

**A Comparative Estimation of Total Factor Productivity
in Japan and Korea (1977-2005)**

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Abstract

There has been a wide-spread skepticism on sustainable growth prospect of East Asia since the Japan's lost decade in the 1990's and Korea's Financial crisis in 1997-1998. The average annual GDP growth rate of Korea's market economy has grown at 5.9 percent during the pre-crisis period of 1977-1995 but has slowed down to 3.5 percent level during the period of 1996-2005 which includes its financial crisis year of 1998. On the other hand, Japan's average annual GDP growth rate has dropped from 3.5 percent during 1977- 1995 to 1.0 percent during the period of 1996-2005 which includes most of its lost decade of 1993-2002. The purpose of this study is to identify the sources of economic growth and to present new estimates of growth accounting for Japan and Korea based on the newly constructed EU KLEMS database following EU KLEMS project guidelines. Even though ageing population and sluggish investment demand withhold another round of high-growth era, the strong ICT sectors in two economies and corporate restructuring process in much more open regimes with continuing FTA with other economies will make both Japan and Korea possible renew their sustainable growth paths. For this purpose, the enhancement of human capital through educational reforms and upgraded OJT programs seem vital to let two economies reach and pass a threshold externality point.

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1.Introduction

There has been a wide-spread skepticism on sustainable growth prospect of East Asia since the Japan's lost decade in the 1990's and Korea's Financial crisis in 1997-1998. The average annual GDP growth rate of Korean economy was at 8.2 percent during the pre-crisis period of 1986-1997 but has slowed down to 4.2 percent level during the post-crisis period of 1998-2004. On the other hand, Japan's average annual GDP growth rate has dropped from 4.2 percent during 1986- 1992 to 0.5 percent during the lost decade of 1993-2002. The real question that remains unresolved is whether the potential GDP levels of two economies have actually declined as much as actual GDP levels accordingly and the potential sources of growth have been halved since their high-growth era.

In the paper we perform international comparison of total factor productivity (TFP) growth for Korea and Japan. We use 72-industry classification following the EU KLEMS guideline for comparability with Japan. Therefore, an analysis based on detailed industry classification gives us better views on productivity and growth, which is difficult to grasp in broader industrial classifications. Industries in an economy have shown different productivity trends and growth patterns according to their characteristics of production, competition policies, and other economic and non-economic circumstances.

We perform value-added growth accounting for the market economy including 6 sectors using EUKLEMS database for the period of 1977-2005 following the practice of EU KLEMS even though Pyo and Ha (2008) has found that value-added function may not be separable within the gross-output production function.. Economic growth rates had declined from the 1980s to the 1990s, and further fell down after the financial crisis in December 1997 in case of Korea. However, since the 1997 financial crisis the sources of growth seem to have switched to TFP-growth based. The productivity resurgence in the post-crisis period is highly concentrated in high-tech manufacturing industries. But lower productivity in service industries seems to work against finding renewed sustainable growth path.

This paper is organized as follows. In Section 2, we introduce Hayashi-Prescott(2002) type growth accounting model but extend it into a multi-sector industry level framework and accommodate augmenting labor and capital input by introducing unemployment rate and capacity utilization rate. Section 3 briefly examines data structure and classification of industries and presents the value-added growth accounting results and compares the results of Japan and Korea in the context of multi-sector growth accounting. The final section concludes the paper with some policy implications.

2. Multi-sector Growth Accounting Model

We adopt the growth accounting model of Hayashi and Prescott (2002) but we extend it into a multi-sector value-added growth accounting model and reformulate it by decomposing employment rate by two meaningful definitions, capital-labor ratio and capital-employment ratio as follows:

$$Y = AK^\theta (hE)^{1-\theta} \quad (1)$$

where Y , K , hE , A and θ represent value-added, physical capital, human capital, technological progress and share of capital income respectively. For notational simplicity, we delete subscript i for a particular industry and t for a particular time from the above equation.

Reformulating some variables, we define:

$$y \equiv \frac{Y}{N} \quad e \equiv \frac{E}{N} \quad x \equiv \frac{K}{Y} \quad (2)$$

where N is economically active population and e and x are employment intensity and capital intensity respectively.

Equation (1) can be expressed:

$$y = A^{1/(1-\theta)} h e x^{\theta/(1-\theta)} \quad (3)$$

Dividing equation (1) by economically active population (N), we derive:

$$\frac{Y}{N} = A \left(\frac{K}{N}\right)^\theta h^{1-\theta} \left(\frac{E}{N}\right)^{1-\theta} \quad (4)$$

and reformulating each variable to per capita terms,

$$y = Ak^\theta h^{1-\theta} e^{1-\theta} \quad \text{where } k \equiv \frac{K}{N} \quad (5)$$

Capital-output ratio which is defined as capital intensity can be expressed as:

$$x = \frac{K}{Y} = \frac{K}{AK^\theta (hE)^{1-\theta}} = A^{-1} K^{1-\theta} (hE)^{-(1-\theta)} \quad (6)$$

$$x = \frac{K}{Y} = \frac{K/N}{Y/N} = \frac{k}{y} \quad (7)$$

$$k = xy$$

Rearranging numerical expression of per capita value-added by using equation (7), we get:

$$\begin{aligned} y &= Ak^\theta h^{1-\theta} e^{1-\theta} \\ &= A(xy)^\theta h^{1-\theta} e^{1-\theta} \\ &= Ax^\theta h^{1-\theta} e^{1-\theta} y^\theta \end{aligned} \quad (8)$$

$$\frac{y}{y^\theta} = y^{1-\theta} = Ax^\theta h^{1-\theta} e^{1-\theta} \quad (9)$$

$$\therefore y = A^{1/(1-\theta)} x^{\theta/(1-\theta)} h e$$

Using definitions of equation (2), we derive:

$$e = \frac{K/N}{K/E} = \frac{k}{k^*}, \text{ where } k^* \equiv \frac{K}{E} \quad (10)$$

Equation (9) combined with equation (10) is as follows:

$$y = A^{1/(1-\theta)} h x^{\theta/(1-\theta)} \frac{k}{k^*} \quad (11)$$

Taking natural logarithm on both sides, we can get growth accounting formula:

$$\log y = \frac{1}{1-\theta} \log A + \log h + \frac{\theta}{1-\theta} \log x + \log k - \log k^* \quad (12)$$

Also, differentiating equation (12) with respect to time, we can get the basic growth accounting equation:

$$\frac{\dot{y}}{y} = \frac{1}{1-\theta} \frac{\dot{A}}{A} + \frac{\dot{h}}{h} + \frac{\theta}{1-\theta} \frac{\dot{x}}{x} + \frac{\dot{k}}{k} - \frac{\dot{k}^*}{k^*} \quad (13)$$

We have also adopted a production function approach with unemployment rate (u) and capacity utilization ratio (v). So, equation (1) can be re-specified as:

$$Y = A(vK)^\theta ((1-u)hE)^{1-\theta} \quad (14)$$

3. Industry Classification and Estimates of TFP in Japan and Korea

This section is divided into two parts. In the first part, we describe 72-Industry Classification and Coverage following the EU KLEMS guideline. The second part presents estimates of TFP in Japan and Korea during the period of 1977-2005.

