



Estimates of Gross Fixed Capital Formation, Net Capital Stock and Capital Intensity in Korea: by 11 Assets and by 72 Industries (1970-2005)

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I . Introduction

- This is the further study of Pyo(2003)
- The purpose of this paper is to construct database according to the EU KLEMS guideline and discuss the application of the KLEM-methodology to the Korean database and to present the result of growth accounting and productivity analysis.
- We have constructed the detailed database of consistent GFCF and net capital stock data for the Korean economy for the period of 1970-2005 according to the EU KLEMS guideline.
- We also generate quarterly net capital stock.



I . Introduction

- The most significant contribution of this paper is to make use of I/O Matrix (Supporting table in I/O Table, Bank of Korea) that has not been used for these kinds of studies.
- We extended the category of the Capital Stock into 11 asset type and 72 industrial sector. This decomposition make the study on productivity more delicate.



I . Introduction

- Main Improvement of this paper
 - 1) We decomposed the GFCF and Capital Stock using I/O Matrix(2000, 2003)
 - 2) We estimated 11 asset type (including Intangibles) and 72 industry following the guideline of EU KLEMS project to make the international comparison of productivity possible.
 - 3) We estimated Intangible capital stock and ICT assets (Information and communication assets) using the GFCF data of Intangible fixed assets (Computer Software) of BOK

II. Classification and Definition of Net Capital Stock

1. EU KLEMS classification of Asset and Industry

<Table 1> Asset Classification of EU KLEMS and National Accounts

EUKLEMS	Asset
1	Residential structures
2	Non-residential structures
3	Infrastructure
4	Transport equipment
5	Computing equipment
6	Communications equipment
7	Other machinery and equipment
8	Products of agriculture and forestry
9	Other products
10	Software
11	Other intangibles

Sources: EUKLEMS(2007), EU KLEMS Growth and Productivity Accounts,
Version 1.0, March 2007, p.35

EUKLEMS	National Accounts
1	Residential structures
2	Non residential structures
3	Infrastructure
4	Transport equipment
5+6+7	Machinery and equipment
10	Intangible fixed asset investment
	Gross Fixed Capital Formation

Sources: National Accounts, Bank of Korea

II. Classification and Definition of Net Capital Stock

1. EU KLEMS classification of Asset and Industry

<Table 2> Industry Classification of EU KLEMS and National Accounts

Industries classification of EU KLEMS			
1	Agriculture	21	Rubber and plastics products
2	Forestry	22	OTHER NON-METALLIC MINERAL PRODUCTS
3	FISHING	23	Basic metals
4	Mining of coal and lignite; extraction of peat	24	Fabricated metal products
5	Extraction of crude petroleum and natural gas and services	25	MACHINERY, NEC
6	Mining of uranium and thorium ores	26	Office, accounting and computing machinery
7	Mining of metal ores	27	Insulated wire
8	Other mining and quarrying	28	Other electrical machinery and apparatus nec
9	Food products and beverages	29	Electronic valves and tubes
10	Tobacco products	30	Telecommunication equipment
11	Textiles	31	Radio and television receivers
12	Wearing Apparel, Dressing And Dying Of Fur	32	Scientific instruments
13	Leather, leather products and footwear	33	Other instruments
14	WOOD AND PRODUCTS OF WOOD AND CORK	34	Motor vehicles, trailers and semi-trailers
15	Pulp, paper and paper products	35	Building and repairing of ships and boats
16	Publishing	36	Aircraft and spacecraft
17	Printing and reproduction	37	Railroad equipment and transport equipment nec
18	Coke, refined petroleum products and nuclear fuel	38	Manufacturing nec
19	Pharmaceuticals	39	Recycling
20	Chemicals excluding pharmaceuticals	40	Electricity supply

Sources: EUKLEMS(2007), EU KLEMS growth and productivity accounts, Version 1.0, March 2007, pp.11-12

II. Classification and Definition of Net Capital Stock

1. EU KLEMS classification of Asset and Industry

<Table 2> Industry Classification of EU KLEMS and National Accounts

Industries classification of EU KLEMS			
41	Gas supply	57	Other real estate activities
42	WATER SUPPLY	58	Renting of machinery and equipment
43	CONSTRUCTION	59	Computer and related activities
44	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of fuel	60	Research and development
45	Wholesale trade and commission trade, except of motor vehicles and motorcycles	61	Legal, technical and advertising
46	Retail trade, except of motor vehicles and motorcycles; repair of household goods	62	Other business activities, nec
47	HOTELS AND RESTAURANTS	63	PUBLIC ADMIN AND DEFENCE; COMPULSORY SOCIAL SECURITY
48	Inland transport	64	EDUCATION
49	Water transport	65	HEALTH AND SOCIAL WORK
50	Air transport	66	Sewage and refuse disposal, sanitation and similar activities
51	Supporting and auxiliary transport activities; activities of travel agencies	67	Activities of membership organizations nec
52	POST AND TELECOMMUNICATIONS	68	Media activities
53	Financial intermediation, except insurance and pension funding	69	Other recreational activities
54	Insurance and pension funding, except compulsory social security	70	Other service activities
55	Activities related to financial intermediation	71	PRIVATE HOUSEHOLDS WITH EMPLOYED PERSONS
56	Imputation of owner occupied rents	72	EXTRA-TERRITORIAL ORGANIZATIONS AND BODIES

Sources: EUKLEMS(2007), EU KLEMS growth and productivity accounts, Version 1.0, March 2007, pp.11-12

II. Classification and Definition of Net Capital Stock

1. EU KLEMS classification of Asset and Industry

Industry classification of National Accounts

National Accounts	Industry	EU KLEMS Code
1	Agriculture, forestry and fishing	1~3
2	Mining and quarrying	4~8
3	Manufacturing	9~39
4	Electricity, Gas and Water Supply	40~42
5	Construction	43
6	Wholesale and retail trade, restaurants	44~47
7	Transport, storage and communication	48~52
8	Financial intermediation	53~55
9	Real estate, renting and business activities	56~62
10	Public administration and defence	63
11	Education	64
12	Health and social work	65
13	Other service activities	66~72

Sources: National Accounts, Bank of Korea

II. Classification and Definition of Net Capital Stock

2. Definition of Net Capital Stock

- Net Capital Stock means Gross Capital Stock minus Gross Capital depreciation cumulated until that time.
- Net Capital Stock=Gross Capital Stock + Gross Fixed Capital Formation – Fixed Capital Depreciation + The value of change by the other factor which alter the Capital Stock + The Gross value of the net change due to the change of holding gain from the change of asset price
- The economy-wide market value of fixed asset at period t
- $$NK_t = I_t + (1 - \delta)I_{t-1} + (1 - \delta)^2 I_{t-2} + \dots$$
$$+ (1 - \delta)^{s-1} I_{t-s+1} + (1 - \delta)^s I_{t-s}$$

III. Estimation of GFCF by Asset and Industry

1. Estimation of GFCF by Asset

- To decompose the 6 asset type GFCF in 1970~2005 of National Accounts into EU-KLEMS 11 asset types, we used the I/O Tables existing irregularly in 1970~2003, and used the fixed weight of 2003 for decomposition after 2003.
- We decomposed ‘Machinery and Equipment’ into ‘IT (Computing Equipment)’, ‘CT (Communication Equipment)’ and ‘Other Machinery and Equipment’ using the weight from IO table, which can tell ‘Computer Equipment’ and ‘Communication and Broadcasting Equipment’ from the ‘Machinery and Equipment’ in the Fixed Capital Formation (private and public).
- For the year when there isn’t I/O Table, we estimated the weight by linear interpolation of near year.

