

**RIETI/G-COE Hi-Stat International Workshop on Establishing
Industrial Productivity Database for China, India, Japan and Korea
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The Productivity Performance in Korean Industries (1990-2008): Estimates from KIP Database

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I. Introduction to KIP Database

- Korea Industrial Productivity (KIP) Database Project in 2007
 - Following EU KLEMS Manual (Timmer et al., 2007)
 - KIP2007 in Dec., 2007: GO, KLEMS, and TFPGO for 72 industries from 1970 to 2005

- Cooperation with Japan Industrial Productivity (JIP) Database through workshops (2007, 2008, 2009)
- International Productivity Conference in Seoul and Tokyo (2007)

KIP versus EUKLEMS

KIP Korea Productivity Center	EUKLEMS www.euklems.net
KIP2007 (Dec., 2007) 72 industries up to 2005 GO VA KLEMS TFPGO(VA)	March 2008 Release 72 industries up to 2005 GO VA KLEMS TFPVA
KIP2008 (Dec., 2008) 72 industries up to 2006 GO VA KLEMS TFPGO(VA)	
KIP2009 (Dec., 2009) 72 industries up to 2007 GO VA KLEMS TFPGO(VA)	November 2009 Release 32 industries up to 2007 GO VA KLM TFPVA
KIP2010 (preliminary) 72 industries up to 2008 GO VA KLEMS TFPGO(VA)	

II. KIP Database: Variables Construction

- Output
 - Gross output (GO) and value-added (VA)
 - Bank of Korea internal data on GO & VA
 - for 78(147) & 397(399) industry data
- Intermediate Input
 - Use U & V tables to divide intermediate inputs into E,M,S

KIP Database: Variables Construction

- Labor Input
 - Employment, Hours, Compensation
 - Sources: Economically Active Population Survey (NSO), Survey Report on Wage Structure (MOL) and etc
 - Labor Composition:
18 types = Gender(2) x Age (3) x Education (3) for 15 industries

Capital Input

KIP	EUKLEMS
<ul style="list-style-type: none">• 1970–1997<ul style="list-style-type: none">– <i>National Wealth Survey</i> (1968, 1977, 1987, 1997)• 1998–2008<ul style="list-style-type: none">– Modified Perpetual inventory method– Country-specific depreciation rates (Pyo et al., 2007)	<ul style="list-style-type: none">• Perpetual inventory method (PIM)• Same depreciation rates for all EU countries

Depreciation Rates by Asset

	(Unit: %)	Pyo et al. (2007)	EU KLEMS (2007)	
Asset type		1987~97	Minimum	Maximum
Residential structure		3.3	1.1	1.1
Non-residential structure		3.0	2.3	6.9
Infrastructure		1.0	2.3	6.9
Transport equipment		16.9	6.1	24.6
Computing equipment		11.5	31.5	31.5
Communications equipment		11.5	11.5	11.5
Other machinery and equipment		9.2	7.3	16.4
Products of agriculture and forestry		9.2	7.3	16.4
Other products		9.2	7.3	16.4
Software		24.71	31.5	31.5
Other intangibles		24.71	31.5	31.5

Issues in KIP DB

- BOK output data updated with chain index
- Labor income share adjustment for self-employment
 - Agriculture, distribution, and personal and business services
- Capital Income share

III. International Comparison

- Data
 - KIP2010 (1981-2008)
 - EUKLEMS Nov. 2009 release (1981-2007)
- Output and TFP measure
 - Value-added, Labor (hours and composition), capital, and TFP

International Comparison

- Countries
 - Korea, 1981-**2008**
 - USA, 1981-2007
 - Japan, 1981-**2006**
 - EU15EX, 1981-2007
- Industries
 - 30 industries
 - 2 AGR/MIN, 13 MFG, 2 UTL/CST, 13 SER

Industry Classification

30 IND	EUKLEMS	Industry Name	MFG/SER
1	AtB	Agriculture, hunting, forestry and fishing	
2	C	Mining and quarrying	
3	15t16	Food , beverages and tobacco	MFG
4	17t19	Textiles, textile , leather and footwear	MFG
5	20	Wood and of wood and cork	MFG
6	21t22	Pulp, paper, paper , printing and publishing	MFG
7	23	Coke, refined petroleum and nuclear fuel	MFG
8	24	Chemicals and chemical	MFG
9	25	Rubber and plastics	MFG
10	26	Other non-metallic mineral	MFG
11	27t28	Basic metals and fabricated metal	MFG
12	29	Machinery, nec	MFG
13	30t33	Electrical and optical equipment	MFG
14	34t35	Transport equipment	MFG
15	36t37	Manufacturing nec; recycling	MFG

Industry Classification

30 IND EUKLEMS		Industry Name	MFG/SER
16	E	Electricity, gas and water supply	
17	F	Construction	
18	50	Sale, maintenance and repair of motor vehicles	SER
19	51	Wholesale trade and commission trade	SER
20	52	Retail trade	SER
21	H	Hotels and restaurants	SER
22	60t63	Transport and storage	SER
23	64	Post and telecommunications	SER
24	J	Financial intermediation	SER
25	70	Real estate activities	Non-Mkt SER
26	71t74	Renting of m&eq and other business activities	SER
27	L	Public admin&defence; compuls. social security	Non-Mkt SER
28	M	Education	Non-Mkt SER
29	N	Health and social work	Non-Mkt SER
30	O	Other community, social and personal services	SER

