cannot continue for long, as it would lead to a decline in the capital share of income and a slowdown in capital accumulation. This is why in many countries, including the United States during the interwar period, any discussion on raising wages focuses on developments in labor productivity.

Table 1 shows the changes in each of the terms in equation (1) for the period 1970–2018 using the JIP Database. In the table, labor productivity growth is further decomposed into the contribution of increases in labor quality, the contribution of increase in capital services input, and the contribution of increases in TFP using growth accounting. In addition, as discussed below, the two sides of equation (1) are not strictly equal due to changes in the terms of trade and other factors. In Table 1, these factors are summarized and shown in the bottom row as “other factors.”

Table 1: Changes in real wages, labor productivity, and the labor income share in Japan

(changes in each period are calculated as the log difference, in %)

	1970–1980	1980–1990	1990–2000	2000–2010	2010–2018
Increase in real wages (hourly labor costs)	58.4	24.2	16.1	3.4	1.2
Labor productivity growth	51.3	45.4	20.8	12.1	5.2
Contribution of labor quality improvements	11.1	7.5	5.8	3.9	0.1
Contribution of increases in capital services input per hour worked	19.6	21.7	15.3	4.8	0.2
Contribution of TFP growth	20.5	16.2	−0.3	3.4	4.9
Changes in the labor share of income	18.8	−9.2	2.4	−1.6	0.3
Other factors (terms of trade, upward bias in the CPI, etc.)	−11.9	−5.9	−6.1	−6.3	−4.1

Source: Fukao and Makino (2022). Based on data from the JIP Database and the consumer price index released by the Ministry of Internal Affairs and Communications.

Note: Figures for 1970–1995 are from the JIP Database 2015 and on a 1993 SNA basis. Figures for 1995–2018 are from the JIP Database 2021 and on a 2008 SNA basis. Real wages are obtained by dividing hourly labor costs in Japan overall (wages paid directly to workers by firms plus employers' share of social insurance premiums, etc.)' by the consumer price index. The JIP Database also provides estimates of the portion of labor costs of the self-employed and unpaid family employees in the income (mixed income) of sole proprietorships and includes these in labor costs. See Fukao and Perugini (2021) for more details on this issue.

Table 1 shows the following. First, real wages in Japan grew hardly at all from the 2000s onward. The main reason for this was the slowdown in labor productivity growth. Until 1990, increases in capital services input due to active capital accumulation as well as TFP growth were the driving forces behind the growth in labor productivity and real wages in Japan. In the 1990s, on the other hand, TFP growth slowed considerably, but further increases in capital services input due to large-scale monetary easing, credit guarantees for small and medium-sized enterprises (SMEs), and other measures promoting investment supported labor productivity growth.

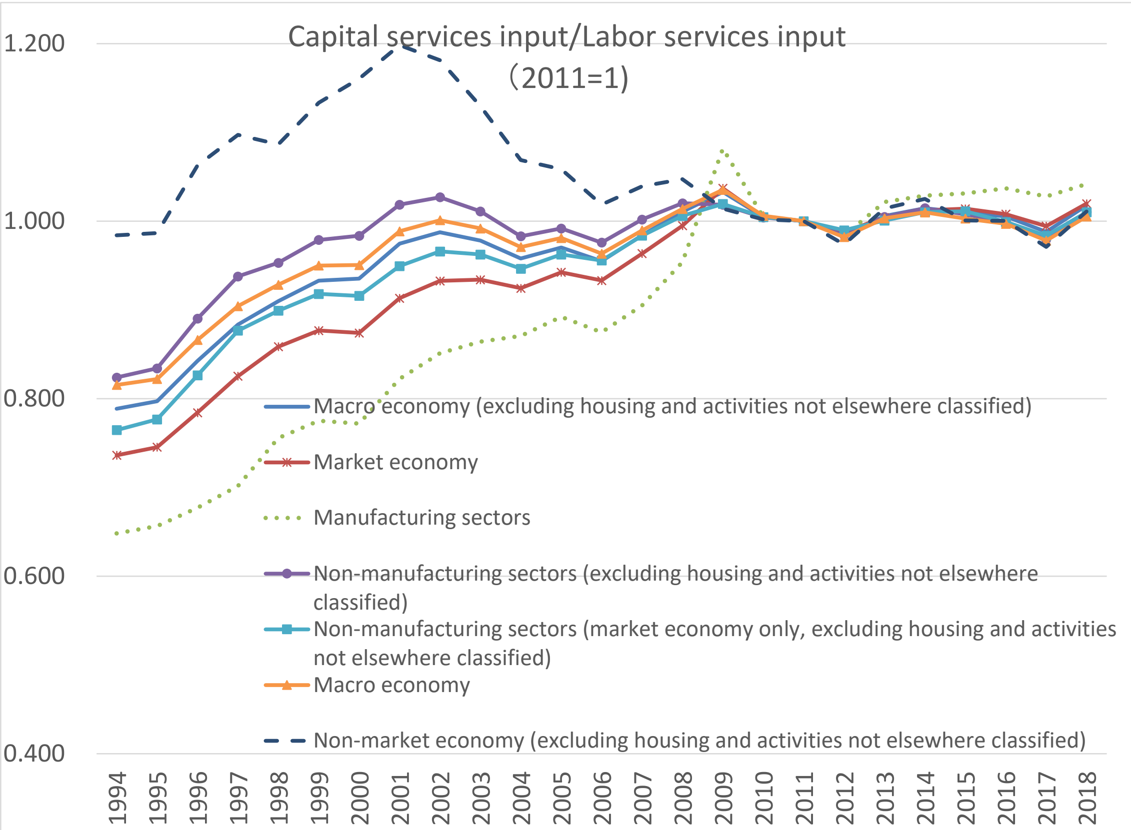
Even though TFP growth recovered somewhat in 2000–2010, labor productivity growth decelerated further due to a slowdown in capital accumulation. In the most recent period, 2010–2018, TFP growth accelerated slightly to 4.9% for the period, but labor productivity growth slowed further as the contribution of capital deepening and increases in labor quality fell to almost zero. As highlighted by Fukao, Kim, and Kwon (2021a), comparison of Japan, the United States, Germany, France, and the United Kingdom for 2005–2015 shows that Japan's TFP growth was second only to that of Germany. Nevertheless, Japan's labor productivity growth was the lowest among the five countries. The reason is that capital deepening essentially came to a standstill in Japan during this period, whereas in the

Western countries labor productivity rose through an increase in capital services input.

The most important fact that Table 1 shows is that the biggest cause of the stagnation of real wages in Japan since 2000 is the slowdown in labor productivity growth, and the biggest cause of the slowdown in labor productivity growth is the sharp decline in the contribution of capital services input growth since around 2000.

This raises the question what caused the stagnation of capital accumulation. Let us examine this point. Figure 1 presents developments in the capital-labor ratio (measured as the ratio of the input of capital services to the input of labor services taking changes in the quality of capital and labor into account, with the value in 2011 set to 1).

Figure 1. Developments in the capital-labor ratio: 1994–2018, 2011=1



Source: JIP Database 2021.

Note: In order to take changes in the quality of capital and labor into account, the ratio of capital services input to labor services input is used.

As Figure 1 shows, the capital-labor ratio in Japan increased rapidly until around 2002. The reason is that although economic growth decelerated markedly after 1991 in the wake of the collapse of the bubble economy, reflecting the decline in TFP growth (see Table 1) and demographic trends (the aging and eventual shrinking of the population), capital accumulation continued as a result of unconventional monetary easing, loan guarantees, increased public investment to stimulate the economy, etc. This situation is similar to the recent situation in the United States and European countries, where capital accumulation continued after the global financial crisis in 2008 -- despite the slowdown in TFP growth -- as a result of unconventional monetary easing policies and public investment.[1]

Since 2002, however, the capital-labor ratio for Japan overall as well as the capital-labor ratios at the sectoral level have essentially stagnated, with manufacturing being the notable exception. However, even in manufacturing, capital deepening more or less came to standstill in 2010, and the capital-labor ratio has increased hardly at all since then. As Figure 1 shows, the capital-labor ratio in the non-market economy (public administration, education, medical services, etc.) already began to decline in 2002. This likely reflects factors such as the rapid increase of the labor-intensive medical and nursing care sectors due to the aging of the population,[2] and the fact that it became difficult to sustain public capital accumulation due to growing government budget deficits caused by deficits in the medical and nursing care sectors and the increase in national debt service expenditures.

Let us consider the reasons for the changes in the capital-labor ratio seen in Figure 1. From a theoretical perspective, the most likely candidate is changes in the ratio of wages to the cost of capital.

Figure 2 shows how the capital-labor ratio is determined under a given ratio of labor costs to capital costs (referred to as the wage-capital cost ratio hereafter). The horizontal axis in the figure represents labor input, while the vertical axis represents capital input. The curve convex to the origin represents the equal product curve for the macroeconomy overall. Returns to scale are assumed to be constant, and equal product curves for different output levels are assumed to have a similar shape.