III. Estimation of GFCF by Asset and Industry

1. Estimation of GFCF by Asset

<Table 4> Weight of ICT assets in Machinery and Equipment from I/O Tables

Weight from I/O Tables		1996	1997	1998 *	1999	2000 *	2001	2002	2003 *	2004	2005
5	Computing Equipment	0.087	0.098	0.109	0.119	0.128	0.105	0.083	0.060	0.060	0.060
6	Communication Equipment	0.107	0.140	0.173	0.175	0.178	0.157	0.136	0.115	0.115	0.115
7	Other Machinery and Equipment	0.806	0.762	0.718	0.706	0.694	0.738	0.781	0.825	0.825	0.825

* The year when there exist I/O Table

III. Estimation of GFCF by Asset and Industry

1. Estimation of GFCF by Asset

<Table 5> The growth rate of ICT asset (%)

Growth rate (%)		1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
5	Computing	33.1	14.3	38.1	4.6	30.3	38.7	41.4	40.5	32.4	-21.4	12.1	17.5
6	Communication	33.1	14.3	38.1	19.0	43.3	42.5	46.2	46.6	59.8	-9.4	21.3	24.5
10	Software	5.9	-9.1	42.6	7.6	10.2	48.2	13.2	-1.6	27.2	11.4	6.6	0.2

Growth rate (%)		1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
5	Computing	21.2	24.0	10.8	66.1	-1.3	48.9	3.7	3.0	25.1	4.6	6.2	24.4
6	Communication	26.6	5.6	-6.6	24.8	14.7	-8.5	22.9	23.0	18.5	-0.5	1.4	15.9
10	Software	3.0	37.1	68.0	29.3	28.5	11.0	24.6	10.6	27.0	18.4	14.6	26.1

Growth rate (%)		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Average
5	Computing	24.9	24.9	2.8	-32.8	40.0	47.9	-24.2	-16.4	-25.9	7.2	7.4	16.4
6	Communication	15.8	57.8	19.5	-25.3	30.8	39.0	-18.7	-7.6	-13.5	7.2	7.4	18.0
10	Software	21.3	16.2	6.4	-0.6	19.5	22.3	6.4	14.2	-0.9	0.9	8.1	16.4

III. Estimation of GFCF by Asset and Industry

1. Estimation of GFCF by Asset

- In the average growth rate of GFCF by asset in the whole periods, Communication equipment(18.0%), Computing equipment(16.4%) and Software(16.4%) shows the highest growth rate.
- Products of agriculture and forestry and Other products aren't identified in the statistical data, and Other Intangibles also doesn't exist in the official statistical data.
- The growth rate of ICT asset GFCF in 1998~2005 is Computing Equipment(0.4%), Communication Equipment(2.4%), Software(8.7%), which is much less than the average in all periods(1970~2005). Maybe IT boom didn't affect gfcf in IT assets much, but affected buildings and other machinery and equipment only.

III. Estimation of GFCF by Asset and Industry

1. Estimation of GFCF by Asset

<Table 6> Growth rate of GFCF by asset (%)

		1970-1983	1984-1997	1998-2005	1970-2005
1	Residential structures	12.8	10.7	1.4	9.4
2	Non-residential structures	11.3	11.1	1.2	8.9
3	Infrastructure	12.1	10.2	-0.1	8.5
4	Transport equipment	13.6	10.0	1.9	9.5
5	Computing equipment	23.3	19.1	0.4	16.4
6	Communications equipment	31.2	14.6	2.4	18.0
7	Other machinery and equipment	19.3	12.9	6.4	13.8
8	Products of agriculture and forestry	0.0	0.0	0.0	0.0
9	Other products	0.0	0.0	0.0	0.0
10	Software	12.7	24.2	8.7	16.4
11	Other intangibles	0.0	0.0	0.0	0.0
	Sum	12.8	11.1	1.6	9.5

III. Estimation of GFCF by Asset and Industry

1. Estimation of GFCF by Asset

<Table 7> GFCF of ICT sector in 1996~2005 (Billion won, 2000 constant prices)

		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
5	Computing equipment	5,051	5,193	3,488	4,884	7,222	5,473	4,577	3,392	3,637	3,906
6	Communication equipment	6,183	7,387	5,516	7,212	10,023	8,146	7,526	6,508	6,979	7,494
10	Software	5,873	6,249	6,209	7,420	9,071	9,650	11,025	10,931	11,027	11,919

III. Estimation of GFCF by Asset and Industry

2. Estimation of GFCF by Industry

A. Estimation of GFCF by Industry in 1970~1997

- Mining, Manufacturing Survey (Report on Industrial Census) exist only after 1999, and I/O Matrix also exist only in 1990, 1995, 2000, 2003
- We have decomposed 13-industry data of *GFCF* from National Accounts into 72 EU-KLEMS industries' *GFCF* by making use of the difference between two benchmark years' NWS capital stock as decomposition weights for the period of 1970-1997.
 - 1) Reduction the NWS in 1968,1977,1987,1997 into 72 industries
 - 2) Estimate the weights by the three inter-period differences of NWS

III. Estimation of GFCF by Asset and Industry

2. Estimation of GFCF by Industry

A. Estimation of GFCF by Industry in 1970~1997

- Decomposition 13-industry data of *GFCF* from National Accounts into 72 EU-KLEMS industries' *GFCF* by making use of the difference between two benchmark years' NWS capital stock as decomposition weights for the period of 1970-1997.
- In this decomposition weights mean the weights in each 13 industries of National Accounts, so that GFCF in each 13 industries of National Accounts remain unchanged.

III. Estimation of GFCF by Asset and Industry

2. Estimation of GFCF by Industry

B. Estimation of GFCF by Industry in 1998~2005

1) Mining and Manufacturing

- For the period of 1998-2005, we have used Report on Industrial Census to redistribute Mining and Manufacturing industries for further detailed industrial classification
- We used the Intangible asset increase as the decomposition weight.

III. Estimation of GFCF by Asset and Industry

2. Estimation of GFCF by Industry

B. Estimation of GFCF by Industry in 1998~2005

2) Agriculture, Forestry and Fishery and Service industries

- ① For Decomposition, We used I/O Matrix(96-asset by 71-industry, not owner based but activity based)
- ② For further decomposition, we estimated the decomposition weight by making use of 1997 NWS(Net value, owner based)

In this decomposition weights mean the weights in each 13 industries of National Accounts, so that GFCF in each 13 industries of National Accounts remain unchanged.

III. Estimation of GFCF by Asset and Industry

2. Estimation of GFCF by Industry

B. Estimation of GFCF by Industry in 1998~2005

2) Agriculture, Forestry and Fishery and Service industries

③ Redistribution of Public Capital

In making use of I/O Matrix, first, We need to redistribute the 71th industrial sector named 'Public Capital' .

