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It's Not Structural Change, but Domestic Demand:

Productivity Growth in Japan

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[Abstract] This paper examines the role of structural change in productivity growth in Japan, focusing on her recent "lost decades", with reference to the United States. Japan is now known to have a sharp slowdown in productivity growth in the 1990s, when we find a slowdown in intra-industry productivity growth is the main cause. We also find that the contribution of inter-industry reallocation of employment is almost zero in the 1990s and even significantly negative in the 2000s. Interestingly, the same holds true in the US, too. We will argue that structural change or the lack of it may not be responsible for the lost decades in Japan, and that these contrasting outcomes between Japan and the US come from a common factor.

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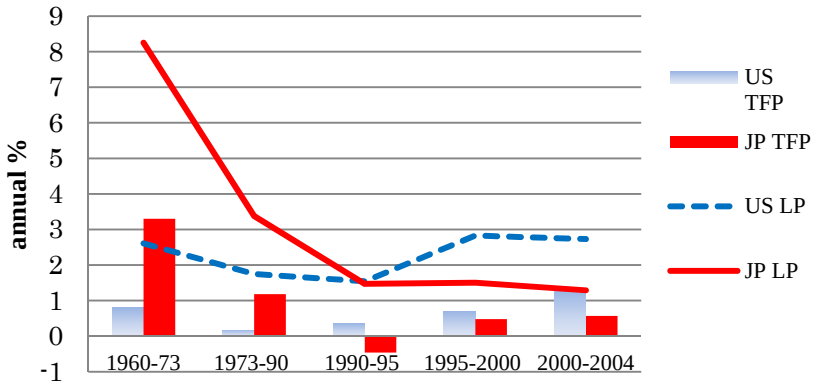
I. Introduction

This paper examines the role of structural change in productivity growth in Japan, focusing on her recent "lost decades", with reference to the United States. As a matter of fact, Japan and the US have shown quite a contrasting performance in terms of aggregate productivity growth before and after the early 1990s (Figure 1). Jorgenson and Nomura (2007) states: Before 1990, "The rapid closing of 3.7% per year in the US–Japan gap in GDP per capita during 1960–1990 was achieved by 2.1% annual growth in relative input per capita and 1.6% annual reduction in the TFP gap." But, after 1990, "Japanese total factor productivity, relative to the US, fell from 86.1 in 1990 to 81.7 in 2000 and 79.5 in 2004, reflecting the sharp acceleration in US TFP growth after 1995 and the more modest recovery of Japanese TFP growth."

Figure 1. Productivity Growth in Japan and US



Note: LP: labor productivity, TFP: total factor productivity.
Source: adapted from Jorgenson and Nomura (2007), Table 2.

Naturally, a number of economists have tackled the issue from various points of view. Naming a few, Hayashi and Prescott (2002) is among those works from a macroeconomic perspective, Miyagawa (2003) from a resource reallocation perspective, and Fukao and Kwon (2005) from a microeconomic perspective. We would like to add something new to these lines of work by looking into the role of sectoral changes in the process of aggregate productivity growth with structural change. To this aim, we decompose labor productivity growth into both intra-industry labor productivity growth and inter-industry reallocation of employment, and then measure their relative contributions to aggregate productivity growth decade by decade.

Rapid economic growth in postwar Japan accompanied large structural change, whose contribution through inter-industry reallocation of labor, we find, amounts to from one third to a half of that of intra-industry growth in the 1960s and 70s, which in themselves are exceptionally high. Now, in contrast, Japan is known to have a sharp slowdown in productivity growth in the 1990s and

her growth recovery is very modest even in the 2000s. Then, how does structural change contribute to the recent slowdown in productivity growth in Japan? While a slowdown in intra-industry productivity growth is the main cause of the aggregate productivity slowdown, we find that the contribution of inter-industry reallocation of employment becomes almost zero in the 1990s and even significantly negative in the 2000s.

Interestingly, inter-industry reallocation is found to negatively contribute to recent productivity growth in the United States, too. Can we reconcile these seemingly contradicting facts with the two economies? We will argue that structural change or the lack of it may not be responsible for the lost decades in Japan, and that these contrasting outcomes come from common factors.

In the next section, we briefly discuss the background and the literature related to our theme. We introduce our simple analytical framework and the dataset to be used there in Section III. Section IV produces a basic result on aggregate labor productivity growth in postwar Japan, by decomposing it into intra-industry labor productivity growth and inter-industry reallocation of labor. We confirm changing patterns of inter-industry reallocation of labor across decades. In Section V, the inter-industry reallocation of labor is scrutinized further on. Discussing growth-reducing reallocation of labor under structural change, we show similar changes in the US and argue that the negative effect of the reallocation on productivity growth is unavoidable, but not very significant.

Turning to intra-industry productivity growth, we examine relative contributions of individual industries to aggregate productivity growth in Section VI. We found some divergent contributions among industries over business cycles in Japan, i.e. cycle-robust industries such as manufacturing and transport and cycle-prone industries such as trade, finance and construction. While the former has remained to support aggregate productivity growth, the latter failed in the lost decades of Japan. In the recent US, both types of industries contributed to its aggregate productivity growth, generating the contrasting performance against Japan. Section VII concludes that long-term productivity growth inevitably accompanies structural change whose resource reallocation may or may not enhance growth, that business cycles affect sectors differently where structural change affects the pattern of cyclical impacts on aggregate productivity growth, and that, while we cannot deny the effect of inadequate structural change in Japan, its slower capital deepening and productivity growth suggest more importance of business cycle impacts as reasons for the lost decades.