IV. Estimates of Comparative Output Growth and Contributions

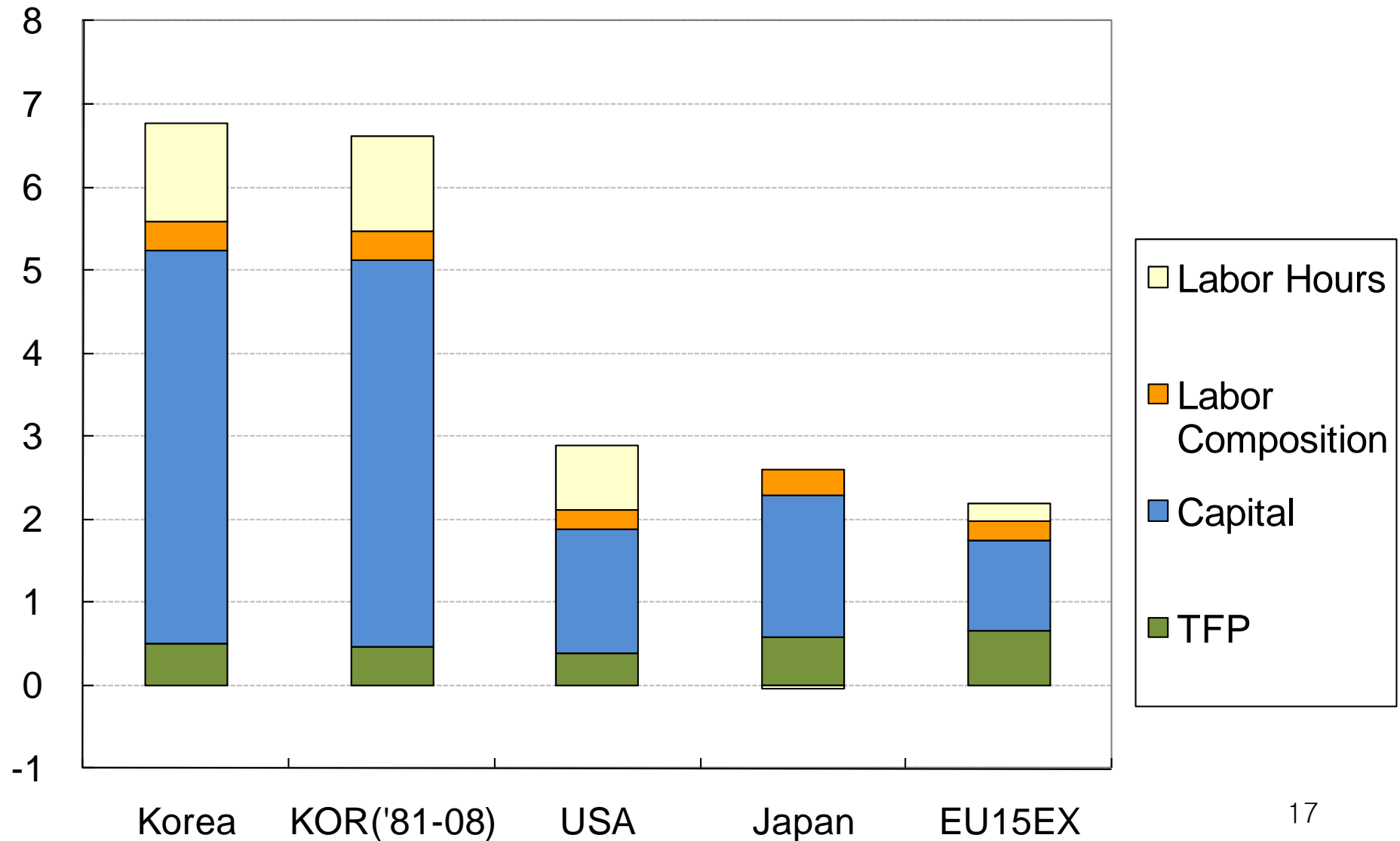
Total Economy

	Output	Labor	Hours	Composition	Capital	TFP
Korea						
1981-2007	6.83	1.59	1.18	0.35	4.75	0.49
(1981-2008)	6.67	1.55	1.15	0.35	4.67	0.46
1991-2000	6.20	1.38	1.02	0.29	4.18	0.64
2001-2007	4.10	0.97	0.50	0.46	2.94	0.19
(2001-2008)	3.89	0.90	0.46	0.43	2.89	0.11
USA						
1981-2007	2.89	1.02	0.79	0.23	1.49	0.39
1991-2000	3.13	1.19	0.96	0.24	1.72	0.22
2001-2007	2.32	0.45	0.19	0.26	1.07	0.80
Japan						
1981-2006	2.56	0.27	-0.04	0.31	1.72	0.58
1991-2000	1.39	-0.10	-0.41	0.31	1.58	-0.09
2001-2006	1.28	0.03	-0.33	0.36	0.96	0.29
EU15EX						
1981-2007	2.19	0.46	0.22	0.24	1.09	0.65
1991-2000	2.13	0.37	0.09	0.28	1.20	0.57
2001-2007	1.93	0.61	0.43	0.18	0.96	0.36

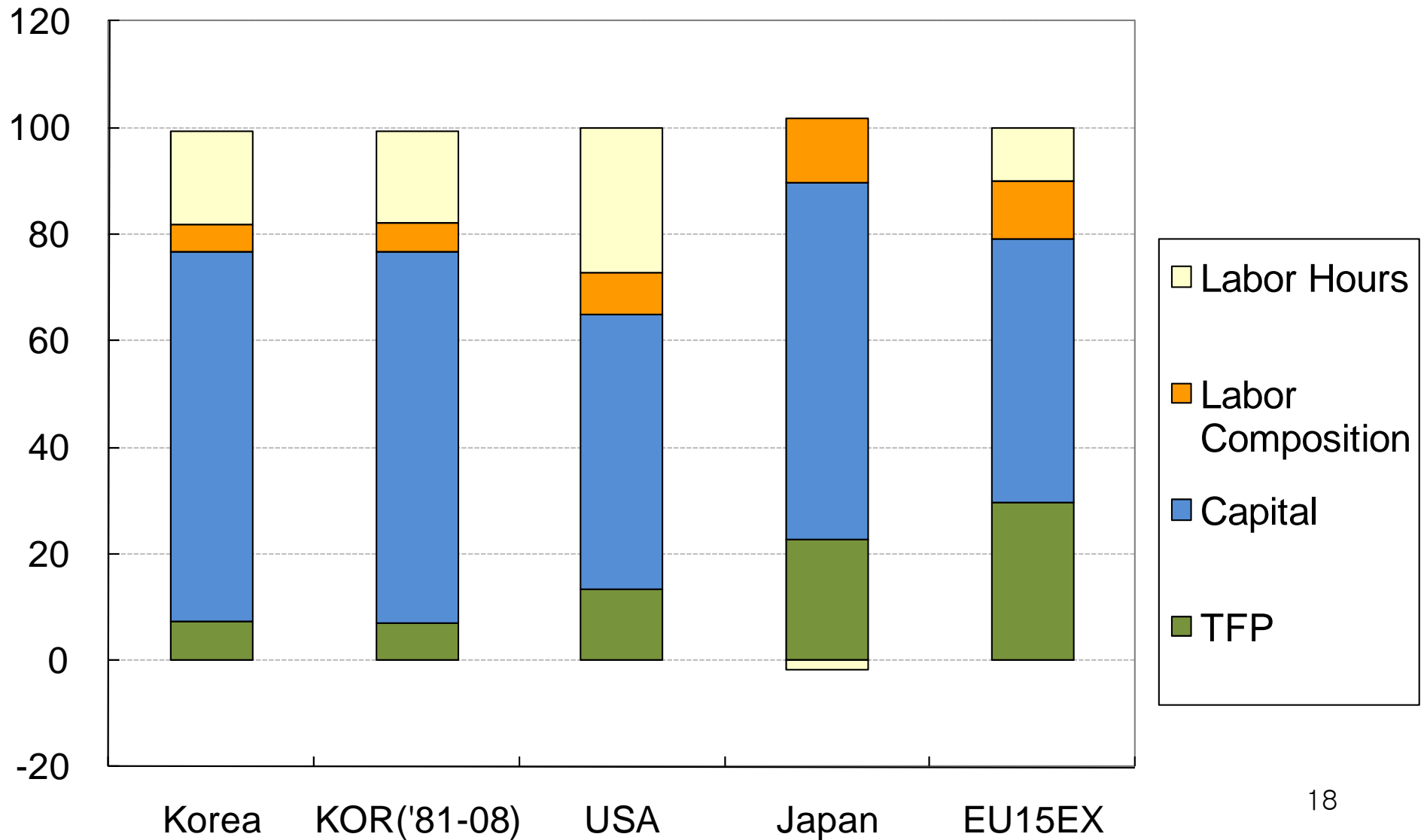
Contributions to Output Growth Total Economy

	Output	Labor	Hours	Composition	Capital	TFP
Korea						
1981-2007	100	23.3	17.3	5.2	69.5	7.2
(1981-2008)	100	23.2	17.2	5.2	69.9	6.9
1991-2000	100	22.2	16.5	4.7	67.4	10.3
2001-2007	100	23.6	12.3	11.3	71.8	4.6
(2001-2008)	100	23.0	11.9	11.1	74.1	2.8
USA						
1981-2007	100	35.2	27.1	8.0	51.4	13.4
1991-2000	100	38.1	30.5	7.5	55.0	7.0
2001-2007	100	19.3	8.2	11.1	46.1	34.6
Japan						
1981-2006	100	10.4	-1.7	12.1	67.0	22.6
1991-2000	100	-6.9	-29.4	22.5	113.6	-6.7
2001-2006	100	2.6	-25.7	28.3	74.5	22.9
EU15EX						
1981-2007	100	20.8	9.9	10.9	49.6	29.6
1991-2000	100	17.4	4.1	13.3	56.1	26.6
2001-2007	100	31.8	22.4	9.4	49.6	18.6