For this, we have consolidated I/O Matrix into 9-asset by 72-industry matrix. Public capital are distributed by only three types of assets: Residential Buildings, Civil Engineering Work and Other Structures

III. Estimation of GFCF by Asset and Industry

2. Estimation of GFCF by Industry

B. Estimation of GFCF by Industry in 1998~2005

2) Agriculture, Forestry and Fishery and Service industries

③ Redistribution of Public Capital

a. Civil Engineering Work

Following the SOC composition ratio (Table 9, p.25) in 1997 NWS, we redistributed 55.4% of public capital into Transport sector, 7.3% into Communication sector, 13% into Electricity, Gas Supply sector, 5.7% into Water supply sector, and 18.6% into irrigation and flood control sector.

b. Other Structures

Redistribution into 72 industries by the weight of each industry except public capital

III. Estimation of GFCF by Asset and Industry

2. Estimation of GFCF by Industry

B. Estimation of GFCF by Industry in 1998~2005

2) Agriculture, Forestry and Fishery and Service industries

③ Redistribution of Public Capital

c. Residential Buildings

According to 1997 NWS, 273,743 billion won (about 90% of Residential buildings) belong to household sector, and 31,694 billion won (about 10% of Residential buildings) belong to Non-Household sector.

<Table 8> Ownership of Residential buildings

Billion Won, 2000 Constant Prices	Net value	Ratio (%)
Residential Buildings	305,437	100.0
Government	3,446	1.1
Corporation	24,173	7.9
Nonprofit Organization	4,075	1.3
Household sector	273,743	89.6

Sources: 1997, National Wealth Survey

III. Estimation of GFCF by Asset and Industry

2. Estimation of GFCF by Industry

B. Estimation of GFCF by Industry in 1998~2005

2) Agriculture, Forestry and Fishery and Service industries

③ Redistribution of Public Capital

c. Residential Buildings

According to this ratio, first, we redistributed 22,858 billion won (about 90% of public capital in residential buildings) into Real Estate Activity.

Then, we redistributed 2,373 billion won (about 10% of public capital) into 72 industries by the weight of each industry in residential buildings.

III. Estimation of GFCF by Asset and Industry

2. Estimation of GFCF by Industry

B. Estimation of GFCF by Industry in 1998~2005

<Table 9> 9 asset × 13 industry consolidated I/O Matrix(2000)
Before the redistribution of public capital

2000		1	2	3	4	5	6	7	8	9	10	11	12	13	14	
	EUKLEMS	Agriculture, etc.	Mining	Manufacturing	Electricity, Gas, Water	Construction	Wholesale, Restaurants	Transport, Communication	Financial	Real estate, etc.	public administration	Education	Health, Social work	Other Service	Public Capital	GFCF
0	Agriculture	93	0	16	1	1	2	5	0	2	22	4	1	20	0	167
1	Residential	0	0	0	0	0	0	0	0	0	0	0	0	0	22,858	22,858
2	Non-Residential	281	10	3,196	297	176	7,816	1,578	490	567	5,260	979	355	1,346	0	22,351
3	Infrastructures	0	0	0	0	0	0	0	0	0	0	0	0	0	40,971	40,971
4	Other Structures	3	20	624	23	1	21	23	15	1	371	9	29	42	2,691	3,874
5	Transport	772	55	2,601	80	410	1,217	8,388	103	930	196	419	191	839	0	16,201
6	Machinery	1,767	53	30,351	1,855	969	2,412	7,253	2,061	1,917	1,510	2,805	1,685	3,463	0	58,102
7	Service	334	20	3,403	287	160	616	1,770	415	486	64	605	322	632	0	9,114
8	Software	2	0	2,454	225	237	772	750	1,497	834	376	1,038	281	112	0	8,576
	Sum	3,252	159	42,645	2,767	1,953	12,856	19,767	4,583	4,738	7,798	5,860	2,863	6,453	66,520	182,214

After the redistribution of public capital

2000		1	2	3	4	5	6	7	8	9	10	11	12	13	
	EUKLEMS	Agriculture, etc.	Mining	Manufacturing	Electricity, Gas, Water	Construction	Wholesale, Restaurants	Transport, Communication	Financial	Real estate, etc.	public administration	Education	Health, Social work	Other Service	GFCF
0	Agriculture	93	0	16	1	1	2	5	0	2	22	4	1	20	167
1	Residential	108	6	391	34	1,097	82	18	10	20,755	1	117	184	55	22,858
2	Non-Residential	281	10	3,196	297	176	7,816	1,578	490	567	5,260	979	355	1,346	22,351
3	Infrastructures	7,621	0	0	7,662	0	0	25,689	0	0	0	0	0	0	40,971
4	Other Structures	10	67	2,043	76	2	70	76	50	4	1,216	31	95	136	3,874
5	Transport	772	55	2,601	80	410	1,217	8,388	103	930	196	419	191	839	16,201
6	Machinery	1,767	53	30,351	1,855	969	2,412	7,253	2,061	1,917	1,510	2,805	1,685	3,463	58,102
7	Service	334	20	3,403	287	160	616	1,770	415	486	64	605	322	632	9,114
8	Software	2	0	2,454	225	237	772	750	1,497	834	376	1,038	281	112	8,576
	Sum	10,987	211	44,455	10,515	3,051	12,987	45,526	4,627	25,496	8,644	5,998	3,113	6,603	182,214

Sources: Input-Output Tables(2000), Bank of Korea

III. Estimation of GFCF by Asset and Industry

2. Estimation of GFCF by Industry

B. Estimation of GFCF by Industry in 1998~2005

<Table 10> 9 asset × 13 industry consolidated I/O Matrix(2003)

Before the redistribution of public capital

2003		1	2	3	4	5	6	7	8	9	10	11	12	13	14	
	EUKLEMS	Agriculture .etc.	Mining	Manufac turing	Electricity, Gas,Water	Construction	Wholesale, Restaurants	Transport, Communication	Financial	Real estate, etc.	public administration	Education	Health, Social work	Other Service	Public Capital	GFCF
0	Agriculture	121	0	13	1	1	3	7	0	4	42	12	2	15	0	221
1	Residential	0	0	0	0	0	0	0	0	0	0	0	0	0	36,556	36,556
2	Non-Residential	377	10	6,736	500	453	12,832	2,350	736	3,150	8,521	2,235	1,298	3,141	0	42,340
3	Infrastructures	0	0	0	0	0	0	0	0	0	0	0	0	0	46,671	46,671
4	Other Structures	12	7	924	22	112	12	18	2	25	592	2	1	8	2,122	3,858
5	Transport	871	62	3,556	124	772	1,516	6,600	146	1,227	571	640	319	1,262	0	17,665
6	Machineray	1,226	62	29,001	1,689	1,156	1,997	4,441	1,239	1,864	1,692	2,659	1,677	2,798	0	51,502
7	Service	218	78	2,647	216	135	491	927	348	430	65	592	336	506	0	6,989
8	Software	3	0	4,071	408	470	1,037	1,576	2,684	1,506	438	1,860	534	395	0	14,983
	Sum	2,827	218	46,948	2,961	3,098	17,888	15,918	5,156	8,205	11,921	8,000	4,167	8,126	85,348	220,783

After the redistribution of public capital

2003		1	2	3	4	5	6	7	8	9	10	11	12	13	
	EUKLEMS	Agriculture .etc.	Mining	Manufac turing	Electricity, Gas,Water	Construction	Wholesale, Restaurants	Transport, Communication	Financial	Real estate, etc.	public administration	Education	Health, Social work	Other Service	GFCF
0	Agriculture	121	0	13	1	1	3	7	0	4	42	12	2	15	221
1	Residential	173	9	625	54	1,755	132	28	15	33,193	1	187	295	89	36,556
2	Non-Residential	377	10	6,736	500	453	12,832	2,350	736	3,150	8,521	2,235	1,298	3,141	42,340
3	Infrastructures	8,681	0	0	8,727	0	0	29,262	0	0	0	0	0	0	46,671
4	Other Structures	26	15	2,054	49	249	26	40	5	55	1,314	5	2	18	3,858
5	Transport	871	62	3,556	124	772	1,516	6,600	146	1,227	571	640	319	1,262	17,665
6	Machineray	1,226	62	29,001	1,689	1,156	1,997	4,441	1,239	1,864	1,692	2,659	1,677	2,798	51,502
7	Service	218	78	2,647	216	135	491	927	348	430	65	592	336	506	6,989
8	Software	3	0	4,071	408	470	1,037	1,576	2,684	1,506	438	1,860	534	395	14,983
	Sum	11,695	236	48,703	11,770	4,990	18,034	45,231	5,175	41,428	12,646	8,189	4,463	8,224	220,783