II. Background

Industrialization accompanies productivity growth as well as structural change. In its early stage, labor and other resources shift from agriculture and other low-productivity traditional sectors into manufacturing and other high-productivity modern activities, resulting in overall productivity and per capita income growth. With the structural change, increasing allocative efficiency could help the economy grow even without productivity growth within sectors. “High-growth countries are

typically those that have experienced substantial growth-enhancing structural change." (McMillan and Rodrik, 2011, p. 1) In fact, this was probably the case in Japan in the postwar rapid growth period of 1955-72.

As early as in the 1960s, however, Baumol (1967) points out that labor shifts from industry to service along with productivity increase in industry, resulting in a decline in the aggregate productivity. Recently, Dennis and Ican (2008) shows that, in addition to this Baumol effect of sectoral productivity differentials, differentials of income elasticity of sectoral demand have also caused labor shift from agriculture to non-agriculture (the Engel effect) in the United States in the past two centuries. In the stage of post-industrialization, therefore, there is no a priori reason why structural change is growth-enhancing any more. There, resources shift toward non-manufacturing or services sectors, whose productivities may or may not higher than those of manufacturing sectors.

Hayashi and Prescott (2002) claim that Japan's prolonged stagnation in the 1990s has been mainly due to supply side factors such as declining labor supply and lowering TFP growth. TFP growth, however, is generally dependent on how it is defined and measured, because it is basically a residual. Differentiation of quality of labor and capital is known to reduce TFP growth, for instance. In fact, TFP growth is also known to include not only pure technological progress, but also reallocation effects of resources. Miyagawa (2003) found that labor reallocation among sectors contributed to the slowdown of labor productivity growth in the 1990s in Japan.

Nevertheless, most of empirical studies on productivity growth in Japan have found a significant decline in TFP growth in the 1990s and its prolonged stagnation since then. By contrast, the US has eventually come out of productivity stagnation since the 1990s, by way of the ICT revolution. There are evidences that show the contribution of ICT capital deepening to the recovery of aggregate TFP growth of the US (including Jorgenson and Nomura (2007)).[1]

We are not certain, however, whether these changes in productivity growth come from supply (technology) shocks or demand shocks (business cycles). Structural change and resource reallocation along with it may generate long-term slowdown of productivity growth under post-industrialization cum globalization. Recession tends to generate labor hoarding and to lower capital utilization, both of which tend to lead to a slowdown of TFP growth.

On top of this above, remember that aggregate productivity growth is simply a weighted average of productivity growth in the industry level. Productivity growth of industries, as will be shown, significantly differs from each other as well as over time along with their changing weights. Which industry contributes to aggregate productivity most and when? How resources are reallocated among

[1] Gordon (2000, 2012) has been skeptical about the longevity of ICT impacts on US productivity growth. In fact, we observe from Jorgenson and Nomura (2007) that TFP growth in IT-manufacturing showed non-negligible slowdown (contribution to aggregate TFP by mere 0.04%) in the period of 2000-04 in comparison with the previous two 5-year periods (0.27% and 0.48%). Bosworth and Triplett (2007), however, argue that robust productivity growth in non-manufacturing in the recent US is more broadly based than only ICT-manufacturing.

industries under structural change? These whole pictures end up with aggregate productivity growth. Now, let us start our scrutiny by introducing our methodology and dataset.

III. Methodology and Dataset

Labor productivity growth in the postwar Japan

According to our calculation (to be shown by Table 1), labor productivity growth across decades in Japan, defining labor productivity as value added per worker, shows the very rapid growth of 9.8 percent a year in the rapid growth period of 1955-69, which was halved to 4.2 percent in the 1970s and further reduced to 3.3 percent in the 1980s. Then, the growth dipped further into only 0.9 percent a year in the 1990s and barely recovered to 1.2 percent in the 2000s (2000-2008). In sum, after the rapid growth period of the 1960s, the labor productivity growth dropped sharply from the 1970-80s to the recent decades.

Methodology

We now decompose the labor productivity growth into intra-industry productivity growth and inter-industry reallocation of labor. An increase (decrease) in labor share in higher (lower) productivity sectors increases (decreases) the aggregate labor productivity of the economy as a whole.

Industry *i*'s intra-industry labor productivity in period *t,* $y_{i,t}$, is defined as:

$$y_{i,t} = \frac{Y_{i,t}}{L_{i,t}}$$

where Y and L are value added and employment of the industry, respectively. Industry *i*'s labor share at *t,* $\theta_{i,t}$, is defined as

$$\theta_{i,t} = \frac{L_{i,t}}{L_t}$$

Then, the aggregate labor productivity in period *t,*y_t, is expressed as a total sum of intra-industry productivity multiplied by labor shares, i.e.

$$y_t = \sum_{i=1}^{n} \theta_{i,t} y_{i,t}$$

Now, we can decompose the aggregate labor productivity change into an intra-industry productivity change and an inter-industry reallocation of labor as:

$$\Delta y_t = \sum_{i=1}^{n} \theta_{i,t-k} \Delta y_{i,t} + \sum_{i=1}^{n} \Delta\theta_{i,t} y_{i,t}$$

By dividing both sides by the labor productivity in period *t-k*, we obtain the following expression in growth terms:

$$\frac{\Delta y_t}{y_{t-k}} = \sum_{i=1}^{n} \theta_{i,t-k} \frac{\Delta y_{i,t}}{y_{i,t-k}} \frac{y_{i,t-k}}{y_{t-k}} + \sum_{i=1}^{n} \Delta\theta_{i,t} \frac{y_{i,t}}{y_t} \frac{y_t}{y_{t-k}} \qquad (1)$$

where the first term in the right-hand side represents the effect of intra-industry productivity growth and the second term represents the effect of inter-industry reallocation of labor on the aggregate productivity growth, both between periods *t-k* and *t*..