3.1 Industry Classification

For EUKLEMS data, data are collected for 71 industries (“Imputation of owner occupied rents” excluded) at the lowest level of aggregation. The industries are classified according to the European NACE revision 1 classification. This classification is very close to the International Standard Industrial Classification (ISIC) revision 3. The Table A-1 in Appendix provides a listing of the industries.

As suggested in the EU KLEMS Manual, we focus on the market economy for international comparison of output and TFP growth. The market economy excludes the following non-market services industries as shown in Table A-2 in Appendix: Imputation of owner occupied rents (56), Other real estate activities (57), Public administration and defense and compulsory social security (63), Education (64), and Health and social work (65). The market economy consists of one ICT (information and communication technology)-producing sector, two goods-producing, and three services-producing sectors: Electrical machinery and post & communication services (26-33, 52), Manufacturing excluding electrical machinery (9-25, 34-39), Other goods producing industries (1-8, 40-43), Distribution Services (44-46, 48-51), Finance and business services excluding real estate (53-55, 58-62), and Personal and social services (47, 66-71).

First, the whole period of the data used for analysis is from 1977 to 2005 because capital input data for Korea from EUKLEMS database are available from 1977. The variables of the model in the paper are the following: Y (Real GDP), h (Hours worked per employed person), E (Number of employed persons), N (Working age population), K (Capital

service), v (Average operating ratio) and u (Unemployment rate). We can get data on Y , K , h and E from EUKLEMS database. The others are from Portal Site of Official Statistics of Japan (e-stat, <http://www.e-stat.ac.jp>), JIP Database (<http://www.rieti.go.jp/en/database/JIP2008/index.html>) and Korean Statistical Information Service(<http://www.kosis.go.kr>). The detailed sources of each data are explained in Appendix.

3.2. Trend of Macroeconomic Variables in Japan and Korea

Before we conduct growth accounting for two economies which had gone through a turbulent period of lost decade or financial crisis in the 1990s, we examine trends of key macro variables. As observed by Hayashi and Prescott (2002), the capital-output ratio (x) of Japan has steadily increased while working hours (h) has declined as summarized in Table 1. The de-trended real GDP per working age population (y) has peaked around 1991-1992 and has steadily declined as shown in Figure 1

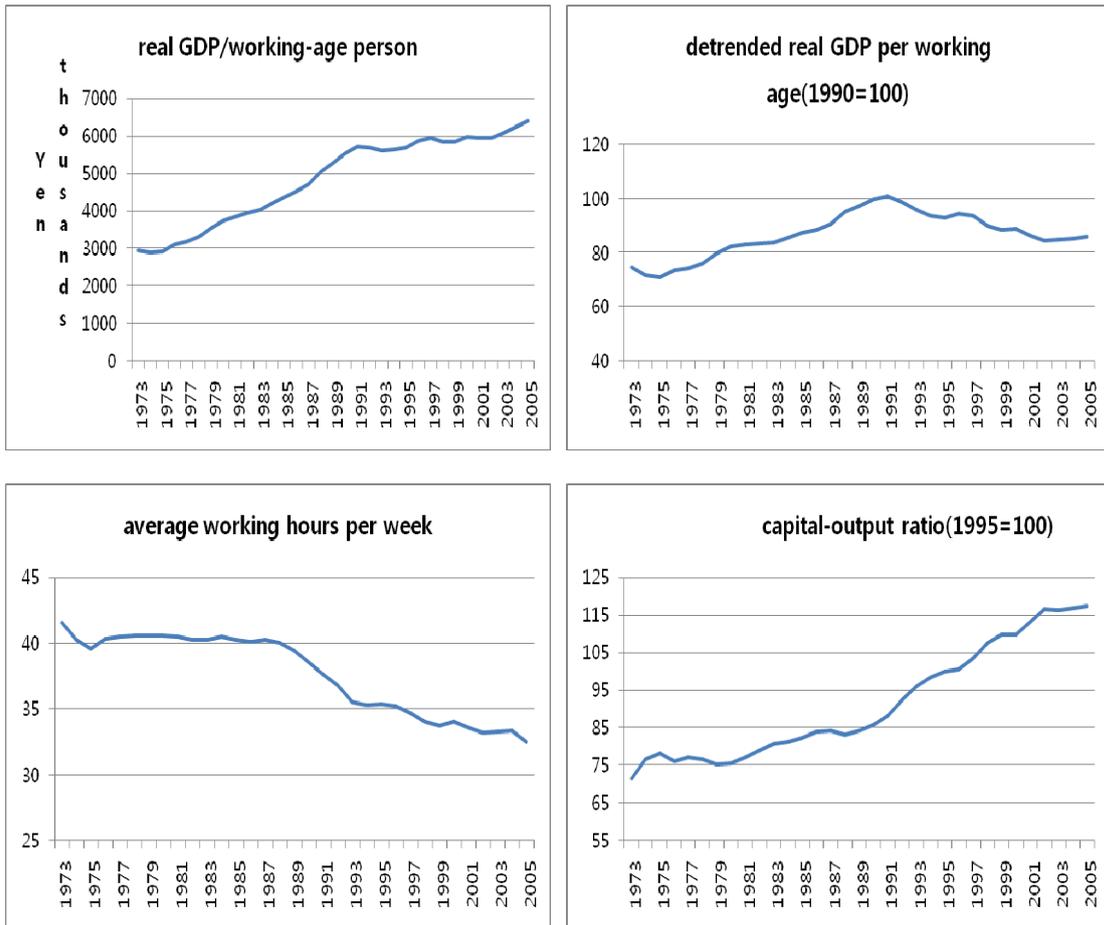
On the other hand as summarized in Table 1 and shown in Figure 1, the trend of key macro variables in Korean economy reveals a somewhat different trend. The capital-output ratio of Korea has also steadily increased up until 1979 but started to fluctuate with the lowest level in 1988 and the highest level in 1998 while working hours has steadily declined. The overall growth rates of capital-output ratio in Korea are negative in both periods. The real GDP per working age population de-trended by a straight line has peaked around 1996, declined in 1998 but began to recover after 1998 as shown in Figure 1.