Further, let us assume free international capital flows, that the domestic labor supply is given, and that the cost of capital in the domestic economy and overseas economies can differ due to government intervention. The macroeconomic capital-labor ratio is then determined by the cost-minimizing behavior of firms.[3]

The figure shows that when the wage-capital cost ratio is w/r_0, the capital-labor ratio in the economy overall, as a result cost minimization by firms, is K/L_0. Suppose now that the wage-capital cost ratio rises to w/r_1 due to an increase in wages and a decrease in the cost of capital. In this case, the

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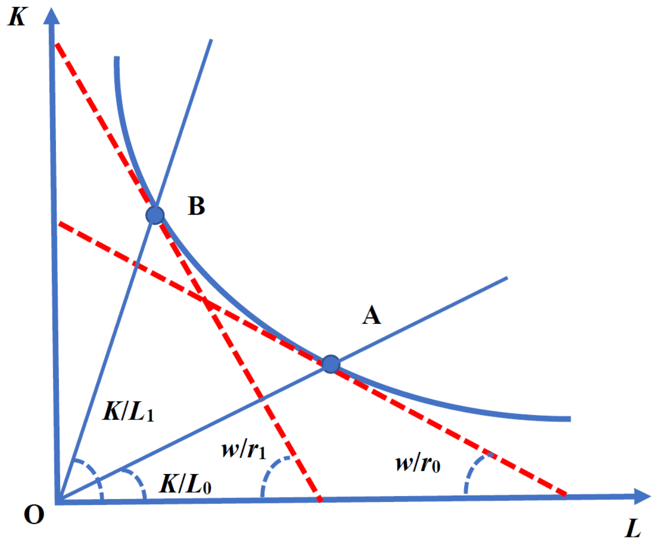
[1] For details, see the study by Fukao, Kim, and Kwon (2021a) mentioned earlier.

[2] Japan's long-term care insurance system was introduced in April 2000. In 2000–2018, among the 100 industries in the JIP Database 2021, total annual hours worked in "nursing care" increased by 2.8 billion hours, second only to the increase of 3.4 billion hours in "other services for businesses."

[3] If there is no international movement of labor, wages are set so that domestic labor supply matches demand. Meanwhile, if we assume that, even when there are free international capital flows, investment involves Uzawa-type adjustment costs (Uzawa 1969), the macroeconomic capital-labor ratio in balanced growth will depend on the balanced growth rate determined by the growth rate of the working population and the rate of technical progress as well as the time preference rate and the shape of the adjustment cost function (see Uzawa's equation (50)). A clear explanation of this issue, including the transition process between long-run equilibria, is provided by Blanchard and Fischer (1989, Chapter 2).

combination of labor and capital that minimizes costs moves from point A to point B, and the capital-labor ratio rises to K/L_1. In other words, there will be a substitution of capital for labor, which has become relatively more expensive.

Figure 2: Substitution between factors of production: The wage-capital cost ratio and the capital-labor ratio



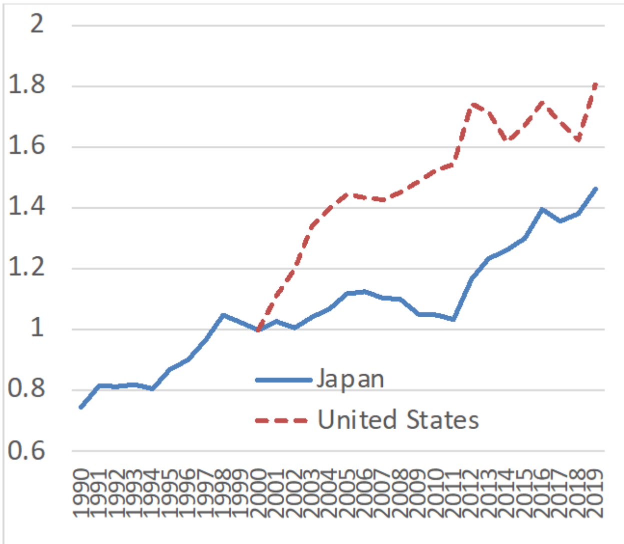
Let us examine whether such substitution between factors of production has occurred in Japan and the United States, using data on the wage-capital cost ratio and the capital-labor ratio. Figures 3 and 4 show the wage-capital cost ratio and developments in labor and capital costs (both in nominal terms) in Japan for the period 1990–2019 and for the United States for the period 2000–2019.

The wage-capital cost ratio in Japan increased significantly in the 1990s and after 2013. In the 1990s, the falling cost of capital due to monetary easing and relatively strong wage growth led to a rapid increase in the wage-capital cost ratio. From 2000 to 2012 (Figure 4(a) and 4(b)), the increase in the wage-capital cost ratio was moderate due to stagnant wages and a deceleration in the decline of the cost of capital, presumably due to the zero lower bound on nominal interest rates. From 2013 onward, the wage-capital cost ratio then rose rapidly again due to unconventional monetary easing as part of Abenomics as well as rising wages, especially in the non-manufacturing sector.

Turning to developments in the United States since 2000, the wage-capital cost ratio increased rapidly until the early 2010s, after which the increase slowed down. We find that steady wage increases are the main factor driving the wage-capital cost ratio until the global financial crisis in 2008 (Figure 4(a)). After the crisis, wage growth slowed down. From 2008 to the early 2000s, the wage-capital cost ratio continued to rise rapidly due to unconventional monetary easing (Figure 4(b)). The increase in the wage-capital cost ratio moderated after the early 2010s, reflecting the unwinding of monetary easing policies as the United States gradually recovered from the global financial crisis.

Next, let us look at developments in the capital-labor ratio, which are depicted in Figure 5. In the case of the United States, the ratio appears to be moving in line with the theoretical considerations above regarding the substitution between factors of production. That is, while the capital-labor ratio rose sharply in the 2000s, when the wage-capital cost ratio increased rapidly, when the rise in the wage-capital cost ratio moderated in the 2010s, the rise in the capital-labor ratio also moderated.

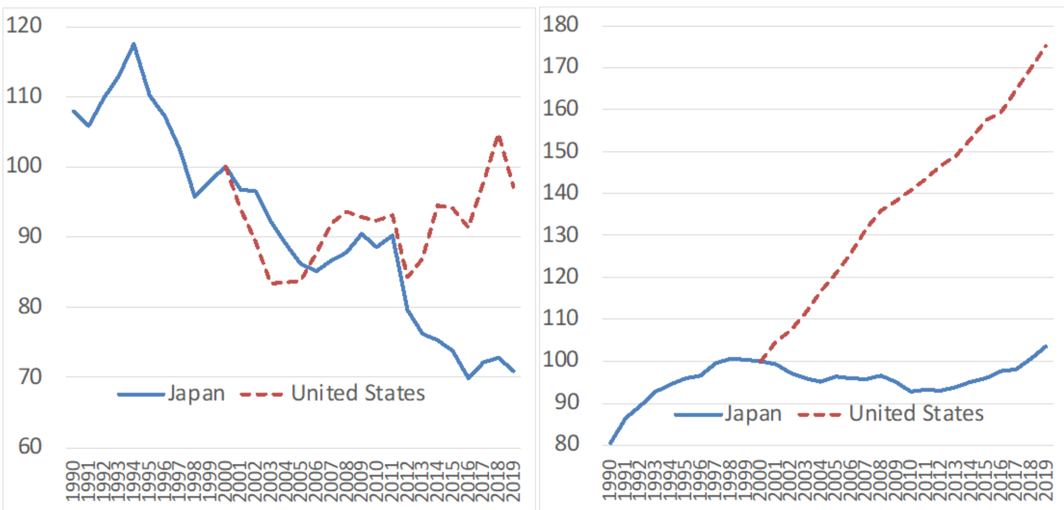
Figure 3. Wage-capital cost ratios:
Japan 1990–2019, United States 2000–2019, both indexed to 1 in 2000



Source: Sano (2022).

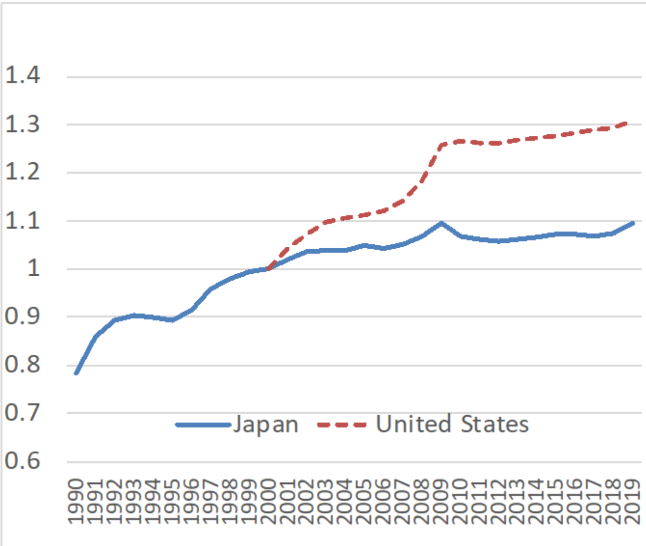
Figure 4: Capital and labor costs (both nominal) in Japan and the United States:
Japan 1990–2019, United States 2000–2019, both indexed to 1 in 2000

(a) Capital cost **(b) Labor cost**



Source: Sano (2022).

Figure 5. Capital-labor ratios for Japan and the United States: Japan 1990–2019, United States 2000–2019, both indexed to 1 in 2000



Source: Sano (2022).

Note: The capital-labor ratio is obtained by dividing the capital stock excluding housing by total hours worked.

In Japan's case, too, the capital-labor ratio rose in the 1990s, when the wage-capital cost ratio increased sharply, while the capital-labor ratio stagnated in the 2000s, when the wage-capital cost ratio remained more or less unchanged, so that developments up to the 2000s are consistent with the theoretical considerations above regarding the substitution between factors of production. However, during the Abenomics period from 2013 onward, the capital-labor ratio remained unchanged despite a substantial increase in the wage-capital cost ratio, which cannot be explained by the theoretical considerations above.