Data

Our data on Japan consists of sectoral and aggregate real GDP and employment for the period of 1955 to 2008 (source: Cabinet Office, Japan). The GDP data for the periods of 1955-69, 1970-89 and 1990-2008 are at 1985, 1990 and 2000 constant prices, respectively. The data covers 12 sectors, i.e. agriculture, mining, manufacturing, construction, utilities, trade, finance, real estate, transport and communication, services, government and nonprofit. For the labor productivity, we use only real GDP per worker instead of real GDP per (man-)hour, mainly because sectoral labor hours are readily available only after 1990 and partly because sectoral labor hours reported may not be very reliable.

As to parallel data on the US, we use sectoral and aggregate value added, chain-type price indices for value added (2005 = 100) and the number of full-time and half-time employees for the period of 1950 to 2008 (source: Bureau of Economic Analysis). The data covers 16 sectors, i.e. agriculture, mining, utilities, construction, manufacturing, wholesale trade, retail trade, transport, information, finance, business service, education, arts, other services, and government. For comparability to the Japanese data, we consolidate wholesale and retail trade into trade and business services, education, arts and other services into services. For comparability reasons, as the labor productivity, we use value added per worker instead of value added per (man-)hour, the latter of which is usually used in the US literature.

IV. Intra-Industry Productivity Growth vs. Inter-Industry Reallocation of Labor

Based on Equation (1) above, Table 1 shows the result of decomposition of aggregate labor productivity growth into intra-industry productivity growth and inter-industry reallocation of labor. The labor productivity growth in the 1960s (1955-69) is as high as 9.8 percent a year, to which the intra-industry growth contributes by 6.3 percent and the inter-industry reallocation by 3.1 percent. Then, the 1970s and 1980s experience more mediocre performances of aggregate productivity growth of 3.1 percent and 2.7 percent, respectively. While both intra-industry productivity growth and inter-industry reallocation positively contribute to the aggregate productivity growth, the contribution of the reallocation declined from 1.1 percent to 0.5 percent across decades.

Table 1. Decomposition of Labor Productivity Growth: Japan

Period	aggregate labor productivity	intra-industry productivity	inter-industry reallocation
1955-69	9.76	6.27	3.49
1970-79	4.15	3.10	1.05
1980-89	3.26	2.73	0.53
1990-99	0.88	0.87	0.02
2000-08	1.16	1.49	-0.29

Source: Authors' calculation with 12 industries.

Things changed downward sharply in the 1990s, i.e. the "lost decade." The labor productivity growth fell to 0.9 percent a year, when the intra-industry productivity growth contributes by 0.9 percent and the inter-industry reallocation by almost nil. The 2000s (2000-2008) witnesses slight recovery of the aggregate productivity growth as 1.2 percent, of which the intra-industry growth contributes by 1.5 percent and the labor reallocation by -0.3 percent.

Table 2 reports the result of simple regression of labor share changes on relative labor productivities, which shows significantly positive correlation between the two in the 1960s and 70s, insignificant correlation in the 1980s and 90s, and then significantly *negative* correlation in the 2000s. That is, labor tended to shift from lower to higher productivity sectors in the 1960s and 70s, but the trend ceased to exist in the 1980s and 90s and the labor shift reversed from higher to lower productivity sectors in the 2000s.

Table 2. Labor Reallocation and Relative Productivity: Japan

(Dependent variable: changes in employment share weighted by employment share)

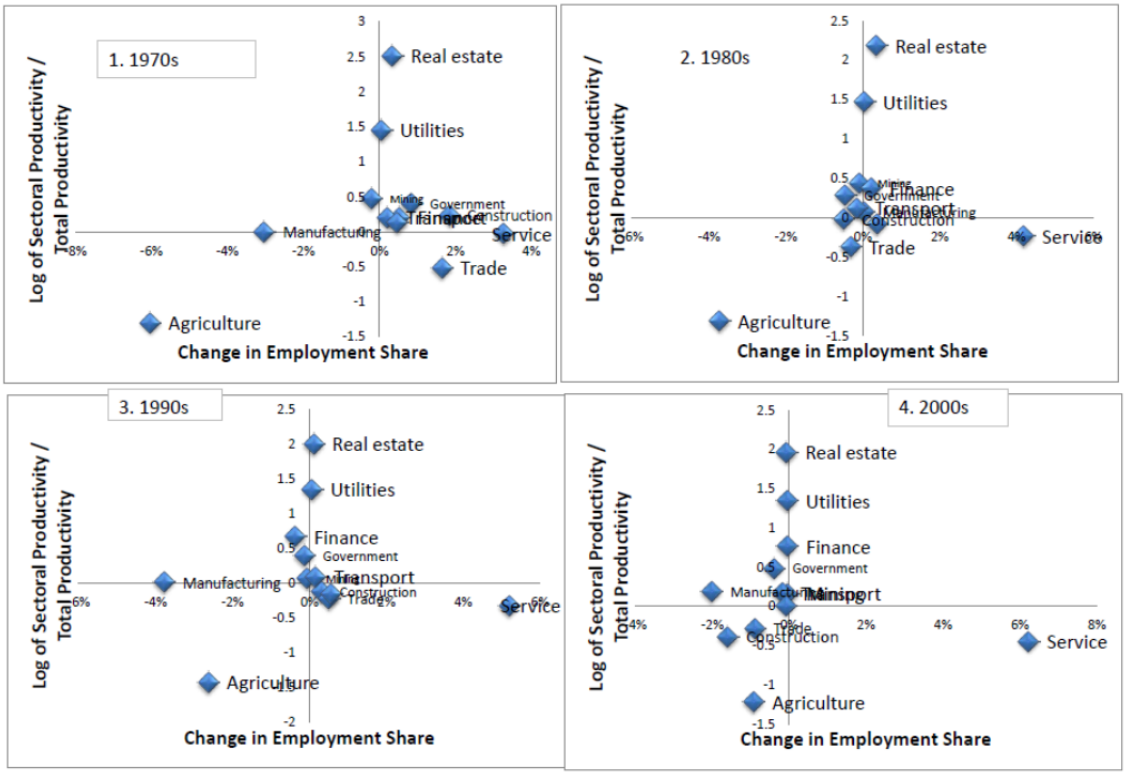
	1960s	1970s	1980s	1990s	2000s
Constant	0.001	0.000	0.000	0.000	0.000
(t-Statistic)	0.385	-0.035	0.466	-0.162	-0.134
Relative Productivity	0.165	0.034	0.012	-0.045	-0.091
(t-Statistic)	3.797**	2.130*	0.756	-1.396	-3.896**
Observations	12	12	12	12	12
R-squared	0.590	0.312	0.054	0.163	0.603