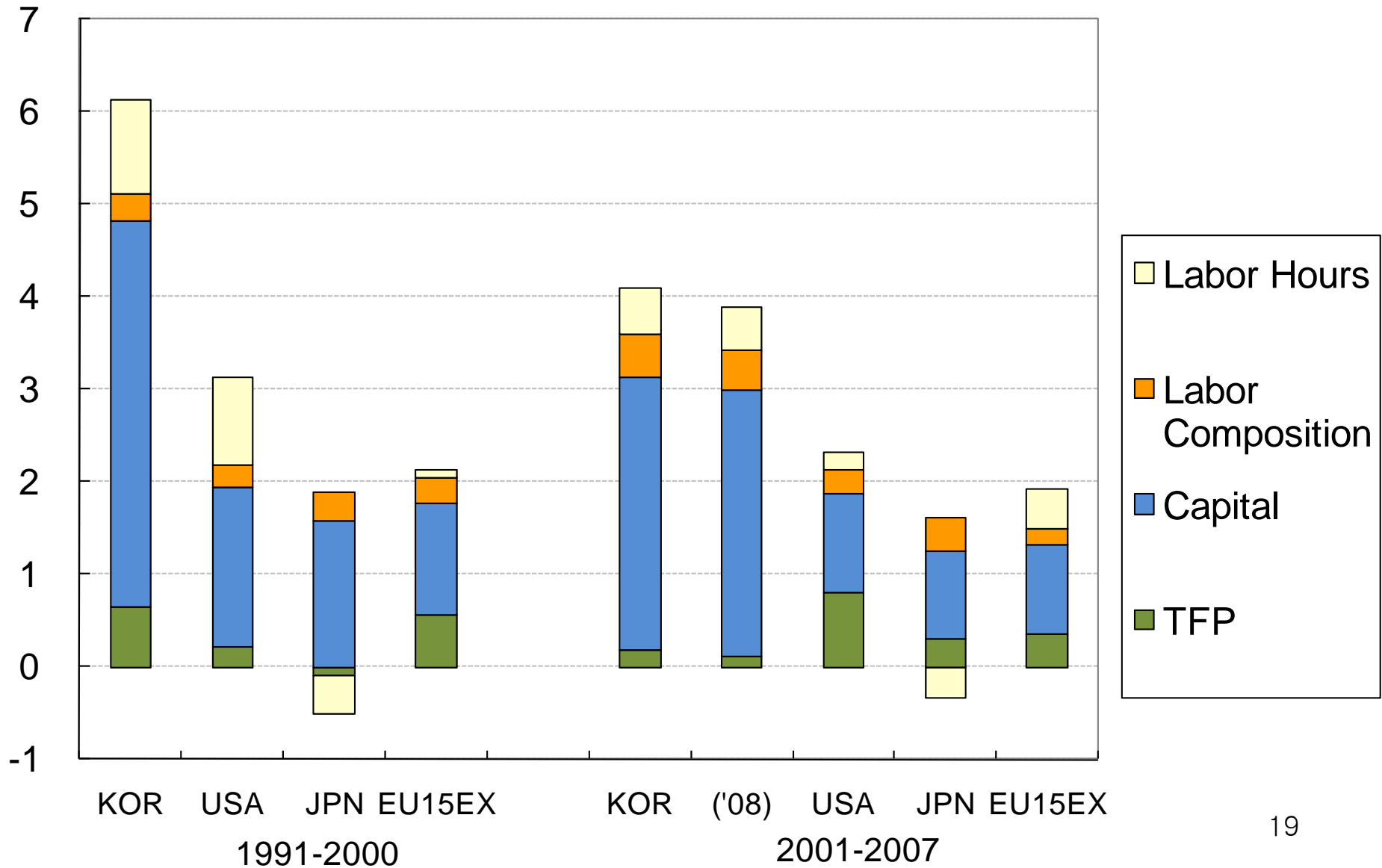
Output Growth and Contributions, Total Economy, 1981-2007



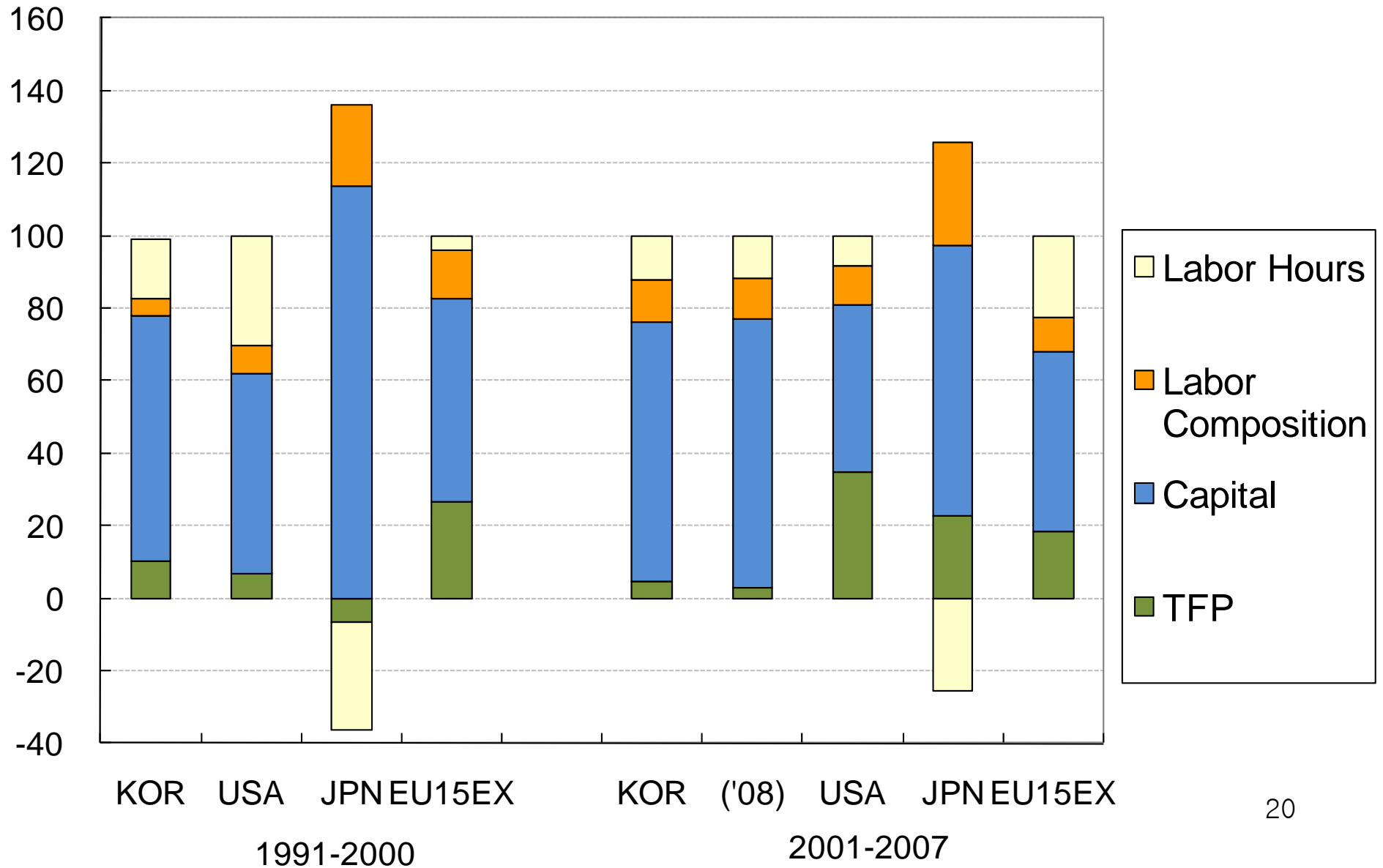
Contributions to Output Growth, Total Economy, 1981-2007