Sources: Input-Output Tables(2003), Bank of Korea



III. Estimation of GFCF by Asset and Industry

2. Estimation of GFCF by Industry

B. Estimation of GFCF by Industry in 1998~2005

2) Agriculture, Forestry and Fishery and Service industries

- ④ After the redistribution of public capital, we decomposed the Agriculture, Forestry and Fishery and Service industries into 72 industries using the sum of 72 industries in I/O matrix as the decomposition weight

III. Estimation of GFCF by Asset and Industry

2. Estimation of GFCF by Industry

B. Estimation of GFCF by Industry in 1998~2005

2) Agriculture, Forestry and Fishery and Service industries

In <Table 11>, to look at the trend of GFCF by industry, we reclassified the EU KLEMS 72 industries into 7 industry category. Specially, we categorized service sector into 4 industry sector according to J.H.Kim, 'Reviving manufacturing in Korea', KDI Report.

<Table 12> shows that Mining/ Manufacturing/ Electricity, Gas, Water Supply (12.5%) and Distribution Service(12.5%) were highest in GFCF growth rate, and IT industry(5.4%) was relatively low.

III. Estimation of GFCF by Asset and Industry

2. Estimation of GFCF by Industry

B. Estimation of GFCF by Industry in 1998~2005

<Table 11> Classification of 7 Industries

Code	Industry	EU-KLEMS code
1	Agriculture, forestry and fishing	1~3
2a	ICT (Computing and communication equipment)	26,30
2b	Other manufacturing/Mining /Electricity, Gas, Water Supply	4~25, 27~29, 31~43
3a	Producer service	52~62
3b	Distribution service	44~46, 48~51
3c	Consumer service	47, 68~71
3d	Social Service	63~67

III. Estimation of GFCF by Asset and Industry

2. Estimation of GFCF by Industry

B. Estimation of GFCF by Industry in 1998~2005

<Table 12> Average growth rate of GFCF by Industry (%)

		1970-1983	1984-1997	1998-2005	1970-2005
	Whole Industry	12.8	11.1	1.6	9.5
1	Agriculture, forestry and fishing	7.4	9.8	2.4	6.1
2	Mining/Manufacturing	18.0	12.3	4.0	12.5
2a	ICT (Computing and communication equipment)	-1.5	13.5	2.6	5.4
2b	Other manufacturing/Mining /Electricity, Gas, Water Supply	17.4	12.3	4.3	12.4
3	Service	12.3	11.0	1.1	9.2
3a	Producer service	12.7	12.9	-0.4	9.8
3b	Distribution service	22.7	9.0	2.0	12.5
3c	Consumer service	7.6	12.5	5.7	9.1
3d	Social Service	11.4	9.8	3.3	8.9

III. Estimation of GFCF by Asset and Industry

3. Estimation of Quarterly GFCF by Asset

- Using the weight which was used in the estimation of yearly GFCF by asset, We decomposed the Quarterly GFCF by 6 assets in National Account into EU-KLEMS 11 Assets.
- We decomposed ‘Machinery and Equipment’ into ‘IT(Computing Equipment)’, ‘CT(Communication Equipment)’ and ‘Other Machinery and Equipment’ using the weight from IO table, which can tell ‘Computer Equipment’ and ‘Communication and Broadcasting Equipment’ from the ‘Machinery and Equipment’ in the Fixed Capital Formation (private+public).

IV. Estimation of Capital Stock by Asset and Industry

1. Estimation of Capital Stock by Asset

A. Estimation of Capital Stock by Asset in 1970~1997

- 1) Change the National Wealth Survey(NWS, ownership based, current prices) in 1968, 1977, 1987, 1997 into 2000 constant prices using the GFCF Deflator in the National Account.

Table) GFCF Deflator

	Deflator(2000=100)
1968	5.23
1977	19.29
1987	48.64
1997	91.11

- 2) Reduction into 6 assets, and interpolation the years when NWS doesn't exist.
- 3) Using the weight from IO Table, We decomposed the Capital Stock by 6 assets in the National Account into EU-KLEMS 11 Assets.

IV. Estimation of Capital Stock by Asset and Industry

1. Estimation of Capital Stock by Asset

B. Estimation of Capital Stock by Asset in 1998~2005

- 1) Fixing the NWS(ownership based, net value) in 1997 by 6 assets into 1997 Capital Stock by asset.
- 2) Intangible asset doesn't exist in the NWS. Therefore we estimated intangible asset in 1997 by adding the Intangible asset investment of National Account with the depreciation rate of 31.5% (recommended by EU-KLEMS).

IV. Estimation of Capital Stock by Asset and Industry

1. Estimation of Capital Stock by Asset

B. Estimation of Capital Stock by Asset in 1998~2005

3) Using the GFCF by 11 assets in 1998~2005, we estimated Capital Stock by 11 assets by Perpetual Inventory Method

In this method, we used the estimated depreciation rate in Pyo, 'Estimate of Capital Stock by Industry and by Asset(1953~2000) in Korea' (Table 4, p.216). We also used the depreciation rate of 31.5% in the Intangible assets

IV. Estimation of Capital Stock by Asset and Industry

1. Estimation of Capital Stock by Asset

B. Estimation of Capital Stock by Asset in 1998~2005

<Table 15> Depreciation rate by Asset type (%)

	Depreciation rate		
	68-77	77-87	87-97
Tangible asset	5.1	5.7	4.6
Residential structures	5.5	1.2	3.3
Non-residential structures	-6.7	-1.3	3.0
Infrastructures	9.7	8.4	1.0
Transport equipment	49.3	28.7	16.9
Machinery and equipment	1.1	11.4	9.2

Sources: Pyo(2003)

IV. Estimation of Capital Stock by Asset and Industry

1. Estimation of Capital Stock by Asset

B. Estimation of Capital Stock by Asset in 1998~2005

<Table 14> The Recommended depreciation rate by EU KLEMS

EU KLEMS	Minimum rate over Industries	Maximum rate over Industries	Rate from Pyo (2003):1987-1997
Residential structures	0.011	0.011	0.033
Non-residential structures	0.023	0.069	0.03
Infrastructure	0.023	0.069	0.01
Transport equipment	0.061	0.246	0.139
Computing equipment	0.315	0.315	0.092
Communications equipment	0.115	0.115	0.092
Other machinery and equipment	0.073	0.164	0.092
Products of agriculture and forestry	0.073	0.164	n.a.
Other products	0.073	0.164	n.a.
Software	0.315	0.315	n.a.
Other intangibles	0.315	0.315	n.a.

IV. Estimation of Capital Stock by Asset and Industry

1. Estimation of Capital Stock by Asset

B. Estimation of Capital Stock by Asset in 1998~2005

- Software(19.5%), Communications Equipment(16.3%), Computing equipment(12.0%) show the highest growth rate over all periods
- Computing equipment shows the negative growth rate in 1998~2005, maybe this is because the depreciation of 31.5% in the computing equipment is too high.