Relative productivity weighted by employment share.

** significant at 5% level; * significant at 10% level.

Figure 2 demonstrates this sea change in inter-industry reallocation of labor. The 1960s witnessed industries with increased labor share and higher relative productivity plotted in the first quadrant of the figure, whilst the 2000s see industries with higher productivity in the second quadrant, implying their employment shrinking. In terms of employment size, in 1980, the largest was manufacturing (24%) and then followed by trade (18%), services (16%), agriculture (13%), construction (10%), government (7%), transport and communication (6%) and finance (3%). In fact, since the 1980s, the services industry is the only industry whose labor share is increasing.

Figure 2. Relative Productivity and Changes in Employment Share: Japan



V. Inter-Industry Reallocation of Labor

A simplistic view may suggest labor shifts toward sectors with higher productivity growth would enhance aggregate productivity growth. Actually “structural reformists” may claim that some structural policies such as those for more flexible labor markets for more efficient reallocation are needed to cope against the above trend or that the trend itself is the result of structural problems inherent in Japan that hamper the shift of labor and other resources to sectors with higher productivity growth . In fact, negative contributions through inter-industry labor reallocation to the aggregate productivity growth come from mainly from manufacturing in both the 1990s (-0.4%) and

the 2000s (-0.3%), whereas from agriculture and finance in the 1980s and from construction, trade and government to a lesser extent.

Is it reasonable, however, to presume that sectors with higher productivity growth should absorb larger labor and other resource factors just like in the rapid growth period of Japan? Looking back at the later stage of industrialization or the post-industrialization of advanced economies, we have witnessed in common that the leading industry in terms of value added and labor is switched from the manufacturing sector to the services sector probably due to structural shifts in aggregate demand as well as "industrial disbundling", where some parts of the manufacturing sector are externalized into non-manufacturing sectors such as business services.

To confirm this general trend of structural changes in industries, we apply the same decomposition of labor productivity growth to the case of the United States. The result is shown in Table 3. In comparison with Japan, the US shows rather stable (though lower) productivity growth across the past decades. As is well known, relatively poor performance can be identified during the 1970s and the 80s, but the productivity growth recovered since the 1990s. More interesting here is the role of inter-industry labor reallocation. It contributed positively to the aggregate productivity growth until the 1970s, but then negatively since the 1980s, whose effects appear increasing.[2]

Table 3. Decomposition of Labor Productivity Growth: US

Period	aggregate labor productivity	intra-industry productivity	inter-industry reallocation
1950-59	2.19	1.95	0.24
1960-69	1.59	1.50	0.10
1970-79	0.82	0.31	0.51
1980-89	1.08	1.12	-0.04
1990-99	1.49	1.71	-0.23
2000-08	1.24	1.62	-0.38

Source: Authors' calculation with 16 industries.

Similar to Japan, manufacturing used to be the largest industry in terms of employment but kept shrinking (from 28% (1950) to 13% (2000) as a labor share), and once the second largest services industry has replaced manufacturing as the largest sector in employment (from 18% to 37%), while other major sectors such as construction (5%), trade (15%), finance (4%), transport and communication (6%) and government (17%), have remained almost the same in relative size. In fact, major negative contributions to the aggregate productivity growth come from mostly manufacturing

[2] A simple regression of labor share changes on relative labor productivities revealed significantly positive correlation in the 1950s, 60s and 70s and then significantly negative correlation in the 2000s.

in the 2000s.

The upshot is, as Baumol (1967) suggested, that recent negative contributions from structural changes through inter-industry reallocation of labor are not very unique to Japan. The negative impact (-0.3% a year) is smaller than or at least comparable to that of the US (-0.4%). Of course, there might be room for structural reforms against structural impediments in factor markets or elsewhere to improve the productivity growth through reallocation of resources, but their potential effects should not be overemphasized.

VI. Intra-Industry Productivity Growth

In the previous section, we discussed the effect of inter-industry reallocation of labor on aggregate productivity growth. Looking at Table 1, however, it is apparent that the major source of the significant slowdown of productivity growth in Japan is not inter-industry labor reallocation, but rather intra-industry productivity growth, as prior studies such as Fukao et al. (2012) had already pointed it out. Parallel figures of the US also confirm this. The recovery of the US productivity growth comes mainly from that of intra-industry productivity growth.

Our next question, therefore, is how so and why. Namely, in our analytical framework, which sector contributes to the significant slowdown of aggregate productivity growth and why it does in Japan? How contrasting is the recent Japanese case to the US case?

Look at Table 4, which shows the decomposition of contributions of intra-industry productivity growth into three elements across selected industries, i.e. intra-industry productivity growth, labor share and productivity level relative to the aggregate labor productivity. Note that these three elements correspond to the three components in the first term on the right hand side of Equation (1). As expected, in the 1990s and the 2000s, a major positive contribution comes from manufacturing by 0.5% and 0.8%, followed by the transport and communication industry by 0.1% and 0.2%, respectively. The trade sector also contributed by 0.3% in the 1990s, but lost steam in the 2000s.