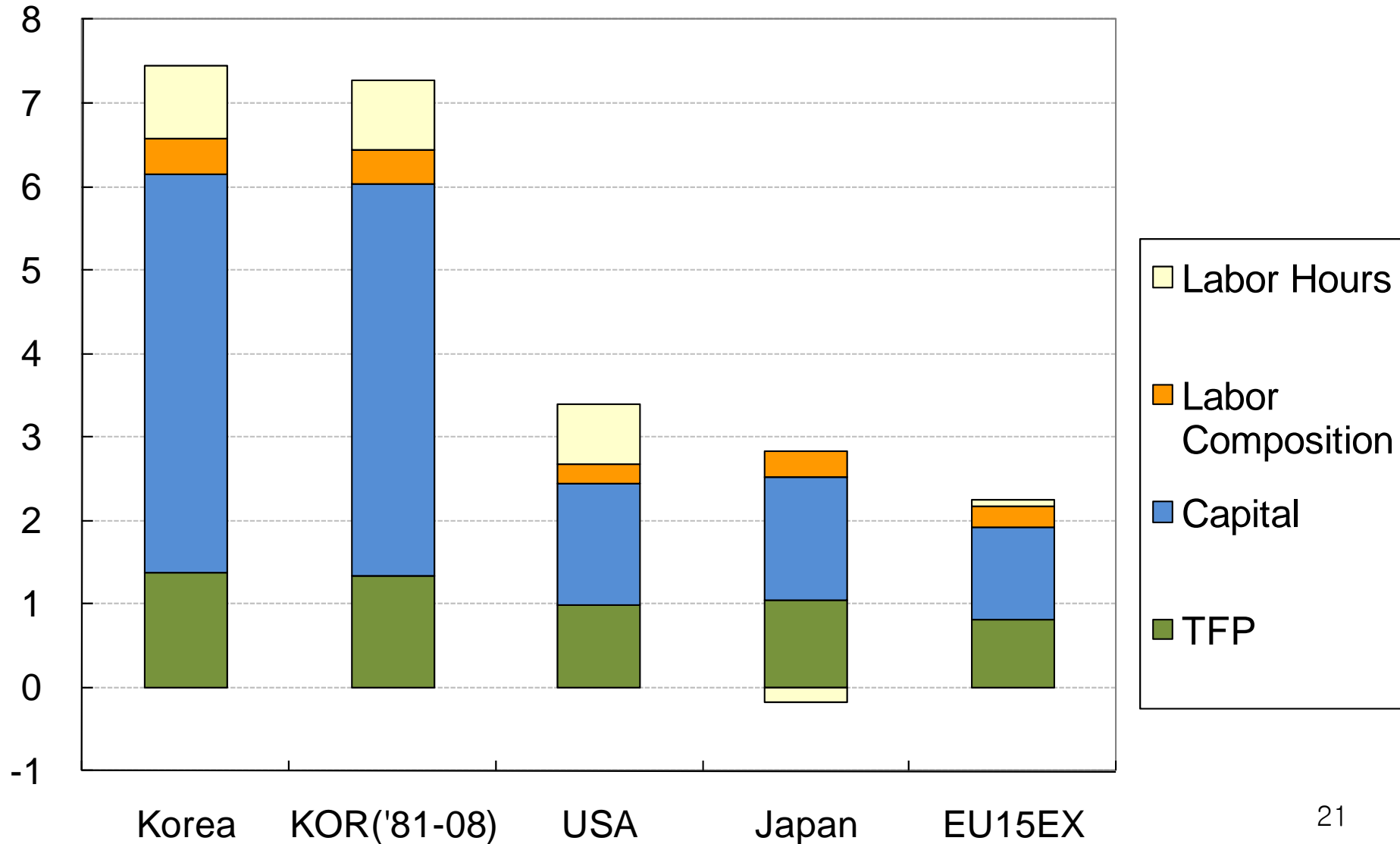
Output Growth and Contributions, Total Economy, 1991-2000 vs. 2001-2007



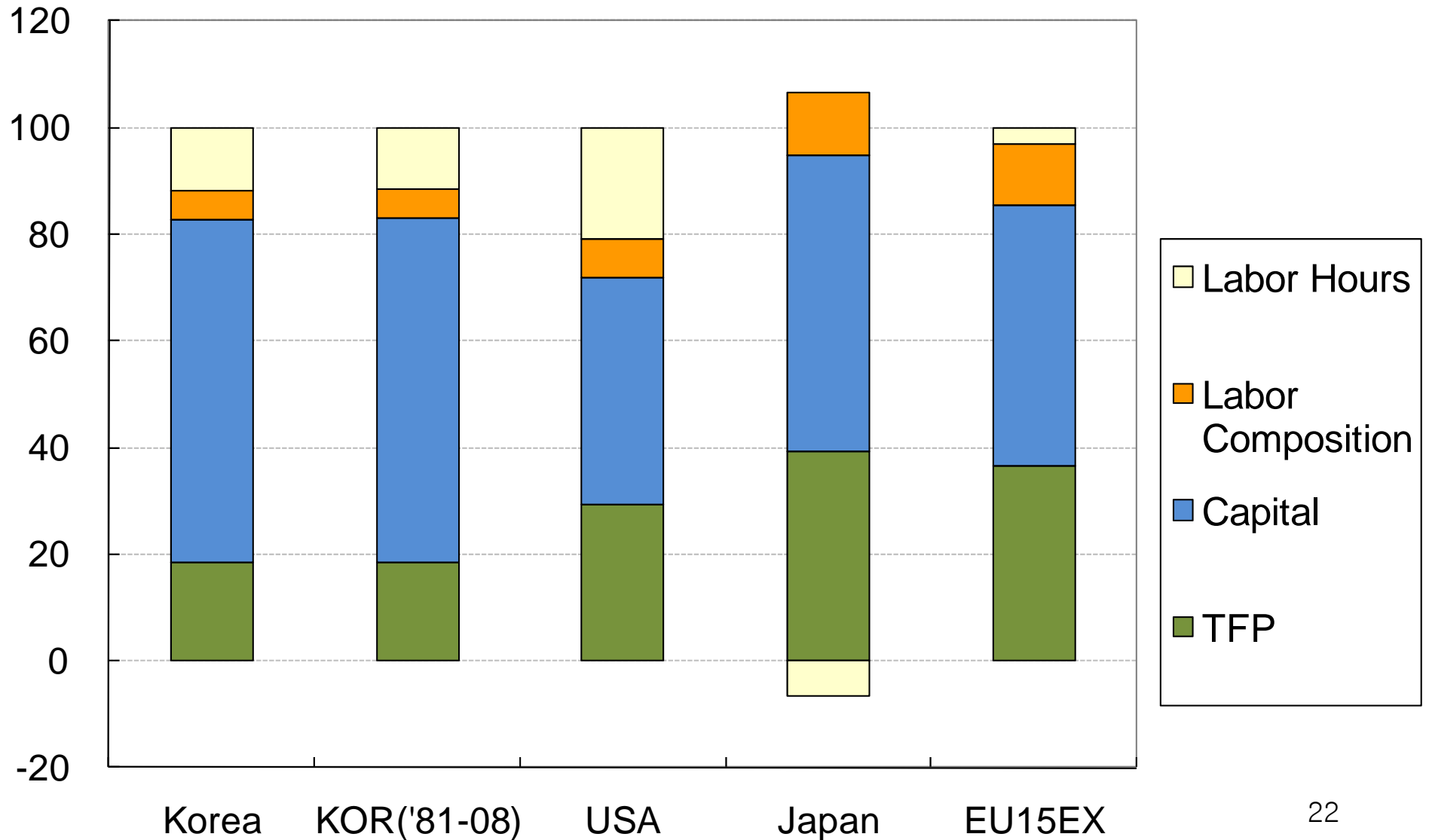
Contributions to Output Growth, Total Economy, 1991-2000 vs. 2001-2007