Table 1 Growth rates of Macro Variables(%)

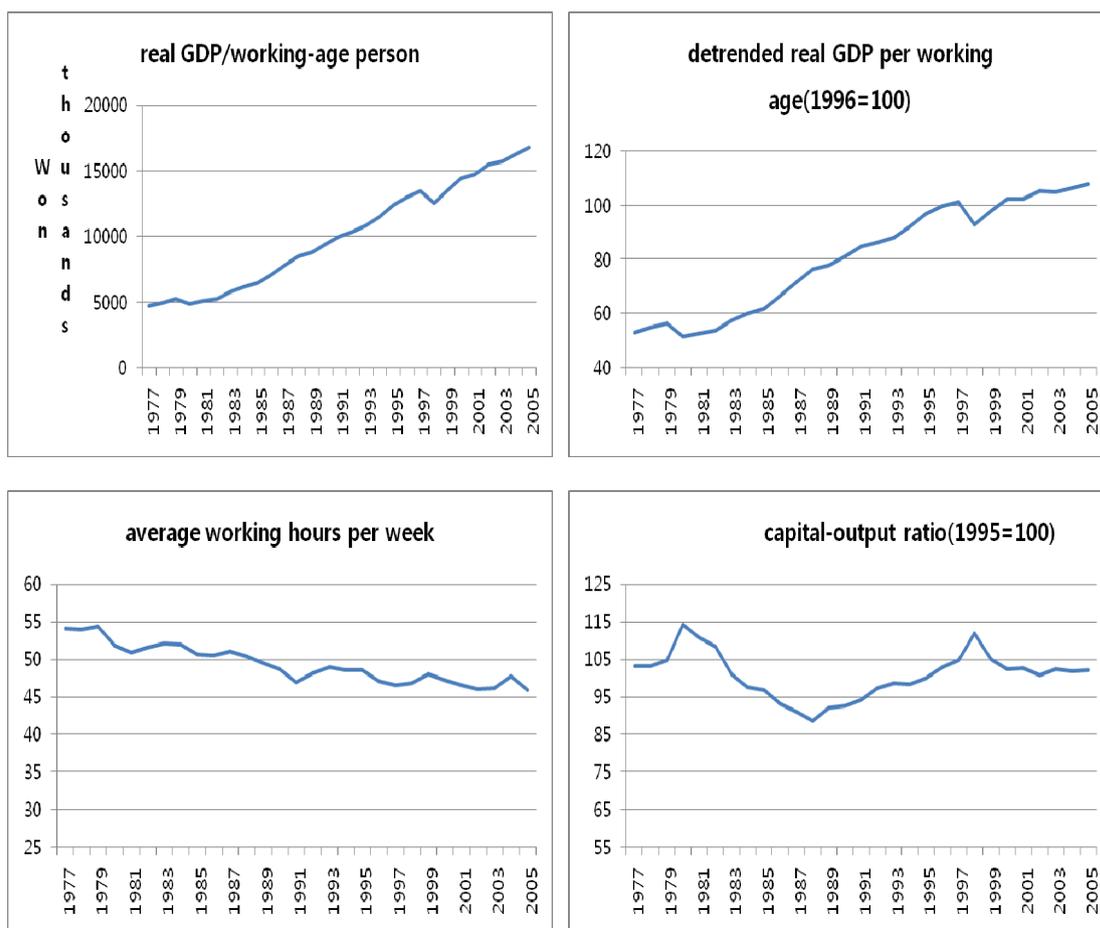
	y	h	e	x	k	k^*
Japan						
1977-2005	2.6	-0.8	0.3	1.2	3.8	3.4
1977-1995	3.5	-0.8	0.8	0.9	4.4	3.5
1996-2005	0.7	-0.9	-0.6	2.0	2.7	3.3
Korea						
1977-2005	5.0	-0.6	0.7	-0.2	4.8	4.1
1977-1995	5.9	-0.6	1.3	-0.1	5.8	4.4
1996-2005	3.3	-0.3	-0.4	-0.7	2.5	2.9

Notes: y = Value-added divided by Working age population, h = Hours worked per employed person, e = Number of employed persons divided by Working age population, x = Capital-Output ratio, k = Capital – labor ratio, k^* = Capital –employment ratio

Figure 1 Trend of Macro Variables in Japanese and Korean Economy
Panel A. Japan



Panel B. Korea



3.3 Estimates of TFP by Multi-sector Growth Accounting Model

We have applied two types of growth accounting model, one with the original version of Hayashi and Prescott and the other with a modified version with further decomposition of employment ratio to 72-industry data of EU-KLEMS Japan and Korea Dataset. As summarized in Table 2, the economy-wide growth decomposition indicates that Japan's value-added growth rate has declined markedly from 3.5 percent during the period of 1977-1995 to 0.7 percent during the period of 1996-2005. The growth rate of TFP declined from 2.5 percent to -0.9 percent, which is consistent with Hayashi and Prescott (2002) who found that the TFP growth rate of Japan declined by more than 2 % points from the 1980s to 1990s. The relative contribution of TFP during the former period was about 70 percent which is rather significant compared to capital intensity growth (30 %). But the picture has been turned around during the latter period of 1996-2005 with higher growth rate of capital intensity (3.1 %) and lower growth rate of TFP (-0.9 %).

The decomposition of 72 sectors into several groups reveals striking patterns of growth in different sub-sectors. For example, in ICT Manufacturing after 1996, the dominant growth of per capita GDP (6.5 %) of the sector is mostly accounted for by the growth rate of TFP (9.9 %) while its capital intensity has grown at the rate of – 1.0 percent implying that capital productivity(Y/K) has increased tremendously during the period reflecting ICT boom. Among Service sectors, Finance and Business Services ranks first in the growth rate of value added (2.9 %) and but with negative growth of TFP (- 1.8 %).

In case of Korea, there was also a marked slow-down in GDP growth between the two sub-periods (5.9 % and 3.3 %) but the slow-down of TFP growth was relatively mild (5.2 % and 4.6 %). The relative contribution of TFP was dominant in both of the sub-periods.

Table 2 Value-Added Growth and Contributions in the Market Economy (%)

Panel A. Japan

	y	h	e	x	θ	TFP
	(1)=(2)+(3)+(4)+(5)	(2)	(3)	(4)		(5)
1977-2005						
Market Economy	2.6	-0.8	0.3	1.6	48.5	1.5
Electrical mach & comm services	9.5	-0.3	-0.3	-4.1	48.9	14.2
Manufacturing excl. electrical	1.4	-0.4	-1.2	1.3	50.8	1.7
Other goods producing industries	0.0	-0.5	-0.6	0.7	55.7	0.3
Distribution services	2.8	-1.1	0.4	-0.8	41.4	4.3
Finance and business services	4.8	-0.7	2.6	4.8	45.4	-2.0
Personal and social services	1.1	-1.1	2.0	4.2	49.4	-4.0
1977-1995						
Market Economy	3.5	-0.8	0.8	1.0	49.3	2.5
Electrical mach & comm services	10.8	-0.4	0.5	-5.8	46.9	16.5
Manufacturing excl. electrical	2.4	-0.5	-0.7	0.5	51.6	3.1
Other goods producing industries	0.5	-0.6	0.3	0.4	58.5	0.3
Distribution services	4.4	-0.9	0.8	-2.0	41.1	6.5
Finance and business services	5.7	-0.6	2.9	5.5	44.7	-2.0
Personal and social services	1.5	-1.1	2.6	3.9	52.5	-3.9
1996-2005						
Market Economy	0.7	-0.9	-0.6	3.1	47.0	-0.9

Electrical mach & comm services	6.5	-0.3	-2.1	-1.0	52.8	9.9
Manufacturing excl. electrical	-0.5	-0.1	-2.2	3.6	49.4	-1.8
Other goods producing industries	-1.4	-0.4	-2.5	1.8	50.3	-0.3
Distribution services	-0.2	-1.4	-0.7	3.6	42.0	-1.7
Finance and business services	2.9	-0.9	2.1	3.5	46.8	-1.8
Personal and social services	0.2	-1.3	0.9	4.1	43.7	-3.5