Table 4. Decomposition of Contributions of Intra-Industry Productivity Growth to Aggregate Productivity Growth: Japan

①Intra-industry productivity growth

	Agriculture	Mining	Manufacturing	Construction	Utilities	Trade	Finance	Real estate	Transport	Service	Government	Nonprofit
1955-69	4.87%	26.08%	13.88%	8.28%	16.62%	24.57%	11.24%	-3.99%	13.47%	6.02%	0.66%	0.45%
1970-79	4.11%	7.23%	5.71%	0.26%	3.43%	7.15%	9.57%	0.70%	0.46%	0.76%	1.89%	1.65%
1980-89	4.97%	-0.92%	3.95%	2.79%	0.92%	3.51%	9.76%	-0.28%	4.20%	0.49%	1.64%	1.02%
1990-99	2.51%	-2.02%	2.07%	-2.49%	0.33%	2.32%	1.19%	0.22%	1.96%	-0.25%	1.93%	-0.28%
2000-08	2.33%	-1.38%	3.63%	-0.36%	2.16%	0.30%	-0.33%	1.63%	2.29%	0.20%	2.09%	4.15%

②Employment share (t-k)

	Agriculture	Mining	Manufacturing	Construction	Utilities	Trade	Finance	Real estate	Transport	Service	Government	Nonprofit
1955-69	41.3%	1.2%	18.4%	5.3%	0.5%	12.2%	1.6%	0.1%	4.4%	9.3%	4.9%	0.8%
1970-79	19.7%	0.5%	26.7%	8.1%	0.5%	16.0%	2.4%	0.6%	5.5%	12.7%	5.8%	1.4%
1980-89	12.9%	0.3%	24.0%	10.1%	0.6%	17.8%	3.0%	1.0%	5.7%	16.1%	6.7%	2.0%
1990-99	8.8%	0.2%	23.2%	9.6%	0.6%	17.2%	3.3%	1.5%	5.6%	22.5%	5.7%	1.8%
2000-08	5.9%	0.1%	19.1%	9.8%	0.7%	17.5%	2.9%	1.6%	5.9%	28.9%	5.6%	1.9%

③Relative productivity (t-k)

	Agriculture	Mining	Manufacturing	Construction	Utilities	Trade	Finance	Real estate	Transport	Service	Government	Nonprofit
1955-69	0.438	0.525	0.689	1.490	4.066	0.332	1.194	86.690	1.082	1.686	3.769	3.226
1970-79	0.258	1.354	0.964	1.510	4.497	0.542	0.962	14.226	1.418	1.136	1.687	1.302
1980-89	0.244	1.848	1.048	1.023	4.693	0.704	1.242	10.396	1.093	0.862	1.391	1.000
1990-99	0.240	1.322	0.962	1.094	3.982	0.707	1.937	7.495	1.047	0.762	1.433	0.869
2000-08	0.287	1.101	1.113	0.723	3.675	0.773	1.992	6.909	1.134	0.680	1.571	0.877

④Contribution to aggregate intra-industry productivity growth (=①*②*③)

	Agriculture	Mining	Manufacturing	Construction	Utilities	Trade	Finance	Real estate	Transport	Service	Government	Nonprofit	Total
1955-69	0.88%	0.16%	1.76%	0.66%	0.33%	1.00%	0.21%	-0.45%	0.64%	0.95%	0.12%	0.01%	6.27%
1970-79	0.21%	0.04%	1.47%	0.03%	0.08%	0.62%	0.22%	0.06%	0.04%	0.11%	0.18%	0.03%	3.10%
1980-89	0.16%	0.00%	0.99%	0.29%	0.02%	0.44%	0.37%	-0.03%	0.26%	0.07%	0.15%	0.02%	2.73%
1990-99	0.05%	0.00%	0.46%	-0.26%	0.01%	0.28%	0.08%	0.02%	0.12%	-0.04%	0.16%	0.00%	0.87%
2000-08	0.04%	0.00%	0.77%	-0.03%	0.06%	0.04%	-0.02%	0.18%	0.15%	0.04%	0.18%	0.07%	1.49%

Source: Authors' calculation.

Labor productivity growth of manufacturing is relatively as robust as 2.1% (1990s) and 3.6% (2000s), while that of the transport and communication industry is also almost comparable (2.0 – 2.3%). The sizable decline in the aggregate productivity growth certainly does not come from the two industries. It resulted from stagnation in such industries as construction, trade and finance. Their labor productivity growth fell from 2.8% to -0.3% (construction), from 3.5% to 0.3% (trade), and from 9.8% to -0.3% (finance), respectively, during the 1990s and the 2000s, and their contribution to the aggregate productivity growth is -0.3% (1990s) as against +0.3% (1980s), 0.0 % (2000s) as against +0.4% (1980s), and 0.0% (2000s) as against 0.4% (1980s), respectively.

Note that the services industry has never showed high productivity growth, nor large contribution to the aggregate productivity growth. Its productivity growth was 0.5% (1980s), -0.2% (1990s) and 0.2% (2000s), and its contribution to the aggregate productivity growth is as modest as 0.07%, -0.04% and 0.04% in each decade. Apparently, the services industry is not responsible for the recent slowdown of the aggregate productivity growth. Also note that the three stagnating industries of construction, trade and finance are relatively dependent on domestic demand. In fact, trade and finance industries are relatively income elastic,[3] while construction is heavily dependent on public expenditure, which has been depressed under the prolonged "lost decades".