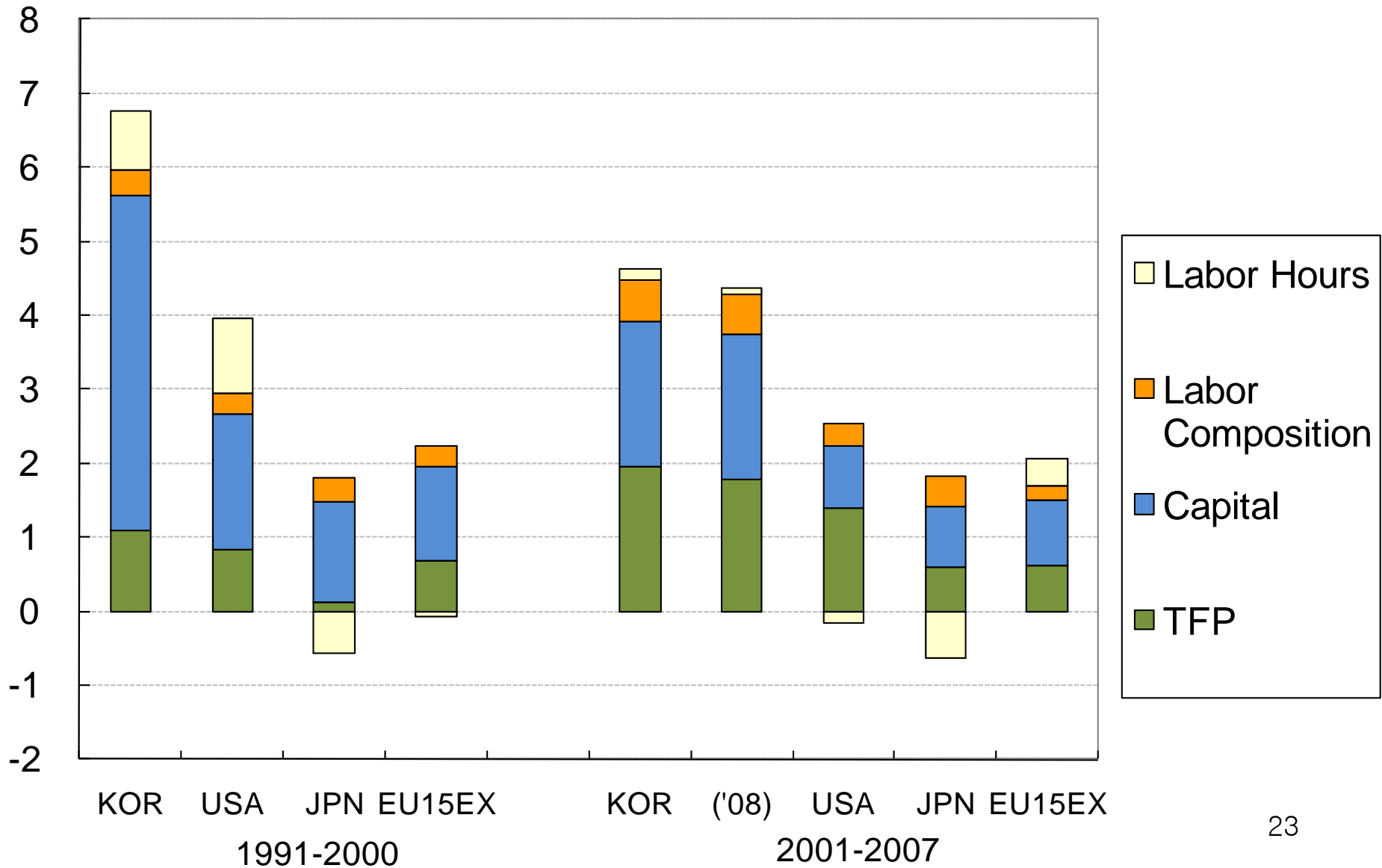
Output Growth and Contributions, Market Economy, 1981-2007



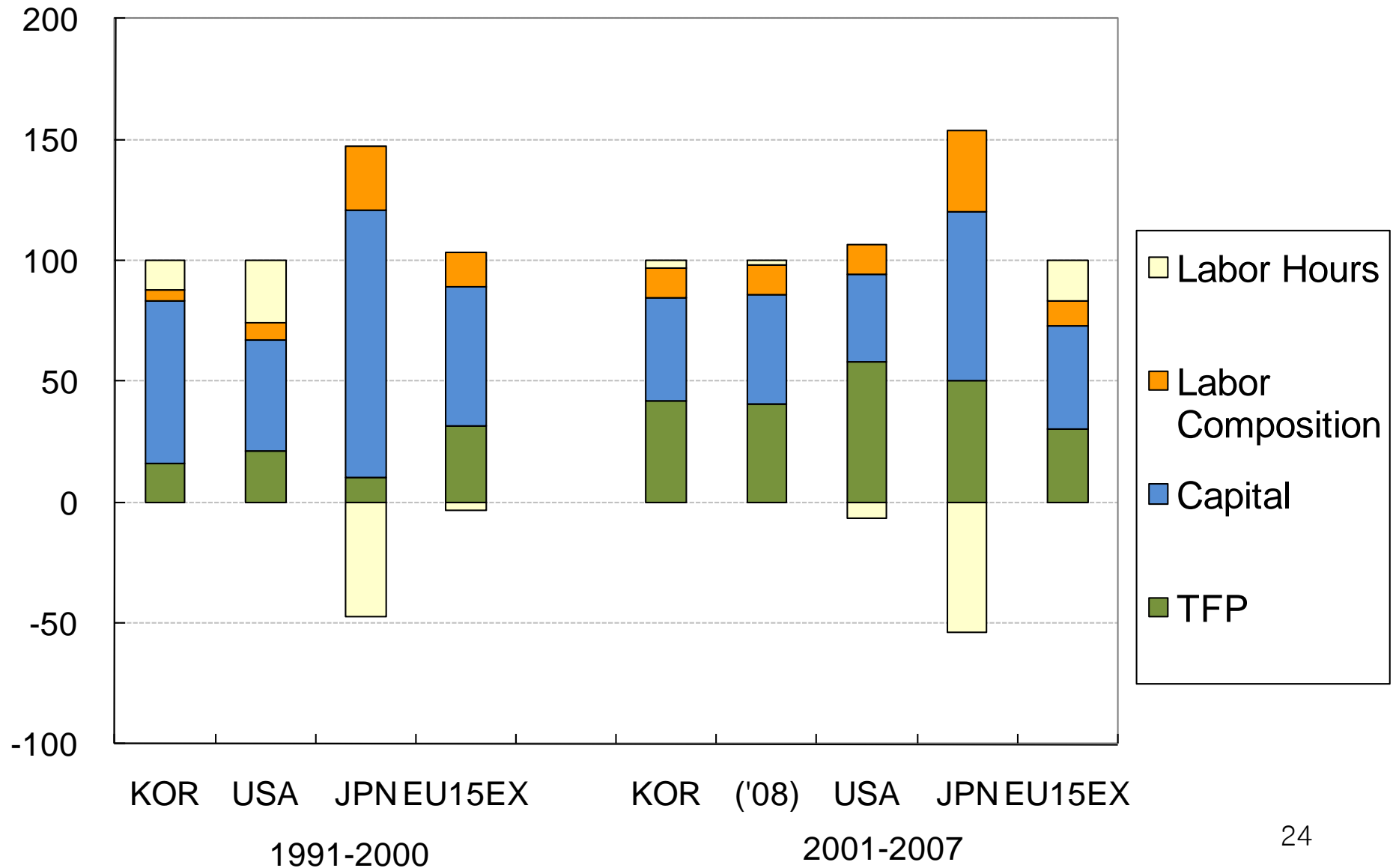
Contributions to Output Growth, Market Economy, 1981-2007