Panel B. Korea

	y	h	e	x	θ	TFP
	(1)=(2)+(3)+(4)+(5)	(2)	(3)	(4)		(5)
1977-2005						
Market Economy	5.0	-0.6	0.7	0.0	54.9	5.0
Electrical mach & comm services	14.7	-0.5	1.9	-4.1	52.4	17.3
Manufacturing excl. electrical	6.0	-0.7	-1.3	-1.8	49.3	9.7
Other goods producing industries	1.6	-0.5	-1.4	0.0	63.4	3.5
Distribution services	3.7	-0.6	2.2	0.0	60.5	2.0
Finance and business services	8.0	-0.3	6.7	-0.3	44.5	1.9
Personal and social services	3.9	-0.4	2.3	8.4	38.8	-6.4
1977-1995						
Market Economy	5.9	-0.6	1.3	0.0	56.9	5.2
Electrical mach & comm services	14.5	-0.3	2.5	-5.3	50.0	17.6
Manufacturing excl. electrical	7.6	-0.7	-0.2	-2.4	48.8	11.0
Other goods producing industries	2.2	-0.5	-0.7	0.0	66.8	3.5
Distribution services	4.6	-0.6	3.6	0.0	65.1	1.6
Finance and business services	10.9	-0.1	8.4	0.2	42.4	2.5
Personal and social services	4.7	-0.5	1.8	1.0	42.2	2.4
1996-2005						
Market Economy	3.3	-0.3	-0.4	-0.6	51.2	4.6
Electrical mach & comm services	15.5	-0.4	1.0	-1.8	56.9	16.7
Manufacturing excl. electrical	2.7	-0.2	-3.0	-1.3	50.2	7.2
Other goods producing industries	-0.2	-0.5	-3.0	0.3	56.9	3.0
Distribution services	1.8	-0.1	-0.6	0.8	51.7	1.7
Finance and business services	2.5	-0.5	3.2	-1.9	48.5	1.6
Personal and social services	2.2	-0.2	2.8	23.9	32.2	-24.3

Notes:

y = Value-added growth rate (%)

h = Contribution of labor hours (%)

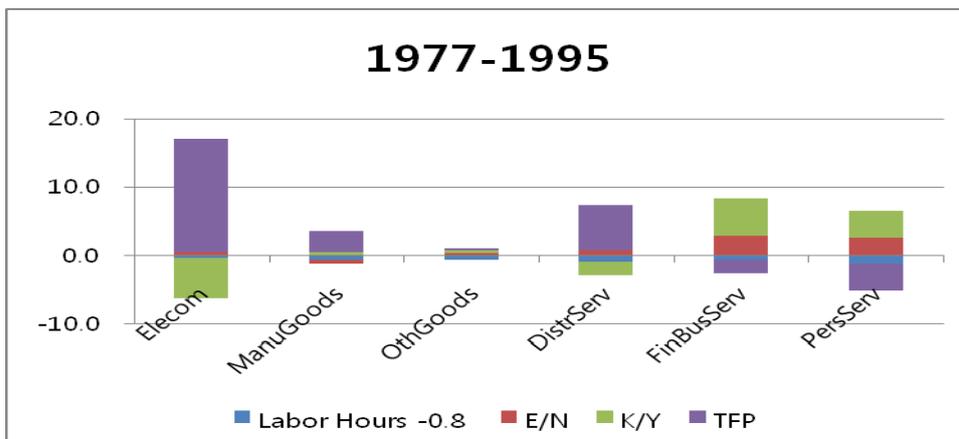
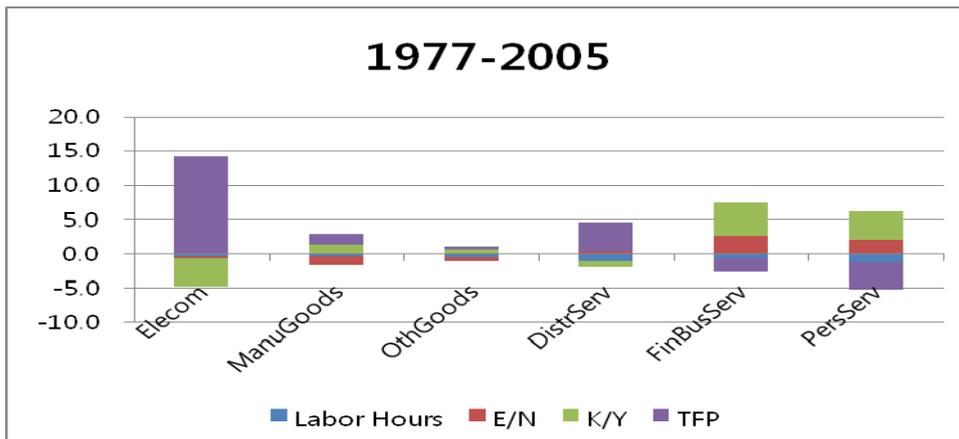
e = Contribution of labor input (%)

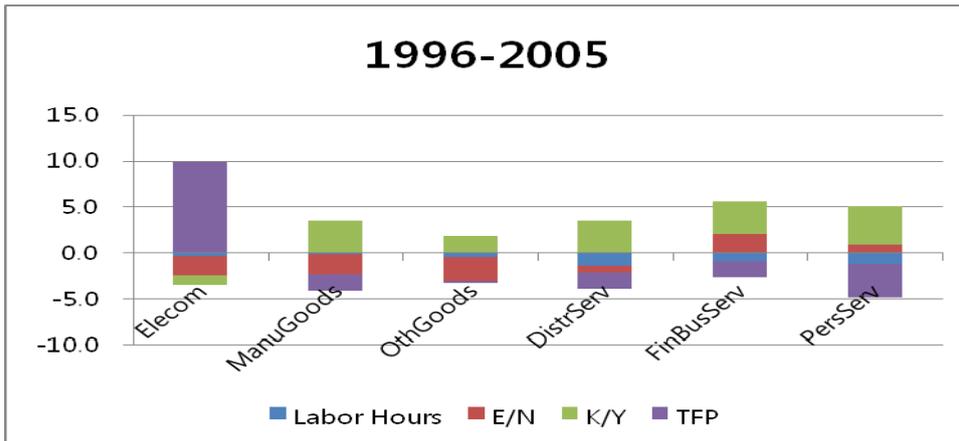
x = Contribution of capital input (%)

θ = value share of capital input (%)