Before drawing any implication for Japan from the analysis so far, let us now turn to the US case. We have seen in Table 3 that, as opposed to the slow recovery of the intra-industry productivity growth in the 2000s in Japan, the US witnessed fairly steady recovery of the intra-industry

[3] The income elasticity of industry *i* is calculated as a ratio of real value-added growth of industry *i* to the aggregate economic growth during a decade. Those industries such as trade and finance have income elasticities higher than one in Japan.

productivity growth since the 1990s . Then, how is the recovery of the US productivity growth attained?

Table 5 is the US counterpart to Table 4. Manufacturing, whose labor share kept decreasing to 13% (2000s), has remained the major contributor of 0.4 - 0.7% a year to the aggregate productivity growth throughout the decades and its intra-industry labor productivity has become as high as 5% a year. Other contributing industries alternate across decades, though. Trade contributed to the aggregate productivity growth by 0.5% (1990s) and 0.2% (2000s), whose own productivity growth was 5.4% and 1.7% respectively. Transport and communication contributed by 0.2% (1990s) and 0.5% (2000s) with its own productivity growth of 2.4% and 6.2% respectively.

Table 5. Decomposition of Contributions of Intra-Industry Productivity Growth to Aggregate Productivity Growth: US

①Intra-industry productivity growth

	Agriculture	Mining	Manufacturing	Construction	Utilities	Trade	Finance	Real estate	Transport	Service	Government
1950-59	2.92%	5.31%	2.01%	2.87%	7.99%	1.23%	-0.09%	5.18%	2.56%	0.52%	0.20%
1960-69	5.98%	4.95%	3.48%	-0.99%	5.43%	1.30%	0.97%	2.11%	4.16%	1.05%	0.21%
1970-79	1.32%	-3.64%	3.09%	-1.74%	0.32%	0.74%	1.09%	-0.20%	3.69%	0.31%	0.07%
1980-89	7.33%	7.55%	4.72%	-0.53%	3.77%	2.37%	-0.07%	-0.84%	1.76%	-0.15%	0.45%
1990-99	2.76%	3.08%	4.42%	-0.02%	3.44%	5.43%	2.33%	1.30%	2.45%	-0.08%	0.18%
2000-08	3.56%	-3.96%	5.29%	-2.89%	0.91%	1.70%	1.21%	1.90%	6.21%	0.58%	0.06%

②Employment share (t-k)

	Agriculture	Mining	Manufacturing	Construction	Utilities	Trade	Finance	Real estate	Transport	Service	Government
1950-59	4.8%	1.7%	27.6%	4.7%	0.8%	13.8%	2.5%	1.1%	8.1%	18.1%	16.8%
1960-69	3.3%	1.1%	25.3%	4.8%	0.8%	14.1%	3.2%	1.0%	6.7%	20.2%	19.5%
1970-79	1.8%	0.8%	23.0%	4.6%	0.7%	14.8%	3.6%	1.0%	6.0%	22.2%	21.4%
1980-89	1.7%	1.0%	19.5%	4.6%	0.7%	15.7%	4.1%	1.3%	5.5%	26.2%	19.6%
1990-99	1.0%	0.4%	12.9%	4.9%	0.4%	15.4%	4.3%	1.5%	5.8%	36.6%	16.8%
2000-08	1.0%	0.4%	12.6%	5.0%	0.4%	15.4%	4.2%	1.5%	5.9%	36.9%	16.8%

③Relative productivity (t-k)

	Agriculture	Mining	Manufacturing	Construction	Utilities	Trade	Finance	Real estate	Transport	Service	Government
1950-59	0.308	3.684	0.449	2.941	1.724	0.643	2.192	8.799	0.618	1.258	1.532
1960-69	0.362	5.023	0.456	3.285	2.798	0.607	1.871	11.911	0.671	1.123	1.337
1970-79	0.496	6.508	0.510	2.325	3.657	0.578	1.725	11.915	0.814	1.056	1.147
1980-89	0.490	3.783	0.594	1.714	3.103	0.542	1.769	10.741	1.036	0.970	1.039
1990-99	0.788	5.617	0.767	1.417	3.909	0.591	1.573	8.606	1.084	0.837	0.947
2000-08	0.957	5.483	0.987	1.168	4.547	0.785	1.794	8.281	1.088	0.698	0.802

④Contribution to aggregate intra-industry productivity growth (=①*②*③)

	Agriculture	Mining	Manufacturing	Construction	Utilities	Trade	Finance	Real estate	Transport	Service	Government	Total
1950-59	0.04%	0.33%	0.25%	0.40%	0.12%	0.11%	0.00%	0.50%	0.13%	0.12%	0.05%	2.04%
1960-69	0.07%	0.26%	0.40%	-0.16%	0.12%	0.11%	0.06%	0.25%	0.19%	0.24%	0.06%	1.60%
1970-79	0.01%	-0.18%	0.36%	-0.19%	0.01%	0.06%	0.07%	-0.02%	0.18%	0.07%	0.02%	0.40%
1980-89	0.06%	0.29%	0.55%	-0.04%	0.08%	0.20%	0.00%	-0.12%	0.10%	-0.04%	0.09%	1.17%
1990-99	0.02%	0.07%	0.44%	0.00%	0.06%	0.50%	0.16%	0.17%	0.15%	-0.02%	0.03%	1.57%
2000-08	0.03%	-0.08%	0.66%	-0.17%	0.02%	0.21%	0.09%	0.24%	0.40%	0.15%	0.01%	1.55%

Source: Authors' calculation.