As Table 1 shows, from the 2000s onward, in addition to the slowdown in the contribution of increases in capital services input, the decline in labor quality improvements also contributed to the stagnation of labor productivity. The contribution of labor quality improvements declined from 5.8 percentage points in the 1990s to 3.9 percentage points in the 2000s and 0.1 percentage point in 2010–2018. Using the JIP Database 2021 to examine reasons for changes in the labor quality index for the macroeconomy as a whole, Table 2 shows that the largest cause of the slowdown in increases in the quality index was the change in employment patterns due to the increase in non-regular employment, while changes in the composition of the workforce in terms of sex (increase in the share of women) and age (retirement of baby boomers) also contributed to the slowdown. Meanwhile, as can be seen from Figure 6, the percentage of all employed persons working less than 35 hours per week has been rising consistently since the 1990s, reaching about 35% in recent years.[4]

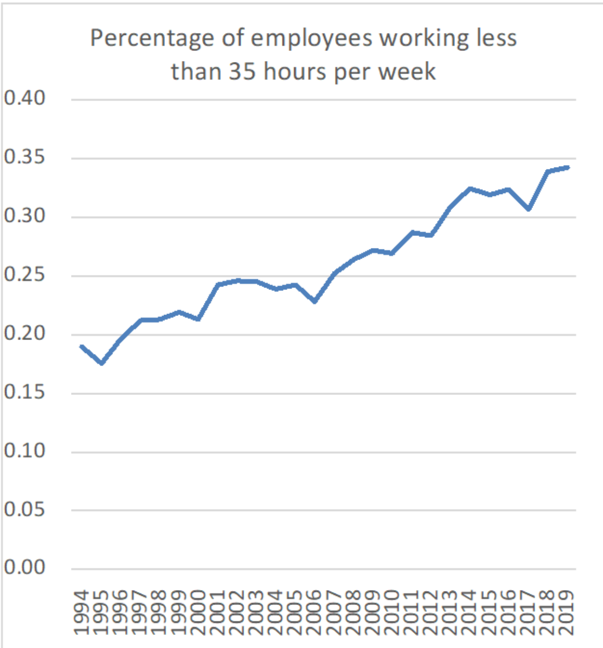
Table 2. Causes of changes in the labor quality index, by factor and period (annualized, period average, %)

	Industry	Type of employment	Sex	Educational attainment	Age
1995-2000	0.11	-0.05	-0.01	0.60	0.03
2000-2005	0.20	0.02	-0.05	0.72	0.11
2005-2010	0.23	0.23	-0.07	0.56	-0.02
2010-2015	0.08	-0.13	-0.04	0.37	-0.01
2015-2018	0.12	-0.20	-0.12	0.12	-0.15

Source: Authors' calculations using the JIP Database 2021.

Note: This table shows the marginal effect of changes in each factor. Due to approximation error, the sum of all factors does not equal the change in the quality index for the economy overall.

Figure 6: Percentage of all employees working less than 35 hours per week, 1994–2019



Source: Labor Force Survey.

Next, let us look at the factors other than labor productivity that contributed to the changes in real wages shown in Table 1, starting with the labor share of income. In the 1980s, the labor share of income declined, so that real wages rose slower than labor productivity. However, since the 1990s, the

[4] In the JIP Database, those working less than 35 hours per week are considered to be part-time employees.

labor share of income in Japan has generally been stable and there has been no sharp decline like that observed in Western countries.

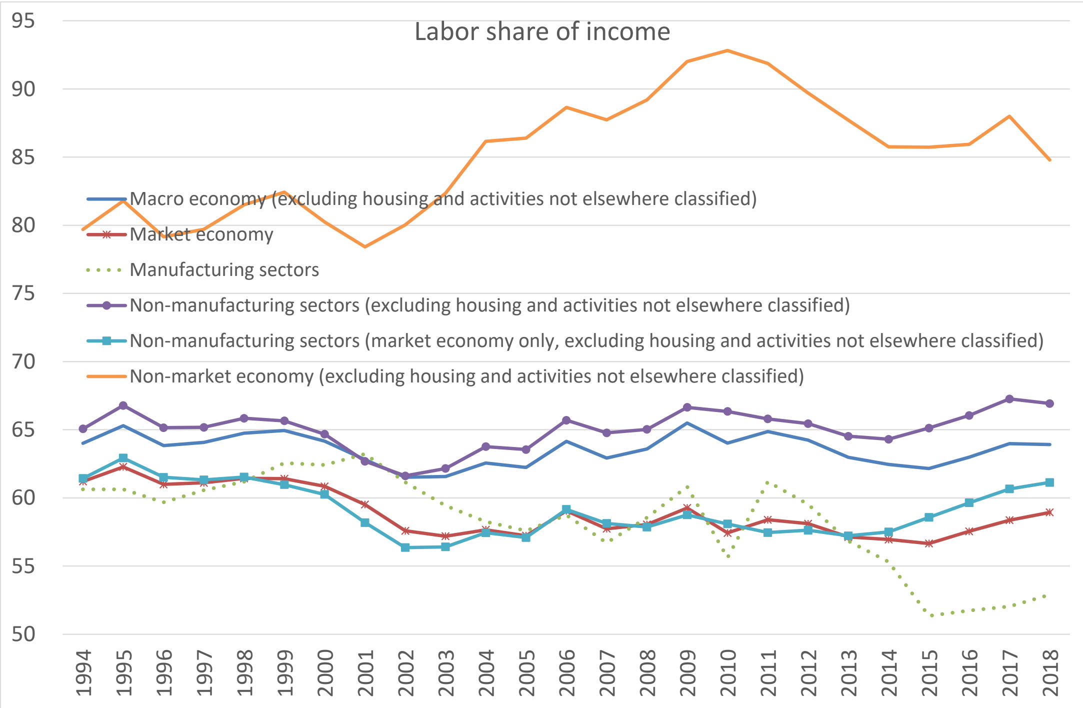
Looking at the labor income share by sector since 1994, from when such data are available in the JIP Database 2021 (on a 2008 SNA basis), Figure 7 shows that labor income shares have changed considerably over time. From the late 1990s to the mid-2000s, the labor share in both manufacturing and non-manufacturing industries fell by about 5 percentage points. The labor share in manufacturing and non-manufacturing industries (market economy only, excluding housing and activities not elsewhere classified) did not recover substantially thereafter and remained flat. However, by around 2010, the labor share of income for the macroeconomy as a whole had recovered almost to the level of the late 1990s. The reason for the recovery in the labor share for the macroeconomy as a whole in the 2000s was the large increase in the labor share in the non-market economy (public administration, education, medical services, etc.).[5] On the other hand, as shown in Figure 1, whereas the labor share in non-manufacturing industries (market economy only, excluding housing and activities not elsewhere classified) increased in the 2010s, that in manufacturing industries fell substantially.

Figure 8 shows development in average markup rates (sales divided by total costs minus 1). The average markup rate in the manufacturing sector increased rapidly after 2012. This suggests that the substantial decline in the labor share in manufacturing industries in the 2010s can be attributed to the rapid increase in firms' average markup rate due to the depreciation of the yen under Abenomics and the relatively weak increase in wages (Fukao 2021).

Figure 9 shows developments in real wages (nominal labor costs per hour worked divided by the consumer price index, indexed to 1 in 2011) by broad sector. In manufacturing industries, real wages declined somewhat in the 2010s, while in the non-market economy they fell substantially. This is due to the increase in non-regular employment in nursing care and general government, as well as the absence of wage increases in the public sector.

[5] In the national accounts, the labor share in the non-market economy exceeds 80% because many non-market sectors of the economy do not generate excess profits and value added is regarded to consist of the sum of labor costs and capital depreciation.

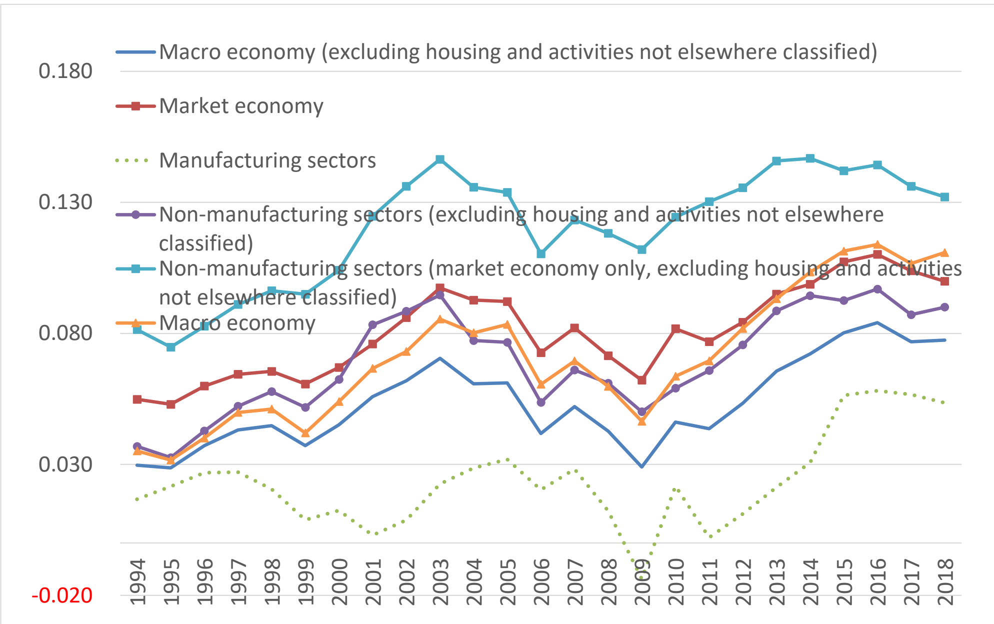
Figure 7: Labor share of income: 1994-2018 (%)



Source: JIP Database 2021.