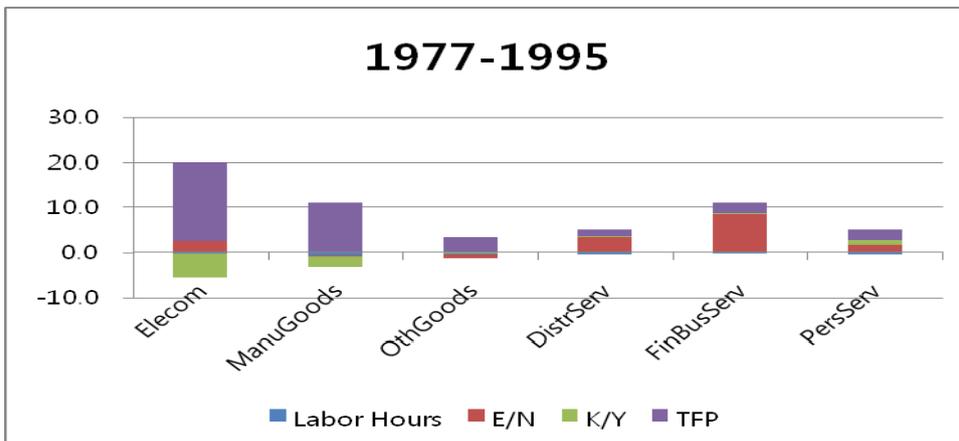
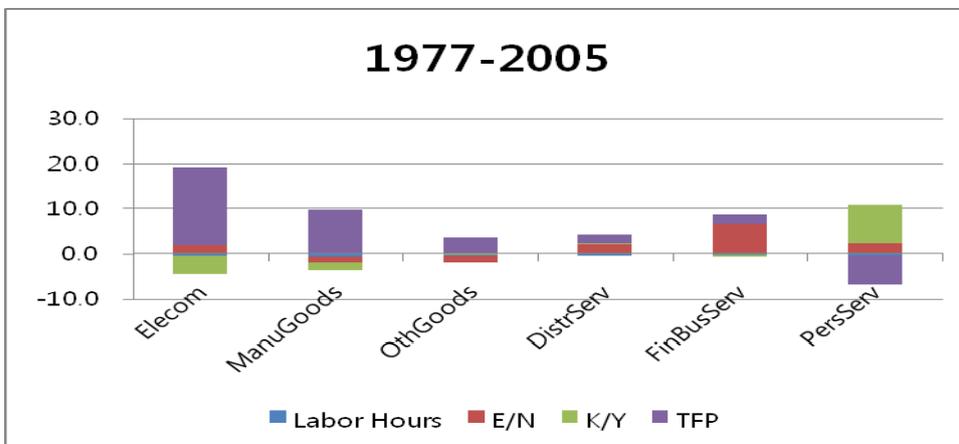
TFP = Contribution of total factor productivity growth (%)

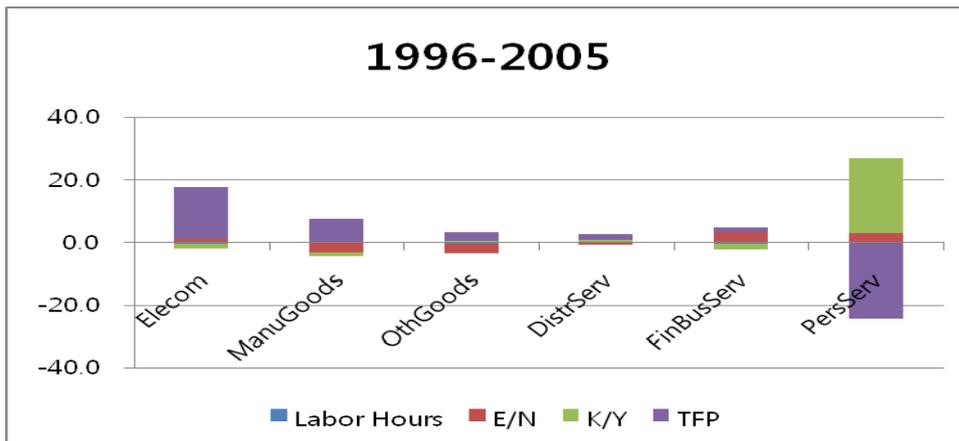
Figure 2 Contributions to Market Economy Value-Added Growth by Sector
Panel A. Japan





Panel B. Korea





Notes:

Elecom = Electrical machinery and post & communication services (26-33, 52)

ManuGoods = Manufacturing excluding electrical machinery (9-25, 34-39)

OthGoods= Other goods producing industries (1-8, 40-43)

DistrServ = Distribution Services (44-46, 48-51)

FinBusServ= Finance and business services (53-55, 58-62)

PersServ= Personal and social services (47, 66-71)

3.4 Value-added Growth Accounting with Effective Labor and capital Input

We have extended multi-sector growth accounting into decomposing employment ratio (e) by capital-labor ratio (k) and capital-employment ratio (k^*) and considering unemployment rate (u) and capacity utilization rate (v) to make both labor input and capital input as effective inputs. The result is summarized in Table 3.

In case of Japan's 1977-1995 period the growth of employment ratio (0.8 %) is decomposed and explained by the difference between the growth rate of capital-labor ratio (4.4 %) and capital-employment ratio (3.7 %). In other words, the capital per-working age population grew faster than the capital per employment which implies the growth rate of working age population was lower than the growth rate of employment during the period in Japan. The growth rate of TFP during the period (3.9 %) becomes naturally larger than that (2.5 %) without considering unemployment rate and capacity utilization rate because the effective input of labor and capital makes input contribution smaller and TFP contribution larger. As a consequence, the growth rate of Japan's TFP during the period of 1996-2005 after considering effective labor and capital input becomes lower (- 2.2 %) than that without (- 0.6 %).

It is interesting to note also that the magnitude of the growth rates of capital-labor ratio and capital employment ratio is reversed during the period of 1996-2005 in Japan. It implies that even though the working age population continued to grow slowly, the growth of employment was even slower than that reflecting Japan's Lost Decade. During this latter period, most of market economy sectors recorded negative growth of TFP after considering unemployment rate and capacity utilization rate except Electrical Machinery and Community Services (5.7 %) and Finance and Business Services (2.4 %).

In case of Korea, a similar trend is observed but with different magnitudes. During its high-growth period of 1977-1995, the growth rate of TFP (7.7 %) after considering unemployment rate and capacity utilization rate becomes bigger than that of market-economy GDP (5.9 %) and the growth rate of TFP (4.9 %) without considering these rates. The growth rate of capital-labor ratio (6.9 %) was bigger than that of capital employment ratio (5.5 %) during the high-growth period of 1977-1995 but it was reversed during the slower-growth period of 1996-2005 as 2.4 % and 3.0 % respectively. It implies that Korea followed a similar trend with Japan that the growth of employment became slower than that of working age population during the period which includes its financial crisis in 1997-1998.

Table 3 Value-Added Growth and Contributions in the Market Economy (%)

Panel A. Japan

	y	h	x	k	k*	θ	u	v	TFP
	(1)=(2)+(3)+(4)+(5)	(2)	(3)	(4)					(5)
1977-2005									
Market Economy	2.6	-0.8	1.6	3.8	3.5	48.5	0.03	0.88	2.1
Electrical mach & comm services	9.5	-0.3	-4.5	5.5	6.0	48.9	0.03	0.87	13.9
Manufacturing excl. electrical	1.4	-0.4	1.5	3.2	4.5	50.8	0.03	0.86	-1.0
Other goods producing industries	0.0	-0.5	0.7	1.9	2.6	55.7	0.03	0.92	-0.9
Distribution services	2.8	-1.1	-0.5	2.7	2.4	41.4	0.03	0.92	4.7
Finance and business services	4.8	-0.7	4.6	7.3	4.7	45.4	0.03	0.91	3.5
Personal and social services	1.1	-1.1	4.0	4.9	2.9	49.4	0.03	0.88	0.2
1977-1995									
Market Economy	3.5	-0.8	1.0	4.4	3.7	49.3	0.02	0.89	3.9
Electrical mach & comm services	10.8	-0.4	-6.5	5.9	5.4	46.9	0.02	0.89	18.1
Manufacturing excl. electrical	2.4	-0.5	0.8	3.4	4.2	51.6	0.02	0.87	1.4
Other goods producing industries	0.5	-0.6	0.5	2.7	2.4	58.5	0.02	0.92	0.9