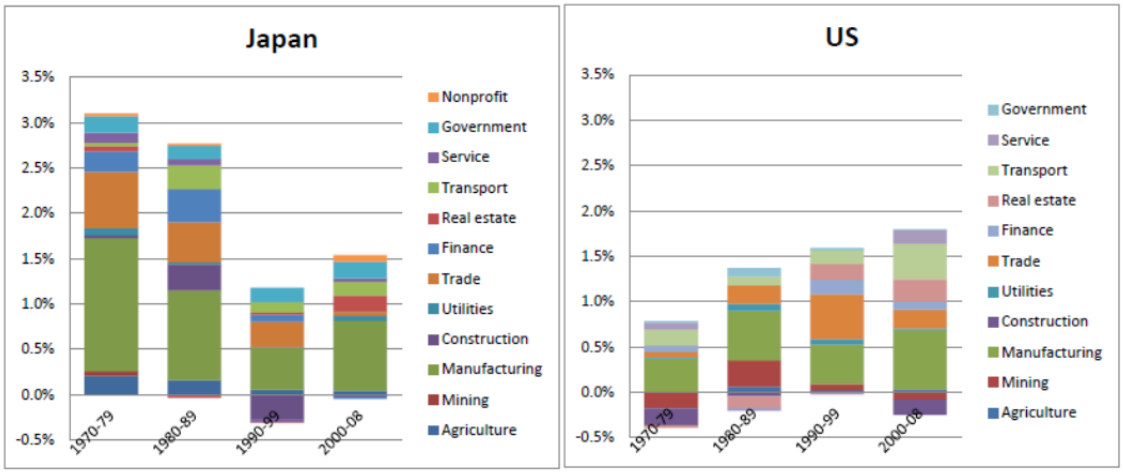
In addition to these relatively sizable industries, both finance and real estate industries contributed to the aggregate productivity growth by 0.1 – 0.2% in the 1990s and 2000s. Their own productivity growth suddenly improved as high as 1.2 to 2.3%, partly reflecting housing booms. Finally, services also contributed to the aggregate growth by 0.15% only for the 2000s without own productivity growth.

Leading (cycle-robust) vs. stagnating (cycle-prone) industries

Figure 3 helps us grasp a overall picture of changes in industry contributions to aggregate productivity growth and their contrast between Japan and the US. In both economies, manufacturing has remained a major contributor, and then transport and communication followed, the latter of which is more significant in the 2000s in the US. Both industries appear relatively robust against

cyclical ups and downs both in Japan and the US in common.

Figure 3. Contribution of Industry to Aggtregate Productivity Growth

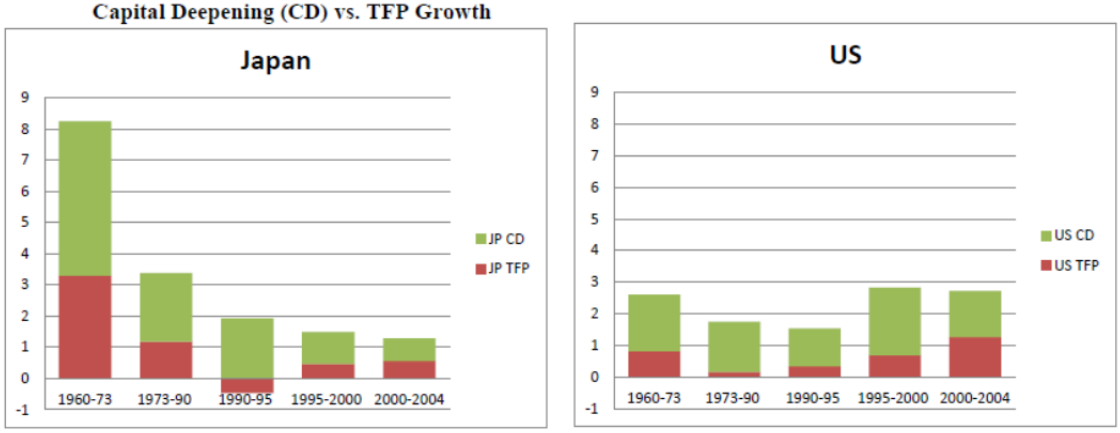


Source: Authors' calculation.

Contributions by trade and finance industries demonstrate quite contrasting results between the two economies. They used to be major productivity contributors next to manufacturing in Japan, but finance ceased to be so in the 1990s and then trade followed in the 2000s. In contrast, both trade and finance remained significant productivity contributors together with transport and communication, and real estate in the US in both the 1990s and 2000s. As pointed out before, this contrast reflects contrasting cyclical phases between the two economies in the recent periods.

An additional evidence for the role of contrasting cyclical phases can be found in Figure 4, where labor productivity growth is decomposed into capital deepening and TFP growth, using estimates by Jorgenson and Nomura (2007). Since the 1990s, stagnated TFP growth and slower capital deepening go hand in hand with each other in Japan, while TFP growth recovery and active capital deepening go together in the US. Cyclical downturn would discourage capital deepening. While capital deepening is not a sufficient condition to generate TFP growth as the US experience in the 1970s and 80s shows, it would be a necessary condition for TFP growth, and then labor productivity growth.

Figure 4. Composition of Labor Productivity Growth
Capital Deepening (CD) vs. TFP Growth



Source: Adapted from Jorgenson and Nomura (2007), Table 2.

VII. Concluding Remarks: It's not structural change, but domestic demand

In the previous sections we scrutinized how individual intra-industry productivity growth contributes to the aggregate productivity growth in Japan in comparison with the United States. Although the two cases at first hand appear very contrasting, we can identify some common factors from the above observation with respect to developments of aggregate productivity growth.

Structural change: labor reallocation is growth-reducing

First, the pattern of inter-industry reallocation of labor in the post-industrialization period is very contrasting to that in the early stage of industrialization in Japan. In the former case, along with the changing aggregate demand structure, labor tends to shift from manufacturing to non-manufacturing industries, which usually leads to dampen the aggregate productivity when manufacturing is of relatively higher productivity. Discussing growth-reducing reallocation of labor under structural change, we showed similar changes in the US and argue that the negative effect of the reallocation on productivity growth is unavoidable, but not very significant.