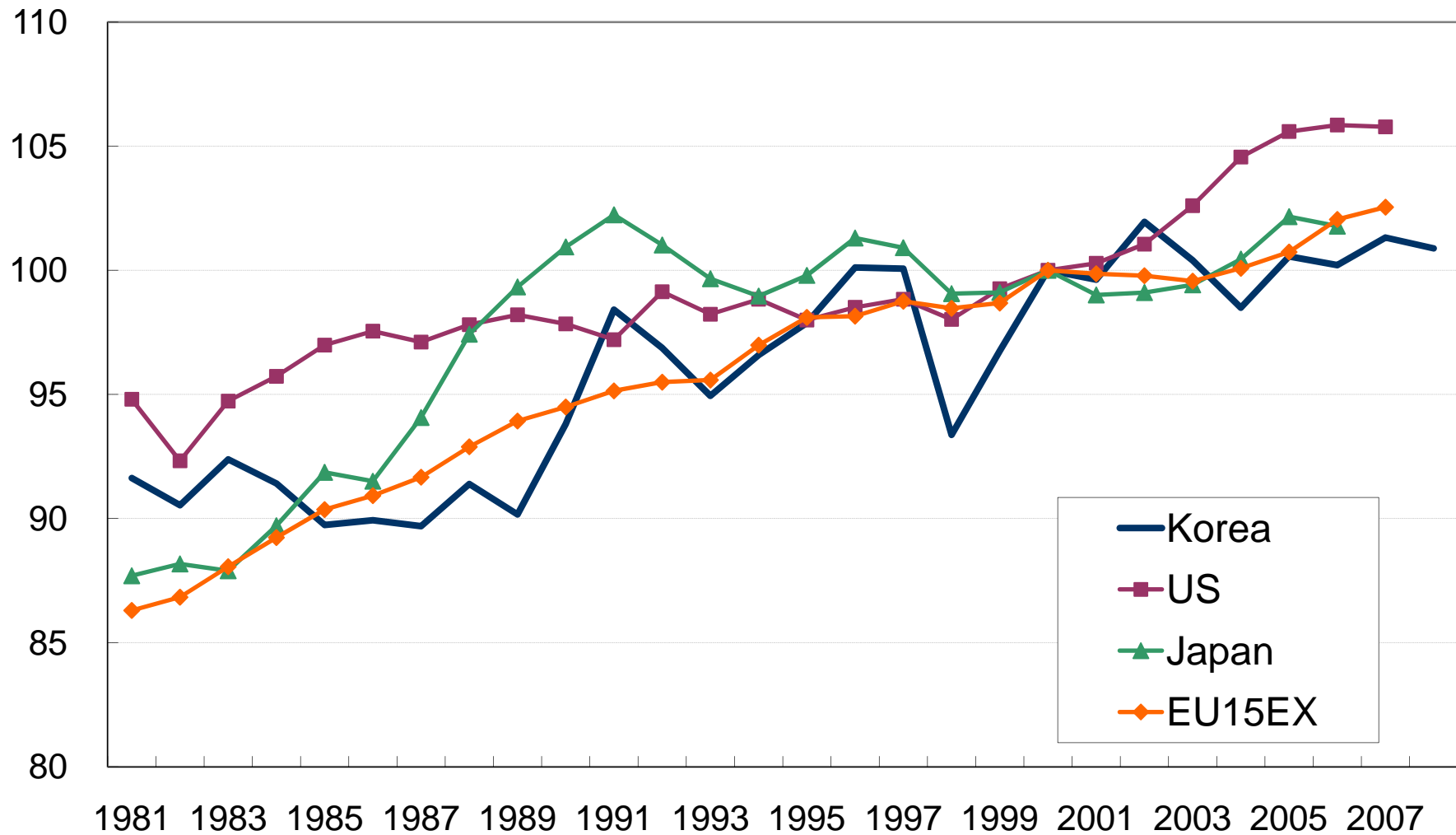
Output Growth and Contributions, Market Economy, 1991-2000 vs. 2001-2007



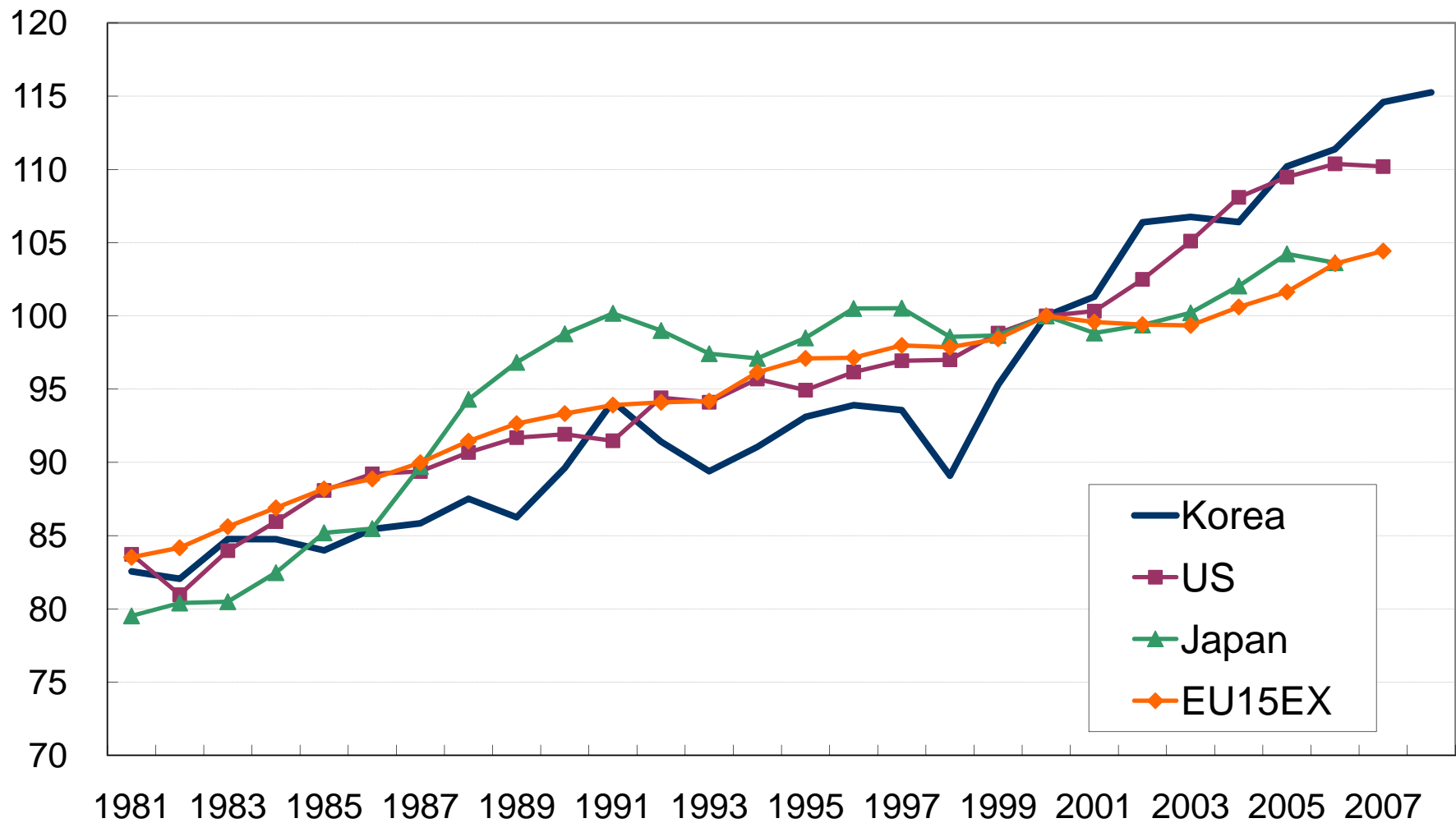
Contributions to Output Growth, Market Economy, 1991-2000 vs. 2001-2007