IV. Estimation of Capital Stock by Asset and Industry

1. Estimation of Capital Stock by Asset

B. Estimation of Capital Stock by Asset in 1998~2005

<Table 16> Average growth rate of Capital Stock by asset (%)

		1970	1983	1984	1997	1998	2005	1970	2005
1	Residential structures		11.2		12.1		4.6		10.1
2	Non residential structures		13.7		11.0		4.7		10.6
3	Infrastructure		13.1		12.4		9.9		12.1
4	Transport equipment		12.2		11.0		1.6		9.3
5	Computing equipment		18.7		17.4		-8.5		12.0
6	Communications equipment		27.1		13.3		4.0		16.3
7	Other machinery and equipment		12.8		10.9		5.9		10.5
8	Products of agriculture and forestry		0.0		0.0		0.0		0.0
9	Other products		0.0		0.0		0.0		0.0
10	Software		22.0		22.5		10.0		19.5
11	Other intangibles		0.0		0.0		0.0		0.0
	Sum		12.9		11.8		6.0		10.8

IV. Estimation of Capital Stock by Asset and Industry

2. Estimation of Capital Stock by Industry

A. Estimation of Capital Stock by Industry in 1970~1997

- 1) Change the NWS (net value, current prices) by 72 Industries in 1997 into 2000 constant prices using the GFCF Deflator in the National Account.
- 2) Using the GFCF by 72 industries in 1998~2005, we estimated Capital Stock by 72 industries by Perpetual Inventory Method

IV. Estimation of Capital Stock by Asset and Industry

2. Estimation of Capital Stock by Industry

B. Estimation of Capital Stock by Industry in 1998~2005

- In this method, we used the estimated depreciation rate by industries in Pyo, 'Estimate of Capital Stock by Industry and by Asset(1953~2000) in Korea' (Table 6, p.216).

IV. Estimation of Capital Stock by Asset and Industry

2. Estimation of Capital Stock by Industry

B. Estimation of Capital Stock by Industry in 1998~2005

<Table 17> Depreciation rate by industrial sector (%)

	Depreciation rate		
	68-77	77-87	87-97
Whole industry	7.7	6.6	4.3
Agriculture, forestry and fishing	49.2	16.4	9.7
Mining and quarrying	18.0	16.3	24.8
Manufacturing	3.7	6.5	5.0
Electricity, Gas and Water Supply	11.5	12.6	8.6
Construction	-4.1	14.5	-7.7
Wholesale and retail trade, restaurants	3.1	5.4	-7.4
Transport, storage and communication	13.1	14.1	17.0
Financial intermediation	4.6	2.1	8.8
Social and private service	7.9	-5.4	-11.5
Public administration and defence	6.7	8.4	2.5

Sources: Pyo (2003)

IV. Estimation of Capital Stock by Asset and Industry

2. Estimation of Capital Stock by Industry

B. Estimation of Capital Stock by Industry in 1998~2005

- ICT sector (22.4%) shows the highest average growth rate over the all periods, followed by Producer Service sector(13.9%), Social Service sector(11.8%)
- But the growth rate of ICT sector drops 41.2% in 1984~1997 to 3.4% in 1998~2005.

IV. Estimation of Capital Stock by Asset and Industry

2. Estimation of Capital Stock by Industry

B. Estimation of Capital Stock by Industry in 1998~2005

<Table 18> Average growth rate of Capital stock by industry (%)

		1970-1983	1984-1997	1998-2005	1970-2005
	Whole Industry	12.9	11.8	6.0	10.8
1	Agriculture, forestry and fishing	12.0	12.6	-4.3	8.5
2	Mining/Manufacturing	12.8	11.7	5.1	10.6
2a	ICT (Computing and communication equipment)	13.9	41.2	3.4	22.4
2b	Other manufacturing/Mining /Electricity, Gas, Water Supply	12.7	11.3	5.2	10.4
3	Service	13.1	11.9	7.5	11.3
3a	Producer service	16.1	8.7	19.4	13.9
3b	Distribution service	11.0	11.7	2.7	9.4
3c	Consumer service	12.6	13.2	5.4	11.2
3d	Social Service	13.8	13.3	5.9	11.8

IV. Estimation of Capital Stock by Asset and Industry

3. Balancing Capital Stock by Industry with by Asset

- We need the ‘balancing process’ to coincide the sum of capital stock by industries with the sum of capital stock by assets.
- 1) Comparison the sum of capital stock by assets with the sum of capital stock by assets in 1970~2005
- 2) Distribution the gap between the two sums in to 72 industries of capital stock by industry.

For the distribution, we used the weight of each sector in the sum of capital stock by 72 industries.

IV. Estimation of Capital Stock by Asset and Industry

4. Estimation of Quarterly Capital Stock

A. Estimation of Quarterly Capital Stock

- We estimated the Quarterly Capital stock by asset from the Yearly Capital stock by asset, using the weight from the Quarterly GFCF by assets in National Account.

- We decomposed the Yearly Capital stock into the Quarterly Capital stock using the weight of the quarterly sum of capital stock over the 11 assets.

IV. Estimation of Capital Stock by Asset and Industry

4. Estimation of Quarterly Capital Stock

B. Estimation of Quarterly Capital Stock by Industry

- The Quarterly GFCF by industry doesn't exist in National Account. Therefore we estimated the Quarterly Capital Stock by subdividing the sum of the quarterly Capital Stock by assets over 11 assets into 72 industries.
- For subdividing, we used the weight of the ratio of each industry in the whole capital stock in the near year.

V. Estimation of Capital Intensity and TFP

1. Growth Accounting Model

- We tried to run Growth Accounting in Korean economy in 1970~2005 using the estimated Capital Stock and Gross Value-Added by industry (Y), Population (N), Number of Employees (E), Average hours worked (h) in EU-KLEMS Korea Database
- We followed the growth accounting method in Hayashi-Prescott(2002) , which mainly use the capital intensity (K/Y)
- We modified the method in Hayashi-Prescott(2002), in that we divided Capital-Labor ratio ($k=K/N$) and Capital-Employment ratio ($k^*=K/E$), and we applied the growth accounting into 72 industries as well.