Distribution services	4.4	-0.9	-1.7	3.8	3.0	41.1	0.02	0.92	7.8
Finance and business services	5.7	-0.6	5.2	8.3	5.5	44.7	0.02	0.92	4.0
Personal and social services	1.5	-1.1	3.6	6.4	3.9	52.5	0.02	0.89	1.5
1996-2005									
Market Economy	0.7	-0.9	3.0	2.6	3.3	47.0	0.05	0.86	-2.2
Electrical mach & comm services	6.5	-0.3	-1.1	4.5	6.8	52.8	0.05	0.82	5.7
Manufacturing excl. electrical	-0.5	-0.1	3.5	2.7	5.0	49.4	0.05	0.84	-6.3
Other goods producing industries	-1.4	-0.4	1.8	0.5	3.2	50.3	0.05	0.92	-5.5
Distribution services	-0.2	-1.4	3.4	0.7	1.5	42.0	0.05	0.91	-3.0
Finance and business services	2.9	-0.9	3.4	5.0	3.0	46.8	0.05	0.91	2.4
Personal and social services	0.2	-1.3	3.8	1.7	0.9	43.7	0.05	0.86	-1.5

Panel B. Korea

	y	h	x	k	k*	θ	u	v	TFP
	(1)=(2)+(3)+(4)+(5)	(2)	(3)	(4)					(5)
1977-2005									
Market Economy	5.0	-0.6	0.2	5.5	4.8	54.9	0.04	0.75	6.3
Electrical mach & comm services	14.7	-0.5	-3.5	9.7	7.8	52.4	0.04	0.75	20.6
Manufacturing excl. electrical	6.0	-0.7	-1.1	5.0	6.3	49.3	0.04	0.75	6.4
Other goods producing industries	1.6	-0.5	0.1	3.0	4.4	63.4	0.04	0.75	0.6
Distribution services	3.7	-0.6	0.1	5.0	2.8	60.5	0.04	0.75	6.4
Finance and business services	8.0	-0.3	1.7	8.6	1.9	44.5	0.04	0.75	13.4
Personal and social services	3.9	-0.4	10.1	6.6	4.3	38.8	0.04	0.75	-3.6
1977-1995									
Market Economy	5.9	-0.6	0.2	6.9	5.5	56.9	0.03	0.74	7.7
Electrical mach & comm services	14.5	-0.3	-4.1	10.5	7.8	50.0	0.03	0.74	21.6
Manufacturing excl. electrical	7.6	-0.7	-1.1	6.8	6.9	48.8	0.03	0.74	9.3
Other goods producing industries	2.2	-0.5	0.0	4.0	4.6	66.8	0.03	0.74	2.1
Distribution services	4.6	-0.6	0.0	6.0	2.3	65.1	0.03	0.74	8.8
Finance and business services	10.9	-0.1	3.8	12.1	3.6	42.4	0.03	0.74	15.6
Personal and social services	4.7	-0.5	4.3	6.1	4.2	42.2	0.03	0.74	2.7
1996-2005									
Market Economy	3.3	-0.3	-0.7	2.4	3.0	51.2	0.04	0.77	3.7
Electrical mach & comm services	15.5	-0.4	-1.8	7.8	6.9	56.9	0.04	0.77	18.6
Manufacturing excl. electrical	2.7	-0.2	-1.4	1.3	4.5	50.2	0.04	0.77	1.1

Other goods producing industries	-0.2	-0.5	0.3	1.0	4.2	56.9	0.04	0.77	-3.2
Distribution services	1.8	-0.1	0.7	2.7	3.5	51.7	0.04	0.77	0.4
Finance and business services	2.5	-0.5	-2.0	0.9	-2.2	48.5	0.04	0.77	8.0
Personal and social services	2.2	-0.2	23.6	6.9	4.3	32.2	0.04	0.77	-18.5

Notes:

y = Value-added growth rate (%)

h = Contribution of labor hours (%)

e = Contribution of labor input (%)

x = Contribution of capital input (%)

k = Contribution of capital –labor ratio(%)

k* = Contribution of capital –employment ratio (%)

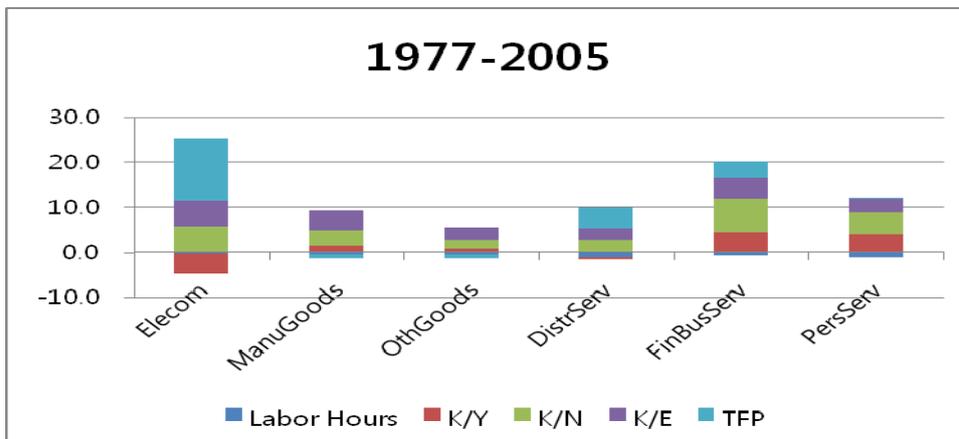
θ = value share of capital input (%)