Note: As in Table 1, the portion of labor costs of the self-employed and unpaid family employees in the income (mixed income) of sole proprietorships is estimated and included in labor costs.

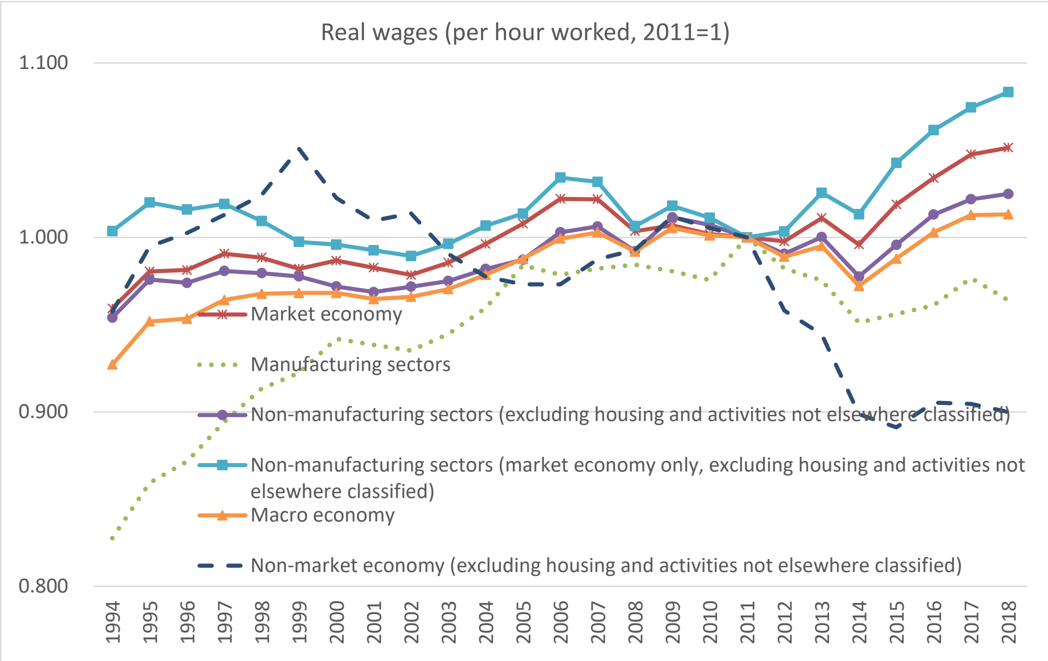
Figure 8. Average Markup Rate (Sales Divided by Total Costs Minus 1): 1994-2018



Source: JIP Database 2021.

Notes: Average markup rate shows gross output minus gross production costs (intermediate inputs + labor costs + ex-ante capital costs) divided by gross production costs.

Figure 9. Real wages: 1994–2018, 2011=1



Source: JIP Database 2021.

Notes: Real wages are labor costs per hour worked divided by the consumer price index. Therefore, the effect of changes in labor quality is included.

Finally, let us look at the other factors in the bottom row of Table 1. As noted earlier, the relationship shown in equation (1) is an approximation. In reality, real wages on the left side of equation (1) are equal to the labor share of income multiplied by nominal GDP at factor costs per hour worked, divided by the consumer price index (CPI). Moreover, labor productivity on the right side of equation (1) is equal to nominal GDP at market prices per hour worked divided by the GDP deflator. Therefore, strictly speaking, the following equation holds:

Real wages = Labor share of income × Labor productivity

× (GDP deflator/CPI)

× (Nominal GDP at factor costs / Nominal GDP at market prices)

This can be further rewritten as follows:

Real wages = Labor share of income × Labor productivity

$\times$ (GDP deflator/Household final consumption expenditure deflator)

$\times$ (Household final consumption expenditure deflator/CPI)

$\times$ (Nominal GDP at factor costs/Nominal GDP at market prices) (2)

Equation (2) indicates that, in addition to developments in the labor share of income and labor productivity, three other factors need to be taken into account as determinants of real wages: (1) the GDP deflator divided by the household final consumption expenditure deflator, (2) the household final consumption expenditure deflator divided by the CPI, and (3) nominal GDP at factor costs divided by nominal GDP at market costs. The "other factors" shown in Table 1 are the sum of these three factors. Table 3 shows how the three factors contributed to changes in real wages.

The GDP deflator/Household final consumption expenditure deflator term changes over time because of differences in the composition of goods and services produced by Japan and the composition of goods and services consumed by households. Japan imports raw materials and fuels for processing and produces and export goods such as machinery for which TFP growth is high and the prices of which tend to gradually decline as a result. For this reason, Japan's terms of trade tend to gradually deteriorate. Moreover, the prices of domestically produced investment goods also tend to decline more than those of consumption goods. As a result, the GDP deflator/Household final consumption expenditure deflator ratio tends to gradually decline.

The Household final consumption expenditure deflator/CPI term changes over time due to the dissociation between the household final consumption deflator and the CPI in the SNA. Whereas the SNA deflator is a Paasche chain-linking index, the CPI is a Laspeyres index and tends to be biased upwards. The CPI also does not cover single-person households well. Since single-person households tend to be younger and purchase more information and communication technology (ICT) related products, such as telecommunication services and digital devices, prices of which decline over time, this difference also creates an upward bias in the CPI. There is also a dissociation between the two statistics in the treatment of households' expenditure for public services, such as education and medical/nursing services. For details on these issues, see Chun et al. (2021).

Finally, the nominal GDP at factor costs/Nominal GDP at market prices term changes over time due to factors such as consumption tax hikes.

Looking at the role of the three factors, Table 3 shows that while the decline in the Household final consumption expenditure deflator/CPI term due to differences in the statistical concepts and construction methods had the largest negative impact on real wages in the 1970s and 1990s,[6] the decline in the GDP deflator/Household final consumption expenditure deflator term due to

[6] As equation (2) shows, the decline in the Household final consumption expenditure deflator/CPI term reduces real wages, which are defined as nominal wages/CPI.

deteriorating terms of trade and other factors[7] also had a large negative impact. According to the latest national accounts, the increase in resource prices due to the Ukraine conflict and the depreciation of the yen have led to a serious deterioration in the terms of trade.

Table 3. Decomposition of other factors influencing real wages

(changes in each period are calculated as the log difference, in %)

	1970-1980	1980-1990	1990-2000	2000-2010	2010-2018
Changes in GDP deflator/Household final consumption expenditure deflator	-11.3	-1.1	-3.9	-0.7	-0.3
Changes in Household final consumption expenditure deflator/CPI	-2.0	-3.4	-2.0	-6.0	-2.6
Changes in GDP at factor costs/GDP at market prices (impact of changes in indirect taxes minus subsidies)	0.7	-1.6	-0.5	0.3	-1.3
Total: Other factors (terms of trade, upward bias in the CPI, etc.)	-11.9	-5.9	-6.1	-6.3	-4.1

Source: Authors' calculation based on the JIP Database, National Accounts of Japan, and consumer price statistics.

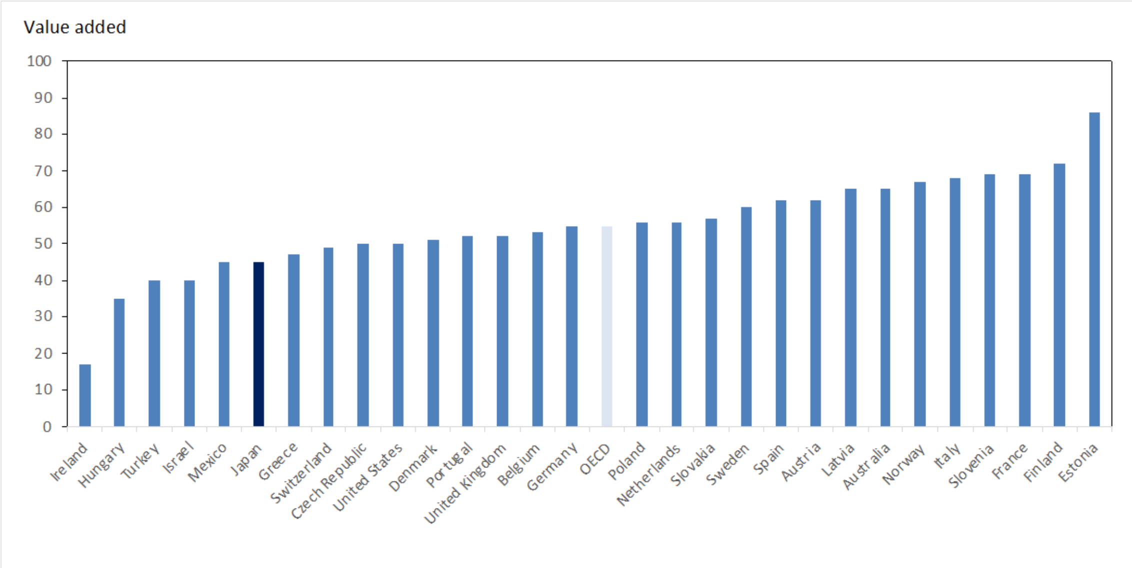
As seen in Table 1, the relative importance of "other factors" has increased in recent years as labor productivity growth has decelerated. These findings suggest that when considering measures related to real wages, it is also essential to re-examine the construction of CPI statistics and analyze the determinants of the terms of trade.