V. Estimation of Capital Intensity and TFP

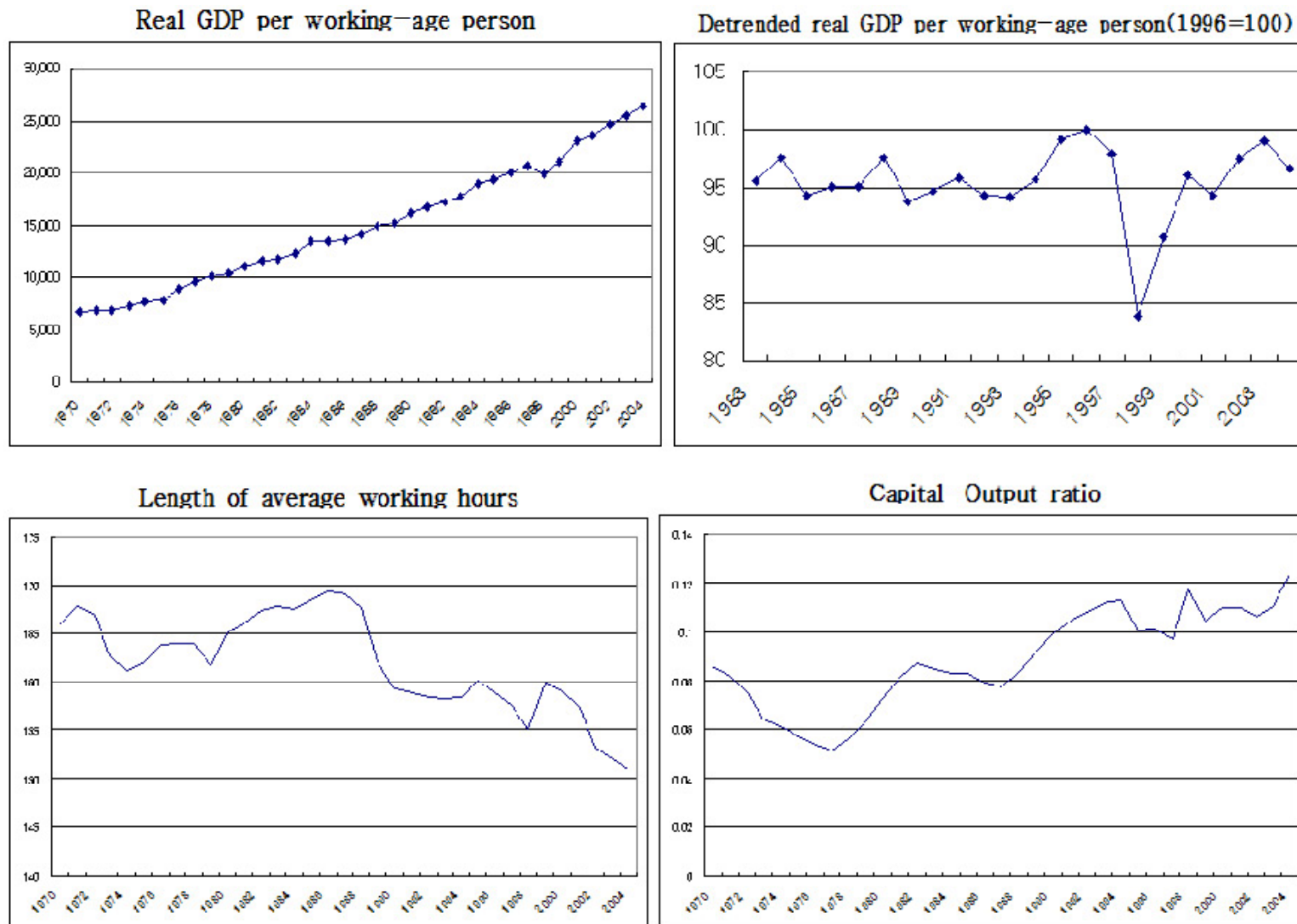
1. Growth Accounting Model

- <Figure 2> shows the trend of the variables used in the Growth Accounting in Korea economy(1970~2004)
- 5% detrended Real GDP per capita shows the Korean economy crisis in 1997~1998
- Average working hours over the whole industry decrease from the peak in 1986
- Capital intensity shows the increasing trend except the period 1997~1998
- Capital intensity shows almost the same trend with that in Hayashi- Prescott t(2002)

V. Estimation of Capital Intensity and TFP

1. Growth Accounting Model

<Figure 2> Trends of Macroeconomic variables in Korea



V. Estimation of Capital Intensity and TFP

1. Growth Accounting Model

Prescott and Hayashi(2002)

FIG. 1. Detrended real GNP per working-age person (1990 = 100).

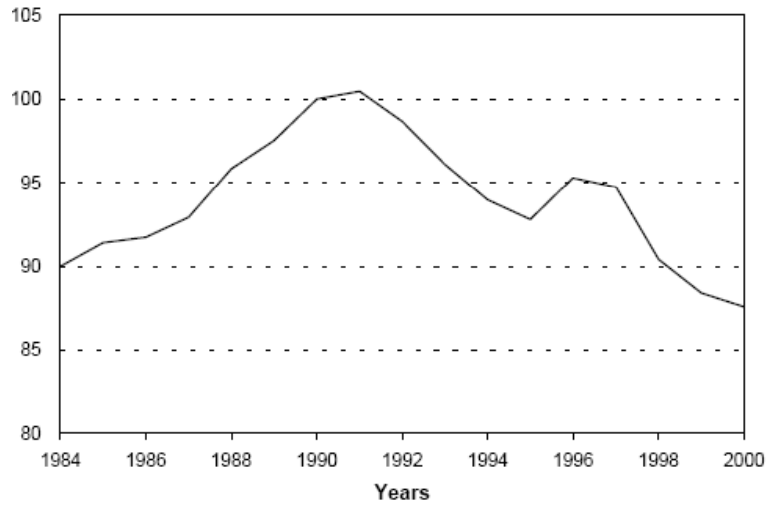


FIG. 2. Length of workweek.

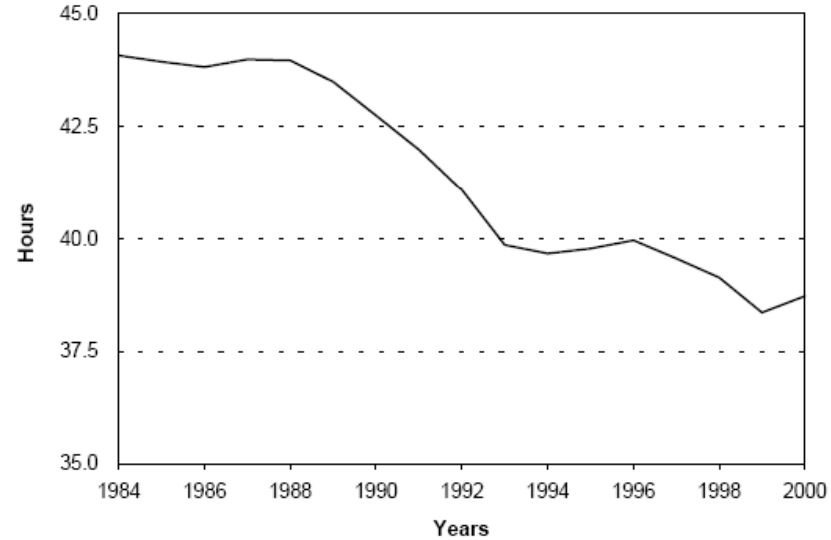
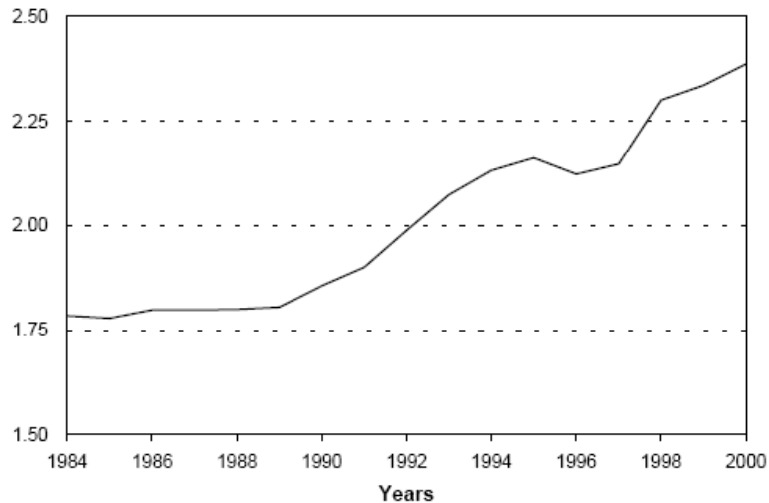


FIG. 3. Capital-output ratio.