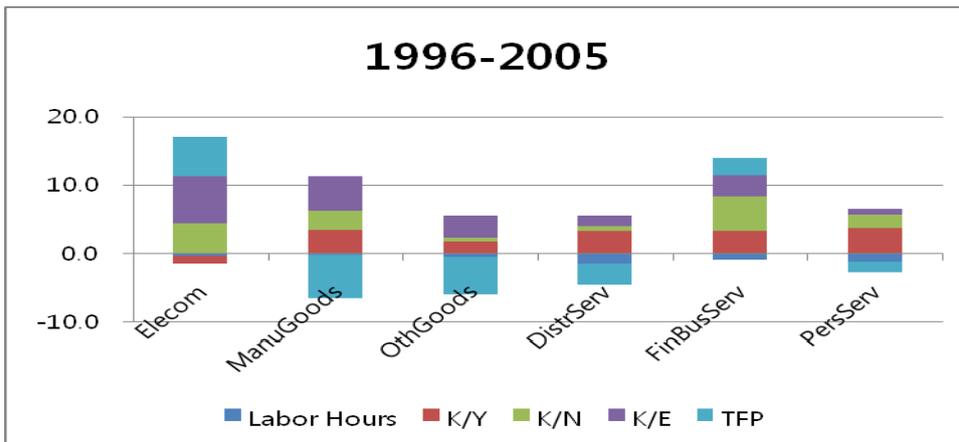
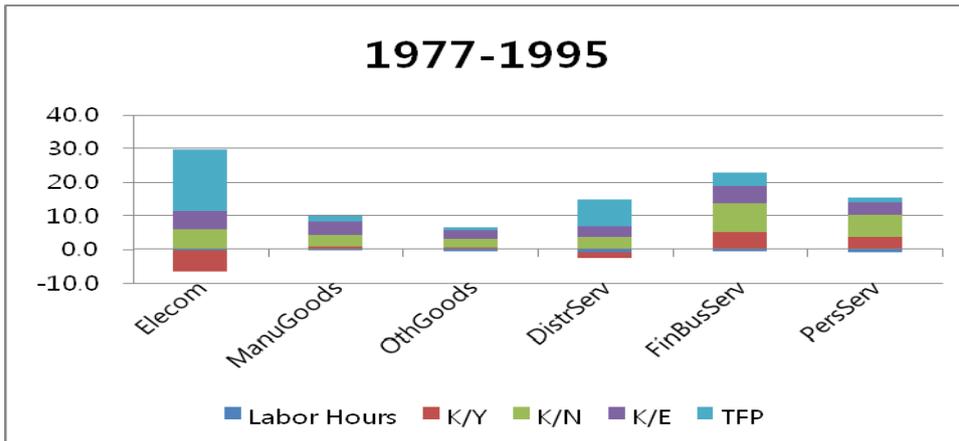
u = average unemployment rate

v = average operating ratio

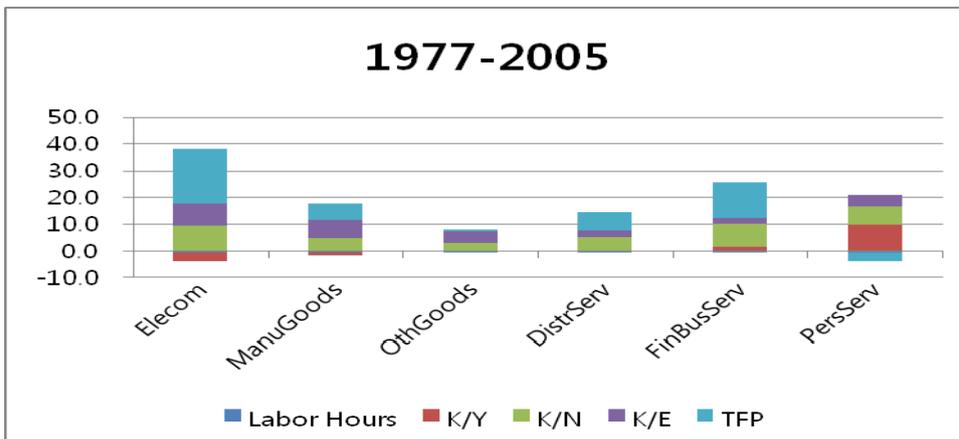
TFP = Contribution of total factor productivity growth (%)

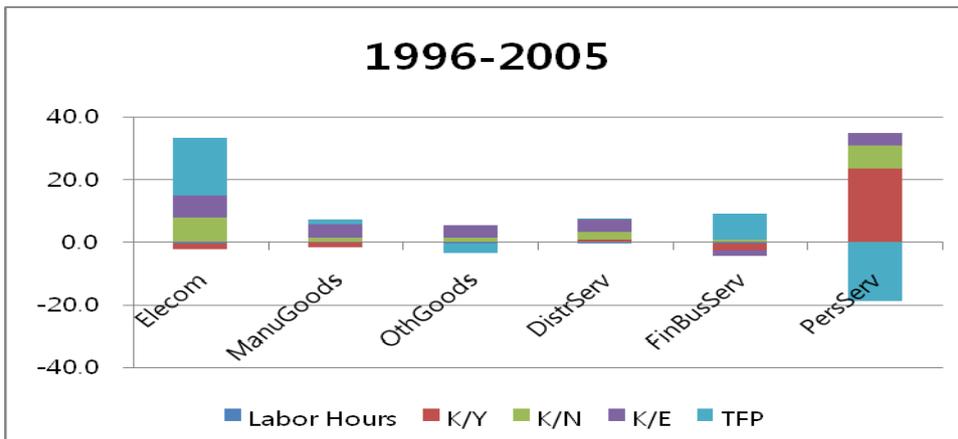
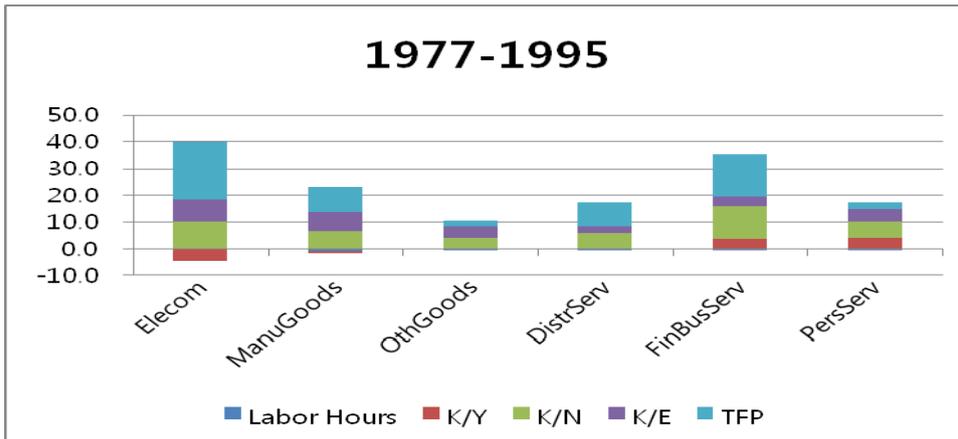
Figure 3 Contributions to Market Economy Value-Added Growth by Sector
Panel A. Japan





Panel B. Korea





Notes:

Elecom = Electrical machinery and post & communication services (26-33, 52)

ManuGoods = Manufacturing excluding electrical machinery (9-25, 34-39)

OthGoods= Other goods producing industries (1-8, 40-43)

DistrServ = Distribution Services (44-46, 48-51)

FinBusServ= Finance and business services (53-55, 58-62)

PersServ= Personal and social services (47, 66-71)

4. Concluding Remarks

According to Hayashi and Prescott (2002), the TFP growth rate of Japan declined by more than 2 % points from the 1980s to 1990s. Fukao and Kwon (2005) argue that this corresponds to a 3 % point decline in the balanced growth rate. On the other hand, Jorgenson and Motohashi (2003) found that the TFP growth of Japan in the 1990s was not substantially lower than in the 1980s.

We have applied the growth accounting model of Hayashi and Prescott type to 72-

industry data of EU-KLEMS Japan Dataset and Korea Dataset. The economy-wide growth decomposition indicates that the relative contribution of TFP during the former period of 1977-2005 was about 70 percent which is rather significant compared to capital intensity growth (30 %). But the picture has been turned around during the post-crisis period of 1996-2005 with higher growth rate of capital intensity (3.1 %) and lower growth rate of TFP (- 0.9 %).