3. Recent developments in the productivity and wage differences between large and small firms

Japan's market economy has been characterized by large differences in labor productivity and wages between large firms and SMEs since the interwar period (the so-called "dual economy," see Nakamura 1983, Nakamura and Odaka 2003 for details). Moreover, as shown by Oi and Idson (1999), the differences in wages between small and large firms are greater in Japan than in the United States. In fact, as indicated in Figure 10, labor productivity differences between small and large firms in Japan are also larger than in most other OECD countries. The substantial differences in Japan mean that if SMEs were able to close the productivity and wage gap vis-à-vis large firms, overall wages in Japan would rise substantially. In this section, we analyze this issue.

[7] GDP includes not only household final consumption but also capital formation as an important component, and the capital formation deflator relative to the household final consumption deflator tends to decline over time.

Figure 10. Labor productivity differences: Firms with 20-49 workers/Firms with more than 250 Workers: 2013



Note: Value added per person employed in 2013 at firms with 20-49 workers relative to that at firms with more than 250 workers (in %).

Source: OECD, *Entrepreneurship at a Glance 2016*.

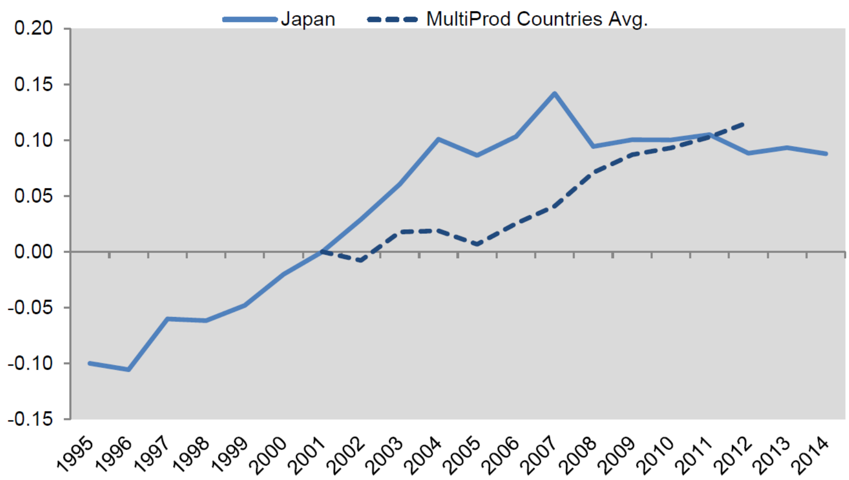
Let us start by considering developments in the productivity and wage differences between SMEs and large firms. Fukao et al. (2014) found that these differences actually widened in the 1990s and early 2000s, especially in the manufacturing sector. In the manufacturing sector, the TFP growth of large firms accelerated during this period. In contrast the productivity growth of SMEs decelerated (Fukao and Kwon 2006). One possible explanation of this phenomenon is that SMEs have been left behind in the ICT revolution and internationalization (Fukao et al. 2016; Ito, Deseatnicov, and Fukao 2016).

Another potential explanation of the slowdown of SMEs' TFP growth is the decline in technology spillovers from large firms (Belderbos et al. 2013). In the manufacturing sector, large assemblers, which produce final goods, have been conducting intensive research and development (R&D) for the development of new products. Meanwhile, SMEs have tended to supply parts and components to these assemblers. Supplier relationships between large assemblers and SMEs are usually stable and tight, and it is likely that SMEs benefited from spillovers from large assemblers. Moreover, probably because of this, the R&D intensity of SMEs is much lower than that of larger firms in Japan. In fact, this gap is much larger in Japan than in other OECD countries (Fukao 2018). However, since the 1990s, Japan's leading export industries, such as the electronics and automotive industries, have increasingly relocated production abroad. Further, likely partly linked to this as well as other factors such as restructuring at large assemblers, buyer-supplier relationships in these industries in Japan have become more open (Paprzycki 2004, Ikeuchi et al. 2015).

Despite the importance of this widening productivity gap between large firms and smaller firms, analysis of the "dual economy" in the non-manufacturing sector has been limited. Another shortcoming of preceding studies is that differences in labor input, such as workers' education level, sex, age, and employment status, between firms of different sizes have not been well studied. Against this background, Fukao et al. (2014) and Fukao (2018) examined these issues by splitting JIP Database data for the market economy by firm size and by industry. However, these two papers cover only the period from 1975 to 2010 and do not provide information for the years after 2010.

In the case of wage and productivity differences across firms, the OECD's MultiProd Project has recently conducted an international comparison of wage and productivity gaps in eighteen countries, most of which are developed economies (Berlingieri et al. 2017). Following up on this study, a group of scholars that provided data on Japan to the MultiProd Project, compared wage and productivity differences with the averages for other MultiProd countries in Ikeuichi et al. (2019). In the study, differences are measured within each industry (at the 2-digit industry level) and averaged across industries. Figures 11, 12, and 13 summarize this comparison. We should note that these three figures do not show productivity and wage gaps differences by firm size but between the 90th and the 10th percentile of firms. For example, Figure 12 shows differences in labor productivity between the most productive and the least productive firms.

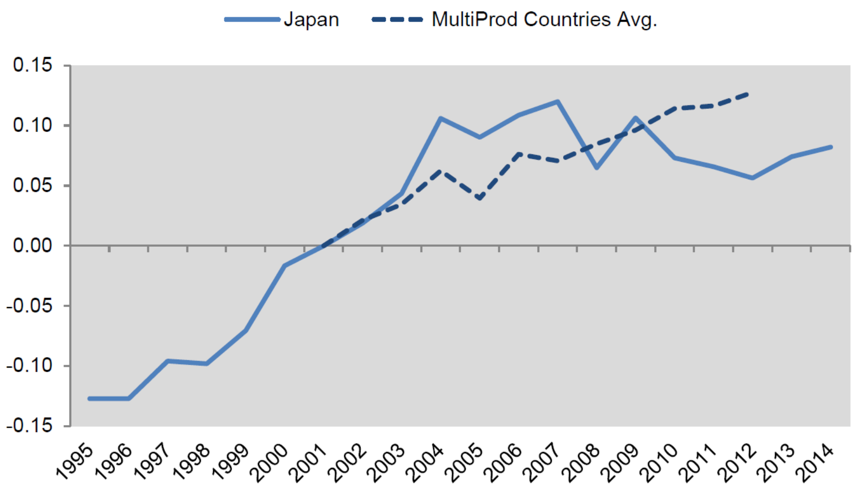
Figure 11: Wage differences across firms: Average across industries, difference between the 90th percentile and the 10th percentile (logarithmic values), 2001=1



Source: Ikeuchi et al. (2019).

Note: The figures for Japan are based on the Basic Survey of Japanese Business Structure and Activities. The survey covers enterprises with 50 or more employees and whose paid-up capital or investment is over 30 million yen. The survey does not cover some industries, such as construction. In the case of other countries in the MultiProd Project, data sources are either business register or tax data, which tend to have broader coverage than the data on Japan.

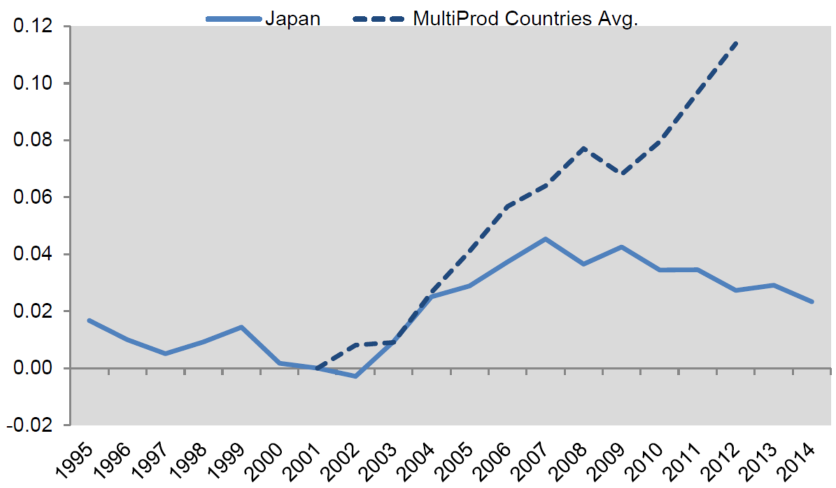
Figure 12: Labor productivity differences across firms: Averages across industries, difference between the 90th percentile and the 10th percentile (logarithmic values), 2001=1



Source: Ikeuchi et al. (2019).

Note: For data sources, see the note for Figure 10.

Figure 13. TFP differences across firms: Averages across industries, difference between the 90th percentile and the 10th percentile (logarithmic values), 2001=1



Source: Ikeuchi et al. (2019).

Note: For data sources, see the note for Figure 10.

Developments in the differences in Japan clearly differ from those of the averages for the other MultiProd countries. In the case of Japan, both the wage gap and the labor productivity gap increased rapidly from the mid-1990s to the mid-2000s. In the case of TFP, the gap substantially increased from 2002 to 2008. All three gaps did not widen from the late 2000s to the mid-2010s. On the other hand, for the MultiProd countries, the three gaps increase throughout most of the period covered by the data, from 2001 to 2012.[8] According to Ikeuchi et al. (2019), these findings remain unchanged when the data are split into the manufacturing and the non-manufacturing sector.