TFP Level: Korea, US, JPN, EU15EX Total Economy, 1981-2008 (2000=100)



TFP Level: Korea, US, JPN, EU15EX Market Economy, 1981-2008 (2000=100)



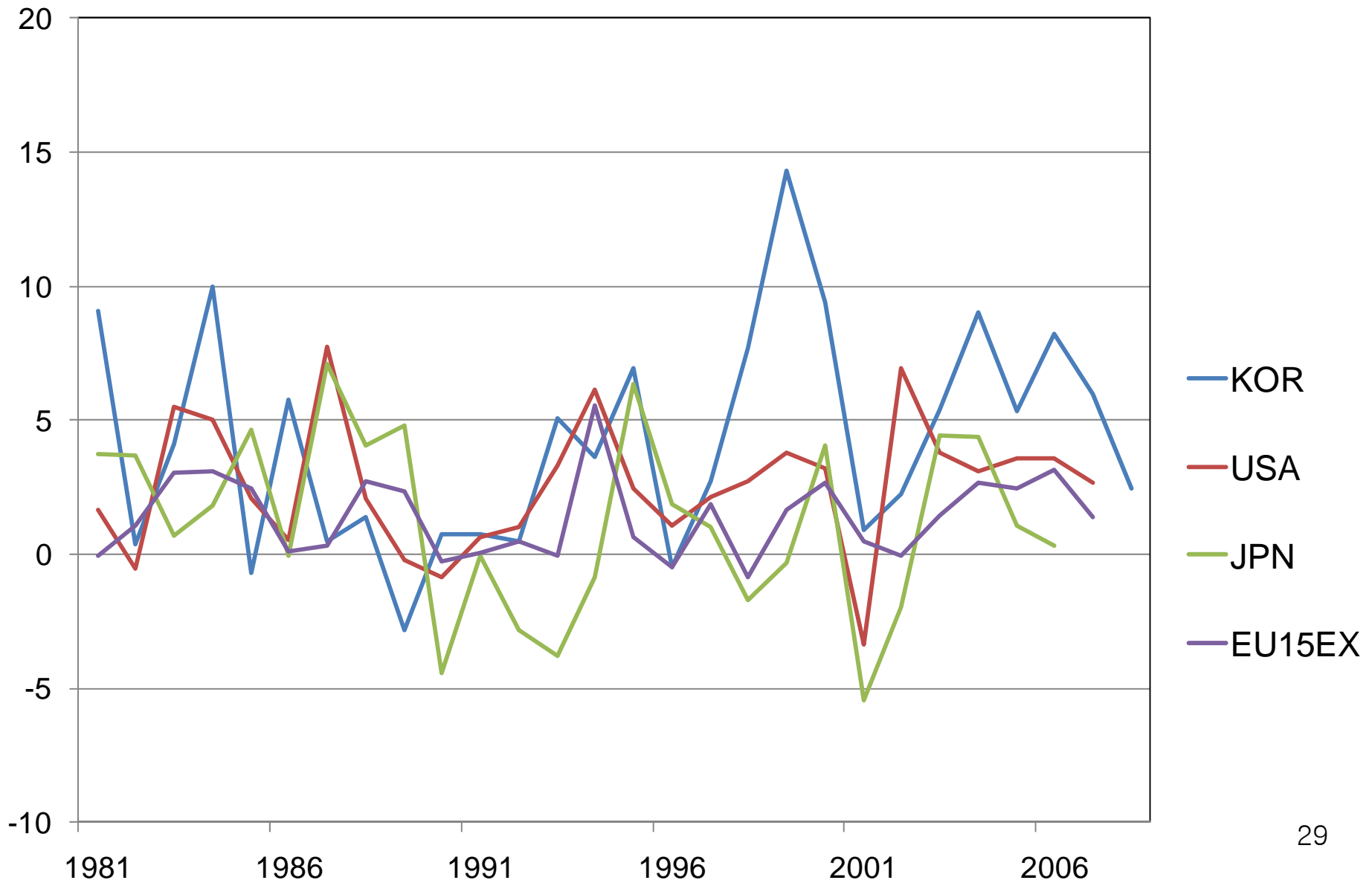
TFP Growth Rates, 1981-2007

	MFG	SER			MKT	TOT
		MKT	NonMKT	TOT		
KOR	3.34	0.28	-2.94	-0.96	1.37	0.49
KOR('81-'08)	3.26	0.29	-2.97	-0.97	1.34	0.46
USA	2.53	0.60	-0.89	-0.06	0.99	0.39
JPN	1.58	1.11	-0.99	0.33	1.04	0.58
AUT	3.09	0.37	-0.34	0.09	1.41	0.96
BEL	1.33	-0.30	-0.46	-0.35	0.37	0.12
DNK	0.19	0.43	-0.26	0.10	0.52	0.26
ESP	0.62	-0.99	-0.40	-0.77	0.06	-0.05
FIN	3.75	0.83	-1.22	-0.09	1.91	1.03
FRA	1.63	0.62	0.58	0.60	1.04	0.89
GER	1.94	-0.29	1.02	0.26	0.54	0.67
ITA	0.95	-0.30	0.42	-0.04	0.32	0.33
NLD	1.91	0.44	-0.01	0.31	0.70	0.50
UK	2.50	0.88	-0.97	0.21	1.30	0.76
EU15EX	1.67	0.28	0.24	0.27	0.82	0.65