The decomposition of 72 sectors into several groups reveals striking patterns of growth in different sub-sectors. For example, in ICT Manufacturing after 1996, the dominant growth of per capita GDP (6.5 %) of the sector is mostly accounted for by the growth rate of TFP (9.9 %) while its capital intensity has grown at the rate of - 1.0 % implying that capital productivity(Y/K) has increased tremendously during the period reflecting ICT boom. Among Service sectors, Finance and business service ranks first in the growth rate of value added (2.9 %) , but Distribution service ranks first in TFP growth (-1.8 %) for the period after 1996.

We have also conducted a multi-sector growth accounting to EU-KLEMS Japan Data set (May 2008 version) and Korea Dataset (August 2008 version) accommodating the concept of effective labor and capital input. For this purpose, we have augmented labor input by unemployment rate and capital input by capacity utilization rate. The Japanese market economy as a whole has grown at the rate of per capita GDP (3.5 %), TFP (3.9 %), capital intensity (1.0 %) with average hours worked (-0.8 %) and employment rate (0.7 %) which is the difference between capital-labor ratio (4.4 %) and capital-employment ratio (3.7 %) during the former period of 1977-1995. The higher-growth of per capita GDP during the earlier period was mainly contributed not by the growth of capital intensity (1.0 %) but by TFP growth (3.9 %). On the other hand, the post-1996 period's slower growth of per capita GDP (0.7 %) was mainly due the reduction in the growth rate of working hours (- 0.9 %) and TFP (-2.2 %).

In case of Korea's market economy, its per capita GDP has grown at the rate of 5.9 mainly helped by TFP growth (7.7 %) during the former period of 1977-1995. On the other hand, the slower growth rate of per capita GDP (3.3 %) in the latter period of 1996-2005 is decomposed by declining working hours (-0.3 %) and capital intensity growth (-0.7 %) but increased TFP growth (3.7 %).

The estimates of present paper indicates that Korea could have maintained 5.0-7.0 % level of potential GDP growth rate and Japan could have maintained 3.0- 4.0 % level

during the first half of 2000s if a better set of investment environment was created during the period of early 2000s as outlined in Pyo (2006). In order to achieve this goal, we have found the faster growth of capital intensity alone or the improvement of capacity utilization and employment rate through expansionary fiscal and monetary policy cannot be a sufficient factor. Both economies need to improve upon higher employment and higher capacity utilization and total factor productivity.

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Appendix

Table A-1. 72-Industry Classification and Coverage

Code	Industry Name	Note
Agriculture and Mining (1-8)		
1	Agriculture	
2	Forestry	
3	Fishing	
4	Mining of coal and lignite; extraction of peat	
5	Extraction of crude petroleum and natural gas and services	2004-2005
6	Mining of uranium and thorium ores	N.A.
7	Mining of metal ores	
8	Other mining and quarrying	
Manufacturing (9-39)		
9	Food products and beverages	
10	Tobacco products	
11	Textiles	
12	Wearing apparel, dressing and dyeing of fur	
13	Leather, leather products and footwear	
14	Wood and products of wood and cork	
15	Pulp, paper and paper products	
16	Publishing	
17	Printing and reproduction	
18	Coke, refined petroleum products and nuclear fuel	
19	Pharmaceuticals	
20	Chemicals excluding pharmaceuticals	
21	Rubber and plastics products	
22	Other non-metallic mineral products	
23	Basic metals	
24	Fabricated metal products	
25	Machinery, nec	
26	Office, accounting and computing machinery	
27	Insulated wire	
28	Other electrical machinery and apparatus nec	
29	Electronic valves and tubes	

30	Telecommunication equipment	
31	Radio and television receivers	
32	Scientific instruments	
33	Other instruments	
34	Motor vehicles, trailers and semi-trailers	
35	Building and repairing of ships and boats	
36	Aircraft and spacecraft	1976-2005
37	Railroad equipment and transport equipment nec	
38	Manufacturing nec	
39	Recycling	N.A.
	Utilities and Construction (40-43)	
40	Electricity supply	
41	Gas supply	
42	Water supply	
43	Construction	
	Services (44-72)	
44	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of fuel	
45	Wholesale trade and commission trade, except of motor vehicles and motorcycles	
46	Retail trade, except of motor vehicles and motorcycles; repair of household goods	
47	Hotels and restaurants	
48	Inland transport	
49	Water transport	
50	Air transport	
51	Supporting and auxiliary transport activities; activities of travel agencies	
52	Post and telecommunications	
53	Financial intermediation, except insurance and pension funding	
54	Insurance and pension funding, except compulsory social security	1976-2005
55	Activities related to financial intermediation	1986-2005
56	Imputation of owner occupied rents	N.A. (Incl. in 57)
57	Real estate activities	
58	Renting of machinery and equipment	
59	Computer and related activities	
60	Research and development	
61	Legal, technical and advertising	

62	Other business activities, nec	
63	Public admin and defense; compulsory social security	
64	Education	
65	Health and social work	
66	Sewage and refuse disposal, sanitation and similar activities	
67	Activities of membership organizations nec	
68	Media activities	
69	Other recreational activities	
70	Other service activities	
71	Private households with employed persons	
72	Extra-territorial organizations and bodies	N.A.

Table A-2. Classification of Market Economy

Industry Name
Market Economy (1-72 except for 56,57,63,64,65)
Electrical machinery and post & communication services (26-33, 52)
Manufacturing excluding electrical machinery (9-25, 34-39)
Other goods producing industries (1-8, 40-43)
Distribution Services (44-46, 48-51)
Finance and business services (53-55, 58-62)
Personal and social services (47, 66-71)

Sources of Data

(1) Japan

1.1 Working Age Population (*N*)

- The working-age population is defined as the number of people between ages 20 and 69 following the definition of Hayashi and Prescott (2002).
- For years up to 2000, Portal Site of Official Statistics of Japan (e-stat, <http://www.e-stat.ac.jp>) has time series for population estimates. To extend time period to 2005, we use the annual report, “Current Population Estimates” at e-stat website.
- For 2005, we use 2005 Population Census data.

1.2 Unemployment Rate (u)

- The data source is the Labour Force Survey. These also can be found at e-stat site.
- We assume that every industry group has the same unemployment rate because unemployment data are not decomposed into industry level.

1.3 Operating Ratio (v)

- Data are available at JIP website.
- Since JIP database reports annual series of 107 industries, we match them with 72-industry classification and then we integrate the classification into 6 groups for market economy.
- Data for 2004 are used for 2005 because of lack of data.

(2) Korea

2.1 Working Age Population (N)

- Data for working age population are available from the National Statistical Office.

2.2 Unemployment Rate (u)

- We use Economically Active Population (EAP) data by the National Statistical Office.
- We assume that every industry groups has the same unemployment rate because unemployment data are not decomposed into industry level.

2.3 Operating Ratio (v)

- We use seasonally adjusted average operating ratio data for v .
- Data source is the National Statistical Office.
- Data for 1980 are used for 1977-1979 because of lack of data.
- Contrary to data for Japan, operating ratio data for Korea exists only for Manufacturing.
- Therefore we assume that every industry group has the same operating ratio.