As mentioned, these three figures do not show productivity and wage differences by firm size. However, since SMEs tend to have lower wages and productivity levels than larger firms, the above results seem to suggest that the gaps between smaller and larger firms have been shrinking. To examine whether this is indeed the case, we update the analysis conducted in Fukao et al. (2014) and Fukao (2018) using data for the 2010s.

We use the following data. For control totals, we use the JIP Database 2021. Doing so means that we assume that prices of outputs and intermediate inputs do not differ across different firm-size groups. To split the data by firm size, we employ the *Corporate Enterprise Annual Statistics*, Ministry of Finance. These statistics provide data on value added, capital stock (tangible assets), number of workers, and total labor costs by firm size within each industry (the financial industry is not covered). From 2005, the statistics also provide data on the stock of computer software. Statistics by firm-size are available only in terms of paid-in capital. Using the microdata underlying the *Establishment and Enterprise Census* for 1996, 1999, 2001, 2004, and 2006 and the *Economic Census for Business Activity* for 2009, 2014, and 2016, we created a matrix of the distribution of workers for each industry by the amount of paid-in capital and number of workers. Using these matrices, we converted statistics by amount of paid-in capital into statistics by number of workers. Data on labor input and wages by firm size and industry are obtained from the *Basic Survey on Wage Structure*, Ministry of Health, Labour and Welfare. *The Basic Survey* provides information on wages by age, sex, education, and employment status and working hours by firm size within each industry. One caveat regarding these statistics is that they do not cover firms with fewer than 10 employees.

For each year and each industry, we conduct level accounting and decompose labor productivity differences between firm-size group s and s' using the following equation:

[8] Andrews, Criscuolo, and Gal (2015) also report that TFP differences between frontier firms, which tend to be large and internationalized, and non-frontier firms have widening in many OECD countries since the 2000s. However, since their data do not cover the 1990s, we cannot judge whether such widening in TFP differences started in the 1990s like in Japan or not.

$$\ln\left(\frac{V_s}{H_s}\right)-\ln\left(\frac{V_{s'}}{H_{s'}}\right)=\ln(q_s)-\ln(q_{s'})+\frac{1}{2}(v_s+v_{s'})\left(\ln\left(\frac{K_s}{q_sH_s}\right)-\ln\left(\frac{K_{s'}}{q_{s'}H_{s'}}\right)\right)$$
$$+\ln(RTFP_{s,s'})$$

where

V_s: Nominal value added of firm-size group s,

H_s: Total hours worked in firm-size group s,

q_s: Labor quality in firm-size group s,

v_s: Cost share of capital in firm-size group s,

K_s: Capital services input of firm-size group s,

$RTFP_{s,s'}$: Relative TFP level of firm-size group s in comparison with that of firm-size group s'.

For the calculation of Jorgenson-Griliches-type labor quality indices, q_s, we use the industry average wage premium of each category of workers. Therefore, the study assumes that there are no differences in labor quality among the same type of worker across different firm-size groups – for instance, male university-educated full-time workers aged 30–34 years in large automobile firms and their counterparts in small automobile firms.

The results of our analyses for the total market economy are summarized in Figure 14. For each variable, we used the three-year centered moving average. For example, the value for 2018 is the average of the values for 2017, 2018, and 2019.

Figure 14 shows that there are huge wage and labor productivity differences between large and small firms. In 2018, wages at large firms (firms with more than 999 employees) were 67% higher than those at small firms (firms with up to 99 employees), while labor productivity was 131% higher (Figure 14(a)).[9] In the same year, wages at medium sized firms (firms with 100 to 999 employees) were 17% higher than those at small firms (firms with up to 99 employees), while labor productivity was 27% higher (Figure 14(b)). Figure 14 also provides a decomposition of the difference in labor productivity into the contribution of the various factors. The results indicate that the labor productivity differences are mainly caused by differences in the capital-labor ratio (capital services input over labor services input). However, TFP differences also play an important role. The contribution of labor quality differences is very small. From 2005, we have additional data on the stock of computer software and can take this factor into account in our level accounting. Since larger firm input more software per working hour, differences in the capital-labor ratio for software contribute to differences in labor productivity. Moreover, since TFP is calculated as the residual, the contribution of TFP differences to labor productivity differences shrinks as a result of taking software input into account.

[9] The value of 67%, for example, is derived from (exp(0.51)−1)×100)=67.

Figure 14(a): Wage and productivity differences (logarithmic values): Firms with more than 999 employees/Firms with up to 99 employees, Total market economy

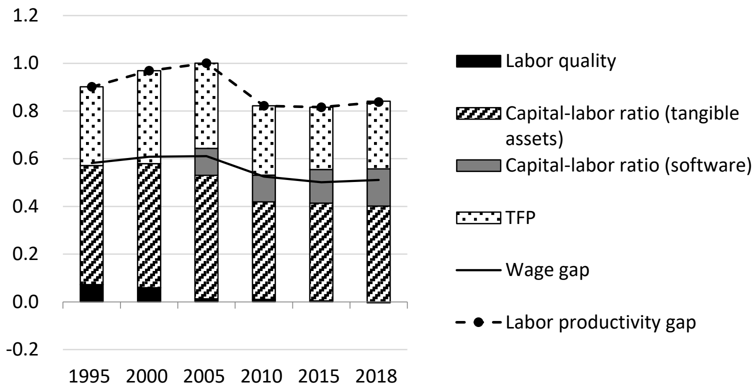
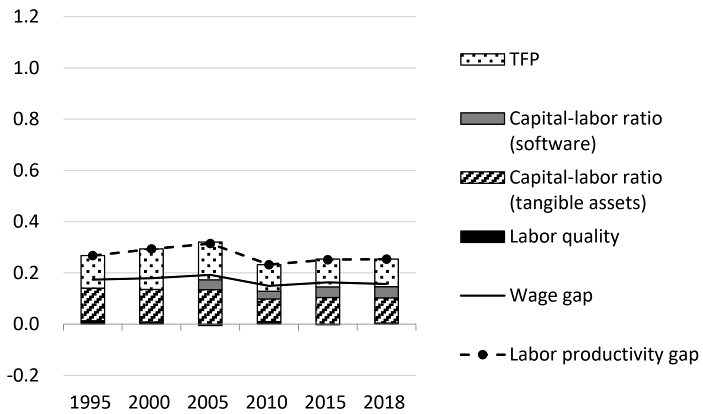


Figure 14(b): Wage and productivity differences (logarithmic values): Firms with 100 to 999 employees/ Firms with up to 99 employees, Total market economy



Source: Authors' calculation.

Note: Our analysis does not cover firms in agriculture, fishery, forestry, finance, insurance, and leasing.

Turning to developments over time, the results show that labor productivity and wage differences both between large and small firms (Figure 14(a)) and medium and small firms (Figure 14(b)) increased from 1995 to 2005, sharply declined from 2005 to 2010, and then remained more or less unchanged through 2018. In the case of large and small firms, the labor productivity gap declined by 16 percentage points and the wage gap by 8 percentage point from 2005 to 2010. Partly, the sharp decline in the gaps can be explained by the 2008 global financial crisis: Japanese exporters, most of which are large assemblers of machinery, experienced a large decrease in exports (Fukao and Yuan 2009), and since most of jobs at large firms are secure, the labor productivity of large manufacturing firms dropped substantially. However, the gaps did not increase again after 2010. Moreover, as we will show later, the decline in the gaps occurred not only in the manufacturing sector but also in non-tradable sectors. Therefore, the decline in the productivity and gaps after 2005 seems to reflect some structural changes, not just an external temporary shock.

Figure 14 also shows that the labor productivity gap declined from 2005 to 2010 mainly because of the decline in the difference in the contribution of the capital-labor ratio for tangible assets. In the case of large and small firms, the difference declined by 10 percentage points. The TFP gap also declined, by 7 percentage points. On the other hand, the difference in the contribution of the capital-labor ratio for software did no decline after 2010. This contribution is calculated by multiplying the capital-labor ratio for software by the cost share of software input. From 2005 to 2018, the difference in the capital labor-ratio for software between large and small firms actually declined substantially. However, since the cost share of software input increased substantially, the difference in the contribution of the capital-labor ratio for software did not decline.

The difference in nominal wages between larger and smaller firms is equal to the difference in nominal labor productivity plus the difference in the labor income share. Therefore, the vertical distance between the line representing the labor productivity gap and the line representing the wage gap in Figure 13 shows the difference in the labor share of income. The labor income share at larger firms tends to be lower than that at smaller firms. Because of this difference, the line for the labor productivity gap is located above the line for the wage gap. Since the difference in the labor income share between larger and smaller firms was stable over time, the vertical distance between the two lines did not change much.