V. Estimation of Capital Intensity and TFP

1. Growth Accounting Model

Value added growth accounting model can be expressed like below:

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

K , hE , A and θ represent physical capital, human capital, technological progress and share of capital income respectively. Reformulating some variables,

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

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 ,

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

V. Estimation of Capital Intensity and TFP

1. Growth Accounting Model

and reformulating each variable to per capita terms,

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

Capital-output ratio is:

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

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

$$k = xy$$

Rearranging numerical expression of per capita value added by using equation (7),

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

V. Estimation of Capital Intensity and TFP

1. Growth Accounting Model

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

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

Using definition of equation (2),

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

Equation (9) combined with equation (10) is like below:

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

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

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

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

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

V. Estimation of Capital Intensity and TFP

1. Growth Accounting Model

- <Table 19> shows the GDP per capita(15~69) growth rate using the above growth accounting equation
- In the whole industry in the period 1970~2004, GDP per capital growth rate(6.5%) is decomposed into TFP factor(2.1%), capital intensity(1.4%), average hours worked(-0.3%) and employment rate(1.6%), and employment rate(1.6%) equals the growth rate of the capital-labor ratio(7.9%) minus the growth rate of capital-employment ratio (6.3%)
- The relative contribution of TFP factor to GDP per capita ($100 * 2.1\% / 6.5\% = 32.3\%$) is estimated very high, which reject the Krugman hypothesis.

V. Estimation of Capital Intensity and TFP

1. Growth Accounting Model

- In the growth accounting result in the period 1998~2004, GDP per capital growth rate(4.3%) is decomposed to TFP growth rate(0.5%), capital intensity growth rate, (3.9%), average hours worked growth rate (-0.6%) and employment rate growth rate(0.6%)
- In this period, the relative contribution of TFP growth rate to GDP growth rate($100 * 0.5\% / 4.3\% = 11.6\%$) is much lower than that in the previous periods, but the relative contribution of capital intensity is much higher ($100 * 3.9\% / 4.3\% = 90.7\%$)

V. Estimation of Capital Intensity and TFP

1. Growth Accounting Model

<Table 19> 72-sector Growth Accounting: Korea (1970-2004)

Period	GDP per capita growth rate (γ)	Factors of growth					
		TFP (Δ)	Capital intensity ($x=K/Y$)	Average hours worked (h)	Employment rate ($e=E/N$)	Capital-labor Ratio (K/N)	Capital-Employment Ratio (K/E)
Economy-wide							
1970-1983	9.2	3.6	0.3	0.1	1.8	9.5	7.7
1984-1997	5.1	1.5	1.1	-0.5	1.9	6.2	4.3
1998-2004	4.3	0.5	3.9	-0.6	0.6	8.2	7.7
1970-2004	6.5	2.1	1.4	-0.3	1.6	7.9	6.3
1	Agriculture, Forestry and Fishing						
1970-1983	8.9	-5.6	7.2	0.9	1.8	16.1	14.2
1984-1997	14.0	-7.1	9.7	0.0	1.9	23.6	21.7
1998-2004	-3.1	1.4	-1.9	-1.4	0.6	-5.0	-5.5
1970-2004	8.5	-4.8	6.3	0.0	1.6	14.8	13.2
2	Mining/Manufacturing/Electricity-Gas and Water Supply						
1970-1983	11.2	6.2	-2.9	0.2	1.8	8.3	6.5
1984-1997	5.8	1.6	2.4	-0.5	1.9	8.2	6.3
1998-2004	7.1	1.9	4.2	-0.6	0.6	11.3	10.8
1970-2004	8.1	3.5	0.8	-0.3	1.6	8.9	7.3

V. Estimation of Capital Intensity and TFP

1. Growth Accounting Model

Period	GDP per capita growth rate (\dot{y})	Factors of growth					
		TFP (\dot{A})	Capital intensity ($x=K/Y$)	Average hours worked (\dot{h})	Employment rate ($\dot{e}=E/N$)	Capital-labor Ratio (K/N)	Capital-employment Ratio (K/E)
2a	ICT(Computer, Manufacture of Communication Equipment)						
1970-1983	18.2	8.0	-1.5	0.3	1.8	16.7	14.9
1984-1997	8.8	-3.2	17.3	-0.9	1.9	26.1	24.2
1998-2004	23.8	20.6	-18.1	-0.4	0.6	5.7	5.1
1970-2004	15.5	5.6	2.8	-0.4	1.6	18.3	16.7
2b	Other Manufacturing/Mining/ Electricity, Gas and Water Supply						
1970-1983	11.1	6.2	-2.8	0.2	1.8	8.3	6.5
1984-1997	5.7	1.7	2.2	-0.5	1.9	7.8	5.9
1998-2004	6.1	1.1	5.1	-0.6	0.6	11.2	10.6
1970-2004	7.8	3.3	0.9	-0.2	1.6	8.7	7.1
3	Service						
1970-1983	8.0	1.0	5.2	-0.2	1.8	13.1	11.3
1984-1997	3.2	1.2	-0.5	-0.4	1.9	2.6	0.7
1998-2004	2.2	-0.7	4.3	-0.4	0.6	6.5	5.9
1970-2004	4.8	0.7	2.6	-0.3	1.6	7.4	5.8

V. Estimation of Capital Intensity and TFP

1. Growth Accounting Model

Period	GDP per capita growth rate (γ)	Factors of growth					
		TFP (Δ)	Capital intensity ($\alpha=K/Y$)	Average hours worked (h)	Employment rate ($e=E/N$)	Capital-labor Ratio (K/N)	Capital-Employment Ratio (K/E)
3a	Producer Service						
1970-1983	9.8	4.6	-1.0	-0.1	1.8	8.8	7.0
1984-1997	2.8	3.6	-6.2	-0.2	1.9	-3.4	-5.3
1998-2004	0.0	-12.0	22.1	-0.4	0.6	22.1	21.6
1970-2004	4.9	1.0	1.6	-0.2	1.6	6.5	4.9
3b	Distribution Service						
1970-1983	10.4	1.2	4.1	-0.3	1.8	14.5	12.7
1984-1997	6.4	1.9	0.7	-0.5	1.9	7.1	5.2
1998-2004	5.8	3.6	-1.7	-0.4	0.6	4.1	3.5
1970-2004	7.8	2.1	1.5	-0.4	1.6	9.3	7.7
3c	Consumer Service						
1970-1983	4.0	-5.5	16.0	-0.2	1.8	20.0	18.2
1984-1997	4.2	4.2	-6.0	-0.8	1.9	-1.9	-3.8
1998-2004	6.3	3.3	2.8	-0.1	0.6	9.1	8.5
1970-2004	4.5	0.5	4.2	-0.4	1.6	8.8	7.2
3d	Social Service						
1970-1983	4.2	-0.3	7.8	0.0	1.8	12.0	10.2
1984-1997	-0.6	-4.6	11.5	-0.4	1.9	11.0	9.1
1998-2004	-0.4	-1.0	2.6	-0.5	0.6	2.2	1.7
1970-2004	1.3	-2.2	8.3	-0.3	1.6	9.6	8.0

V. Estimation of Capital Intensity and TFP

2. Revised Hayashi-Prescott Growth Accounting for Korea

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

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

- <Table 20> has shown the growth accounting results based on (1)'