Given this "natural" pattern of structural changes, the negative contribution of inter-industry reallocation of labor is likely and inevitable. This is not to deny, however, that there is always a room for minimizing this negative impact on growth by more efficient reallocation of labor as well as more enhanced productivity of non-manufacturing. As to the magnitude of its growth-reducing effect, its contribution to aggregate productivity growth was -0.3% or one fifth of that of intra-industry productivity growth (1.5%) in the 2000s as we confirmed in Section IV. Thus, this negative effect on aggregate productivity growth is not dominant, but not insignificant, either.

Cyclicality: non-negligible cyclical factors?

Second, both persistent stagnation and recovery of the aggregate productivity growth depend on business cycles closely. Examining relative contributions of individual industries to aggregate

productivity growth, we found some divergent contributions among industries over business cycles in Japan, i.e. relatively cycle-robust industries such as manufacturing and transport and cycle-prone industries such as trade, finance and construction. While the former has remained to support aggregate productivity growth, the latter failed in the lost decades of Japan. In the recent US, both types of industries contributed to its aggregate productivity growth, generating the contrasting performance against Japan.

Positive contributions from income-elastic industries such as construction, trade, finance and real estate are indispensable to regain aggregate productivity growth natural to an individual economy. Somehow manufacturing and transport and communication industries turn out to be relatively robust against business cycles at least in terms of labor productivity both in Japan and the United States. The lost decades in Japan appear to have wiped out potential contributions to the aggregate productivity growth by those cycle-prone non-manufacturing industries as construction, trade and finance.[4]

Sectoral productivity: inadequate reallocation of resources? slow capital deepening and slow TFP growth?

Third, we can find some interesting differences in intra-industry productivity growth by industry over time as well as across countries. As already pointed out, both manufacturing and transport and communication industries show steady productivity growth over business cycles in both countries, but their growth rates witness some divergence in the recent decades. The US has seen steady increases in productivity growth in both industries, which may suggest some room for Japan to narrow the gap.[5]

Booms and busts hit and will hit those industries as trade and finance, resulting in their productivity slowdown or their recovery, as is also pointed out. Their productivity growth, however, does not show any steady movements, so that it seems generally difficult to discuss their "natural" rates. While we cannot deny the effect of inadequate structural change in Japan, its slower capital deepening and productivity growth suggest more importance of business cycle impacts as reasons for the lost decades. Finally, as far as this industry classification goes, labor productivity growth in services is minimal in both countries to affect the aggregate productivity growth. Given this, enhancing its productivity seems to have little impact on the aggregate productivity growth.

[4] Considering the contributions of income-elastic industries such as trade, finance, real estate and services to the aggregate productivity growth, the recovery of the US productivity growth may not be as robust as have been thought, especially when growth-depressing inter-industry structural changes are unavoidable. Bosworth and Triplett (2007) claim that the productivity growth in these industries are more broad based than just cyclical-prone.

[5] Jorgenson and Nomura (2007) points out that a decade of deflation depressed investment in IT equipment and software, leading to slower productivity growth in transport and communication industry in Japan.

References

Baumol, William J., 1967, "Macroeconomics of Unbalanced Growth: The Anatomy of Urban Crisis," *American Economic Review*, vol. 57(3), pp. 415-426.

Bosworth, Barry P. and Jack E. Triplett, 2007, "The Early 21st Century U.S. Productivity Expansion is *Still* in Services," *International Productivity Monitor*, No. 14, Spring.

Dennis, Benjamin N., and Talan B. Ican, 2008, "Engel versus Baumol: Accounting for Structural Change Using Two Centuries of U.S. Data," *Explorations in Economic History*, Vol. 46(2), pp. 186-202.

Fukao, Kyoji and Hyeog Ug Kwon, 2006, "Why Did Japan's TFP Growth Slow Down in the Lost Decade? An Empirical Analysis Based on Firm-Level Data of Manufacturing Firms," *The Japanese Economic Review*, vol. 57(2), pp. 195-228.

Fukao, Kyoji, Tsutomu Miyagawa, Hak K. Pyo and Keun Hee Rhee, 2012, "Estimates of Total Factor Productivity, the Contribution of ICT, and Resource Reallocation Effects in Japan and Korea," in Matilde Mas and Robert Stehrer, eds, *Industrial Productivity in Europe: Growth and Crisis*, Edward Elgar Publishing.

Gordon, Robert J., 2000, "Does the "New Economy" Measure up to the Great Inventions of the Past?" *Journal of Economic Perspectives*, Volume 14, Number 4, Fall.

Gordon, Robert J., 2012, "Is U.S. Economic Growth Over? Faltering Innovation Confronts the Six Headwinds, " *NBER Working Paper* 18315, August.

Hayashi, Fumio and Edward C. Presott, 2002, "The 1990s in Japan: A Lost Decade," *Review of Economic Dynamics*, Vol. 5(1), pp. 206-235.

Jorgenson, Dale W, and Koji Nomura, 2007, "The Industry Origins of the US-Japan Productivity Gap," *Economic Systems Research*, vol. 19(3), pp. 315-341.

McMillan, Margaret S. and Dani Rodrik, 2011, "Globalization, Structural Change and Productivity Growth," *NBER Working Paper*, no. 17143.

Miyagawa Tsutomu, 2003, "Ushinawareta Junen to Sangyo Kozo no Tenkan (The Lost Decade and Structural Change)," in Kikuo Iwata and Tsutomu Miyagawa, eds, *Ushinawareta Junen no Shinin wa Nanika (What are Real Factors in the Lost Decade in Japan?)*, Toyokeizaishinposha Publisihing.