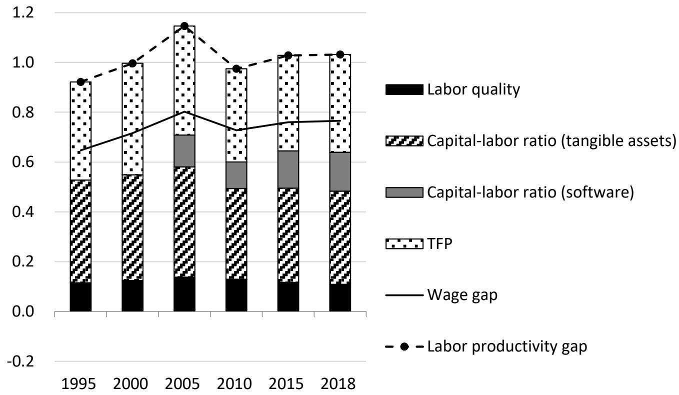
Next, let us turn to our results for each industry. As shown in Figure 14(b), the wage and productivity differences between medium-sized firms (with 100-999 employees) and small firms (with fewer than 100 employees) are not very large. Therefore, the figures below show the results for the wage and productivity differences between large and small firms only.

Figure 15(a) shows the results for the manufacturing sector. Developments in both labor productivity and wage differences over time mirror those in Figure 14(a) for firms overall: differences increased substantially from 1995 to 2005, dropped considerably between 2005 and 2010, and then remained more or less unchanged.

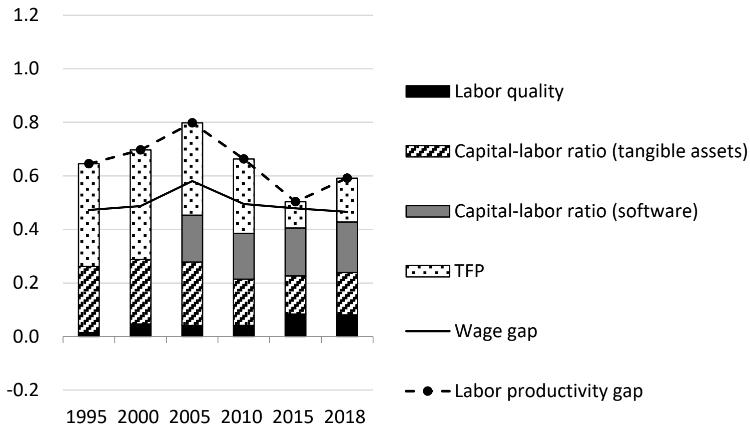
The main driver of these developments are differences in TFP. Since for 1995–2000 differences in the contribution of the capital-labor ratio for software are included in the TFP gap, it useful to look at the sum of differences in TFP and the capital-labor ratio for software for 2005 to 2018 when considering developments over the entire period. Doing so shows that the contribution of TFP differences (including the contribution of software) increased substantially from 1995 to 2005, fell between 2005 and 2010, and then increased slightly from 2010 to 2015.

Figure 15: Wage and productivity differences (logarithmic values): Firms with more than 999 employees/Firms with up to 99 employees

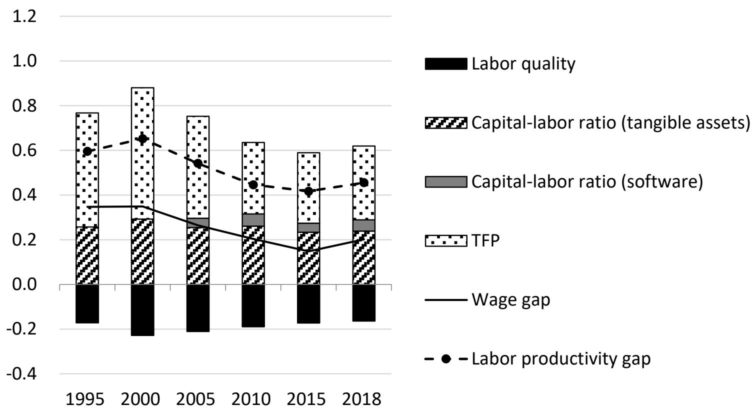
(a) Manufacturing



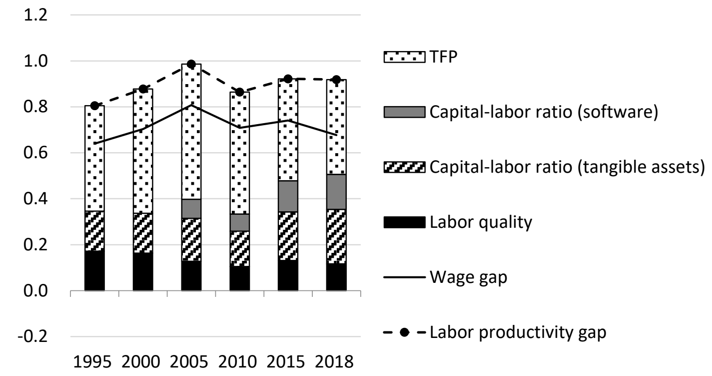
(b) Wholesale



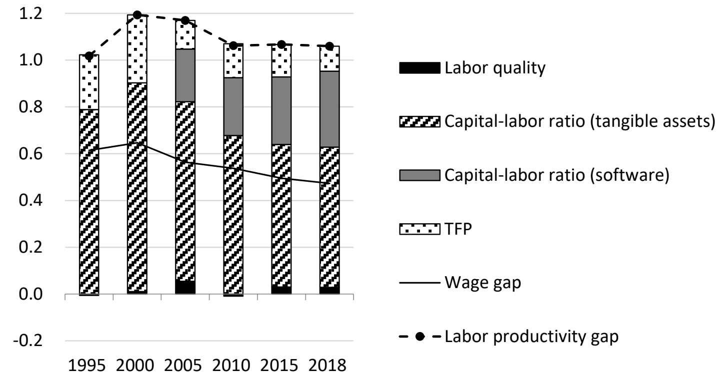
(c) Retail and eating and drinking places



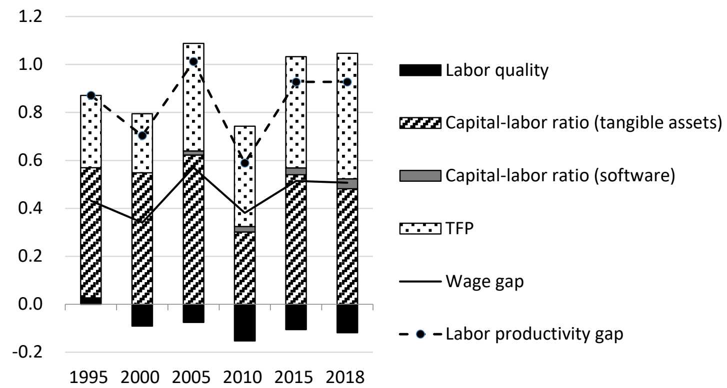
(d) Construction



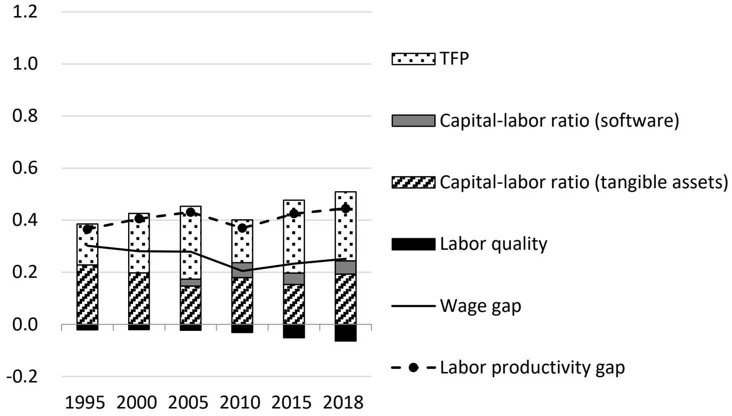
(e) Transportation and communication



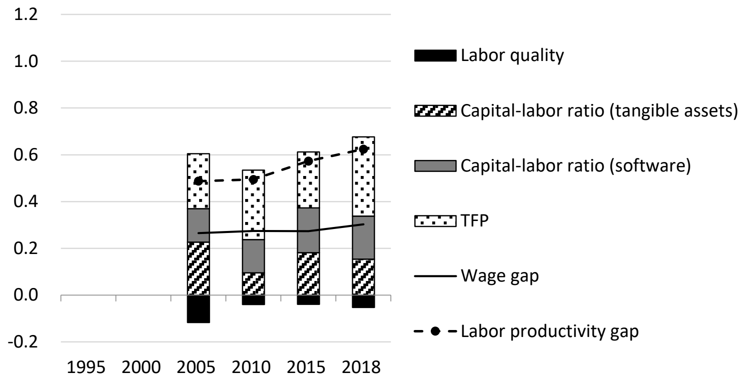
(f) Real estate



(g) Personal services



(h) Other services



Source: Authors' calculation.