V. Estimation of Capital Intensity and TFP

2. Revised Hayashi-Prescott Growth Accounting for Korea

<Table 20> 72-sector Growth Accounting with Capacity Utilization and Unemployment Rate Considered: Korea (1970-2004)

Period	GDP per capita growth rate (γ)	Factors of growth							
		TFP (A)	Utilized Capital Intensity			Average hours worked (h)	Employment rate (e)	capacity utilization ratio (ν)	employment rate ($1-u$)
				Growth rate of v	Capital intensity ($x=K/Y$)				
Economy-wide									
1970-1983	9.2	3.6	0.30	0	0.3	0.1	1.8	0.75	0.96
1984-1997	5.1	1.3	1.56	0.46	1.1	-0.5	1.9	0.79	0.97
1998-2004	4.3	0.4	4.34	0.44	3.9	-0.6	0.6	0.77	0.96
1970-2004	6.5	2.0	1.68	0.28	1.4	-0.3	1.6	0.77	0.96
1	Agriculture, Forestry and Fishing								
1970-1983	8.9	-5.6	7.20	0	7.2	0.9	1.8	0.75	0.96
1984-1997	14.0	-7.5	10.16	0.46	9.7	0.0	1.9	0.79	0.97
1998-2004	-3.1	1.0	-1.46	0.44	-1.9	-1.4	0.6	0.77	0.96
1970-2004	8.5	-5.0	6.58	0.28	6.3	0.0	1.6	0.77	0.96
2	Mining/Manufacturing/Electricity Gas and Water Supply								
1970-1983	11.2	6.2	-2.90	0	-2.9	0.2	1.8	0.75	0.96
1984-1997	5.8	1.3	2.86	0.46	2.4	-0.5	1.9	0.79	0.97
1998-2004	7.1	1.8	4.64	0.44	4.2	-0.6	0.6	0.77	0.96
1970-2004	8.1	3.3	1.08	0.28	0.8	0.3	1.6	0.77	0.96

V. Estimation of Capital Intensity and TFP

2. Revised Hayashi-Prescott Growth Accounting for Korea

Period	GDP per capita growth rate (γ)	Factors of growth							
		TFP (A)	Utilized Capital Intensity	Growth rate of v		Average hours worked (h)	Employment rate (e)	capacity utilization ratio (V)	employment rate ($1-u$)
				Growth rate of v	Capital intensity ($x=K/Y$)				
2a	ICT(Computer, Manufacture of Communication Equipment)								
1970-1983	18.2	8.0	-1.50	0	-1.5	0.3	1.8	0.75	0.96
1984-1997	8.8	-3.5	17.76	0.46	17.3	-0.9	1.9	0.79	0.97
1998-2004	23.8	20.5	-17.66	0.44	-18.1	-0.4	0.6	0.77	0.96
1970-2004	15.5	5.5	3.08	0.28	2.8	-0.4	1.6	0.77	0.96
2b	Other Manufacturing/Mining/ Electricity-Gas and Water Supply								
1970-1983	11.1	6.2	-2.80	0	-2.8	0.2	1.8	0.75	0.96
1984-1997	5.7	1.4	2.66	0.46	2.2	-0.5	1.9	0.79	0.97
1998-2004	6.1	1.0	5.54	0.44	5.1	-0.6	0.6	0.77	0.96
1970-2004	7.8	3.2	1.18	0.28	0.9	-0.2	1.6	0.77	0.96
3	Service								
1970-1983	8.0	1.0	5.20	0	5.2	-0.2	1.8	0.75	0.96
1984-1997	3.2	0.9	-0.04	0.46	-0.5	-0.4	1.9	0.79	0.97
1998-2004	2.2	-0.8	4.74	0.44	4.3	-0.4	0.6	0.77	0.96
1970-2004	4.8	0.6	2.88	0.28	2.6	-0.3	1.6	0.77	0.96

V. Estimation of Capital Intensity and TFP

2. Revised Hayashi-Prescott Growth Accounting for Korea

Period	GDP per capita growth rate (γ)	Factors of growth							
		TFP (A)	Utilized Capital Intensity	Growth rate of v	Capital intensity ($x=K/Y$)	Average hours worked (h)	Employment rate (e)	capacity utilization ratio (V)	employment rate ($1-u$)
3a	Producer Service								
1970-1983	9.8	4.6	-1.0	0	-1.0	-0.1	1.8	0.75	0.96
1984-1997	2.8	3.3	-5.74	0.46	-6.2	-0.2	1.9	0.79	0.97
1998-2004	0.0	-12.2	22.54	0.44	22.1	-0.4	0.6	0.77	0.96
1970-2004	4.9	0.8	1.88	0.28	1.6	-0.2	1.6	0.77	0.96
3b	Distribution Service								
1970-1983	10.4	1.2	4.1	0	4.1	-0.3	1.8	0.75	0.96
1984-1997	6.4	1.5	1.76	0.46	0.7	-0.5	1.9	0.79	0.97
1998-2004	5.8	3.5	-1.26	0.44	-1.7	-0.4	0.6	0.77	0.96
1970-2004	7.8	1.9	1.78	0.28	1.5	-0.4	1.6	0.77	0.96
3c	Consumer Service								
1970-1983	4.0	-5.5	16.0	0	16.0	-0.2	1.8	0.75	0.96
1984-1997	4.2	3.9	-5.54	0.46	-6.0	-0.8	1.9	0.79	0.97
1998-2004	6.3	3.3	3.24	0.44	2.8	-0.1	0.6	0.77	0.96
1970-2004	4.5	0.4	4.48	0.28	4.2	-0.4	1.6	0.77	0.96
3d	Social Service								
1970-1983	4.2	-0.3	7.80	0	7.8	0.0	1.8	0.75	0.96
1984-1997	-0.6	-4.9	12.06	0.46	11.6	-0.4	1.9	0.79	0.97
1998-2004	-0.4	-1.0	3.04	0.44	2.6	-0.5	0.6	0.77	0.96
1970-2004	1.3	-2.3	8.58	0.28	8.3	-0.3	1.6	0.77	0.96



VI. Conclusion

- In the average growth rate of GFCF by asset in the whole periods, Communication equipment(18.0%), Computing equipment(16.4%) and Software(16.4%) shows the highest growth rate.
- Products of agriculture and forestry and Other products aren't identified in the statistical data, and Other Intangibles also doesn't exist in the official statistical data.



VI. Conclusion

- When we see the trend of the estimated GFCF by industry, Mining/Manufacturing/Electricity, Gas, Water Supply(12.5%) and Distribution Service sector(12.5%) show the highest growth rate, and IT Industry(5.4%) show relatively very low growth rate.
- When we see the trend of the estimated Capital Stock by asset, Software(19.5%), Communications Equipment(16.3%), Computing equipment(12.0%) show the highest growth rate over all periods.
- Computing equipment shows the negative growth rate(-8.5%), and this suggest that the depreciation of 31.5% in the computing equipment which is recommended by EU-KLEMS is too high.



VI. Conclusion

- When we see the Capital stock by industry, ICT industry(22.4%) show the highest growth rate, followed by Producer service sector(13.9%) and Social Service sector(11.8%)
- The growth rate of ICT manufacture industry dropped from 41.2% in 1984~1997 to 3.4% in 1998~2005
- In the result of Growth Accounting, GDP per capital growth rate(6.5%) is decomposed into TFP factor(2.1%), capital intensity(1.4%), average hours worked(-0.3%) and employment rate(1.6%), and employment rate(1.6%) equals the growth rate of the capital-labor ratio(7.9%) minus the growth rate of capital-employment ratio(6.3%)