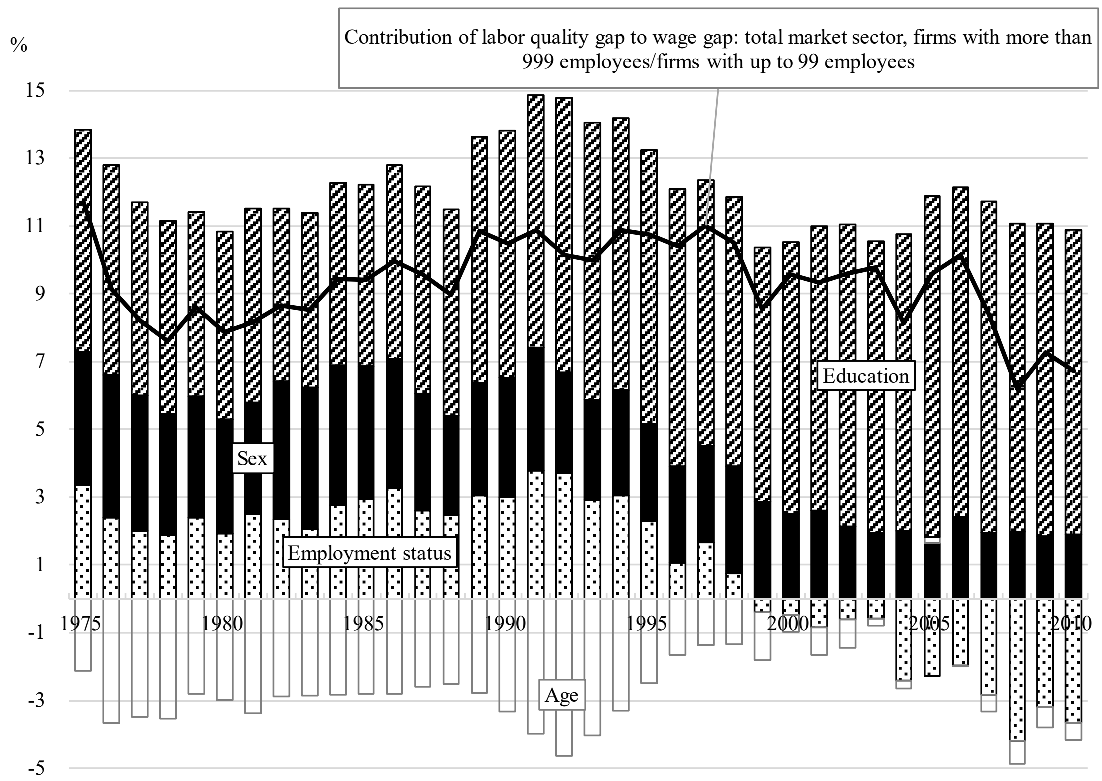
Note: The industry classification of the *Corporate Enterprise Annual Statistics* changed substantially from 2000 to 2005. Because of this change, we were not able analyze other services before 2005.

In wholesale, retail and eating and drinking places, construction, and transportation and communication, both labor productivity and wage differences peaked in 2000 or 2005 and have declined since then. On the other hand, in personal services and other services labor productivity differences have increased, although wage differences have remained more or less unchanged.

One of the most interesting findings of the analysis above is that wage differences are quite large, while differences in labor quality based on the Jorgenson-Griliches approach are not that large. To examine this in more detail, Figure 16 shows the results of decomposing the labor quality gap in the total market sector between firms with 1,000 or more employees and firms with fewer than 100 employees in terms of the contribution of various worker characteristics. It shows that the main reason why the quality of labor at large firms is higher than that at small firms is differences in education. Looking at developments over the period covered in the figure shows that the labor quality gap declined over time and stood at 7% in 2010. The decline was mainly caused by the increase of non-regular employees at large firms, which in Figure 15 is included in the contribution of the "employment status."

It is important to note that although the wage gap between the two firm groups is 69% (Figure 14(a)), measured labor quality explains only 7 percentage points of this gap in 2010. Rebick (1993) reports that in the United States, about one third of firm-size wage differences are explained by labor characteristics, such as education, experience, etc., while in Japan it is only one tenth. Our result for Japan is roughly consistent with his Rebick's finding.

Figure 16. Decomposition of the labor quality gap: Total market sector, Firms with more than 999 employees/Firms with up to 99 employees

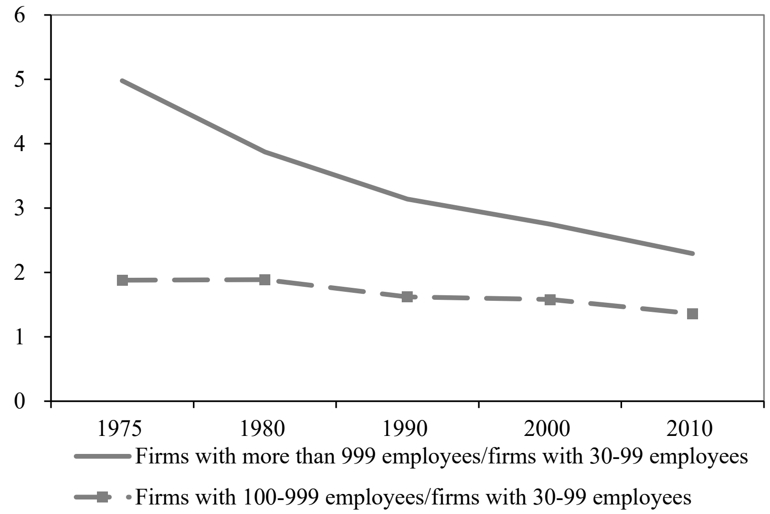


Source: Fukao (2018).

What causes the firm-size wage differences that cannot be explained by worker characteristics? One possible explanation is that since labor mobility across firms is limited in Japan, workers at large firms enjoy rents as a result of belonging to larger, more productive firms. However, since most large firms remain large and do not go bankrupt, it is difficult to understand why employees at large firms can continue to enjoy windfalls in the form of high wages. Two other explanations seem more plausible. The first is differences in on-the-job and off-the-job training. As shown in Figure 17, large firms in

Japan tend to provide much more job training for workers than SMEs. Using microdata on labor turnover and resulting wage changes, Genda (1996) found that firm-size differences in job training contributed much more to firm-size wage differences than unmeasured ability differences. The second explanation is that, in Japan, graduates of top-ranked universities are much more likely to get a job at a large firm than other graduates (Higuchi 1994). This suggests that there might be a large gap in innate ability across workers in different firm-size groups that is difficult to measure using the Jorgenson-Griliches approach.

Figure 17. Off-the-job training expenses (including opportunity costs) by firm size: Total market sector



Source: Fukao (2018).

Firm-size wage differences that are not explained by the standard Jorgenson-Griliches approach account for about 62 percentage points (the 69% in Figure 14(a) minus the 7% in Figure 15) in 2010. If we assume that all of this gap is due to labor quality differences, the TFP of firms with more than 999 employees relative to firms with less than 100 employees, when measured without taking such difficult-to-measure labor quality differences into account, will be overestimated by this difference of 62 percentage points times the labor income share, which is around two-thirds in Japan. This means that we could explain 41 percentage points of firm-size TFP differences by such difficult-to-measure labor quality differences, which is larger than the total TFP gap of 34 percentage points in Figure 14(a). As Fukao (2018, Table 1) points out, small firms are much more prevalent in Japan than in the United States. Firms with fewer than 1,000 employees account for 72% of all employment. In the case of the United States, such firms account for only 55%. This indicates that the low productivity and low wage rates of SMEs are a particularly pressing issue in the case of Japan.

If we assume that all of the firm-size wage differences not explained by the standard Jorgenson-Griliches approach are caused by difficult-to-measure labor quality differences, almost all of the firm-size TFP differences can be explained by this factor. Therefore, in order to understand firm-size TFP differences and the slowdown in Japan's TFP growth, it is important to examine such firm-size labor quality differences in more detail.

4. Conclusion

Labor productivity and real wages in Japan have barely increased since the 2000s. In this paper, we explored the causes of this stagnation using the latest JIP Database and government statistics. The results show that this stagnation was mainly due to sluggish capital accumulation and almost no increase in the capital-labor ratio, as well as sluggish growth in labor quality due to the increase in non-regular employment and other factors. Our theoretical considerations regarding the substitution between factors of production suggest that the capital-labor ratio should rise as the wage-capital cost ratio rises. In Japan, the wage-capital cost ratio rose rapidly in the 1990s and after 2012 due to monetary easing policies and other factors, and in the 1990s, the capital-labor ratio rose as expected, contributing to an increase in labor productivity and real wages. However, the capital-labor ratio hardly increased during the period of monetary easing since 2012.

Our findings indicate that in terms of capital accumulation and labor productivity growth, the so-called "lost three decades" – the period of long-term stagnation from the 1990s to recent years – can be divided into two, clearly different periods: until the mid-2000s and from the mid-2000s onward.

We also explored the causes for the sluggish capital accumulation and wage developments by splitting the JIP Database by firm size. We found that while until the mid-2000s, the labor productivity and wage advantage of large firms vis-à-vis small firms increased on the back of steady TFP growth and capital accumulation, after the mid-2000s, the differences in capital-labor ratios, TFP, and labor quality between large and small firms narrowed in many industries, leading to smaller differences in labor productivity. Thus, it can be said that in the first half of the lost three decades, it was small firms that were mainly responsible for the sluggish productivity growth, whereas in the second half, it was large firms that were mainly responsible.

The results of the analysis here are consistent with those of Fukao et al. (2021), who used the Economic Census to examine productivity dynamics in the period 2011–2015, and Fukao, Kim, and Kwon (2021b), who examine the productivity dynamics of listed firms using financial data of listed firms spanning a period of more than five decades. The first of these studies found evidence of the selection mechanism being at work in 2011–2015, primarily among small firms, and that this was the main cause of the TFP growth in many industries. On the other hand, the second study focusing on listed – i.e., large – firms, found that the reallocation of resource across firms as well as capital accumulation and TFP growth within firms have been extremely sluggish since the mid-2000s.

In sum, in the first half of the lost three decades, large firms succeeded in raising productivity through restructuring and increased hiring of non-regular workers. However, the lack of investment for the future, such as restructuring and investment in research and development (Belderbos et al. 2013), may have contributed to the sluggish labor productivity and TFP growth among listed firms since the mid-2000s.

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