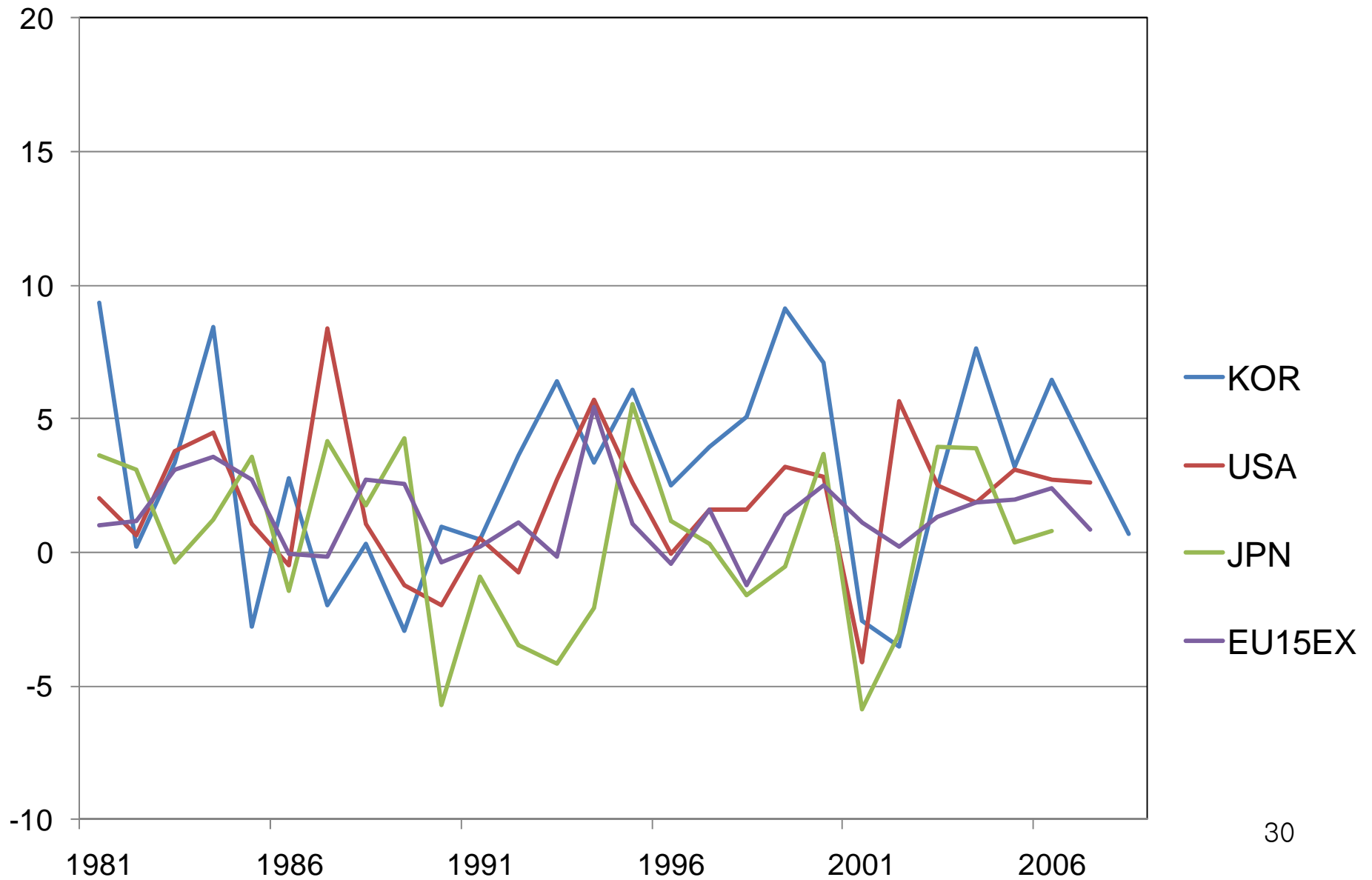
TFP Growth Rates, 1991-2000 vs. 2001-2007

	MFG	SER			MKT	TOT
		MKT	NonMKT	TOT		
1991-2000						
KOR	4.45	-0.32	-0.85	-0.60	1.10	0.64
USA	2.39	0.38	-1.10	-0.26	0.84	0.22
JPN	0.57	0.78	-0.78	0.21	0.12	-0.09
EU15EX	1.41	0.26	0.28	0.27	0.69	0.57
2001-2007						
KOR	3.75	1.30	-5.94	-1.55	1.95	0.49
KOR('01-'08)	3.44	1.21	-5.68	-1.50	1.78	0.11
USA	3.61	1.55	-0.39	0.72	1.39	0.39
JPN	0.68	0.67	-0.51	0.21	0.59	0.58
EU15EX	1.73	0.34	-0.26	0.09	0.62	0.65

TFP Growth Gap between Manufacturing and Services Sectors, 1981-2008



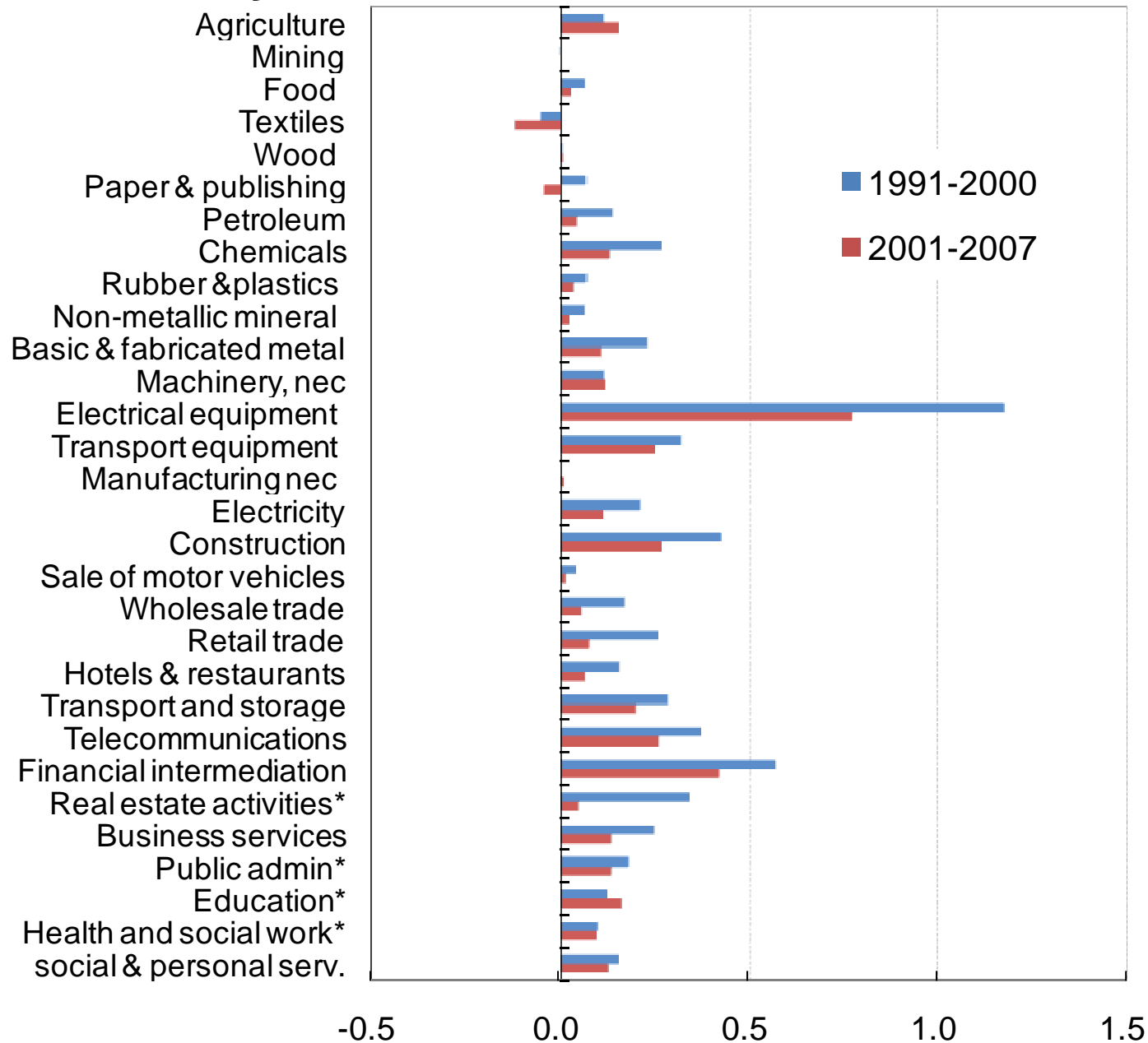
TFP Growth Gap between Manufacturing and Market Services Sectors, 1981-2008



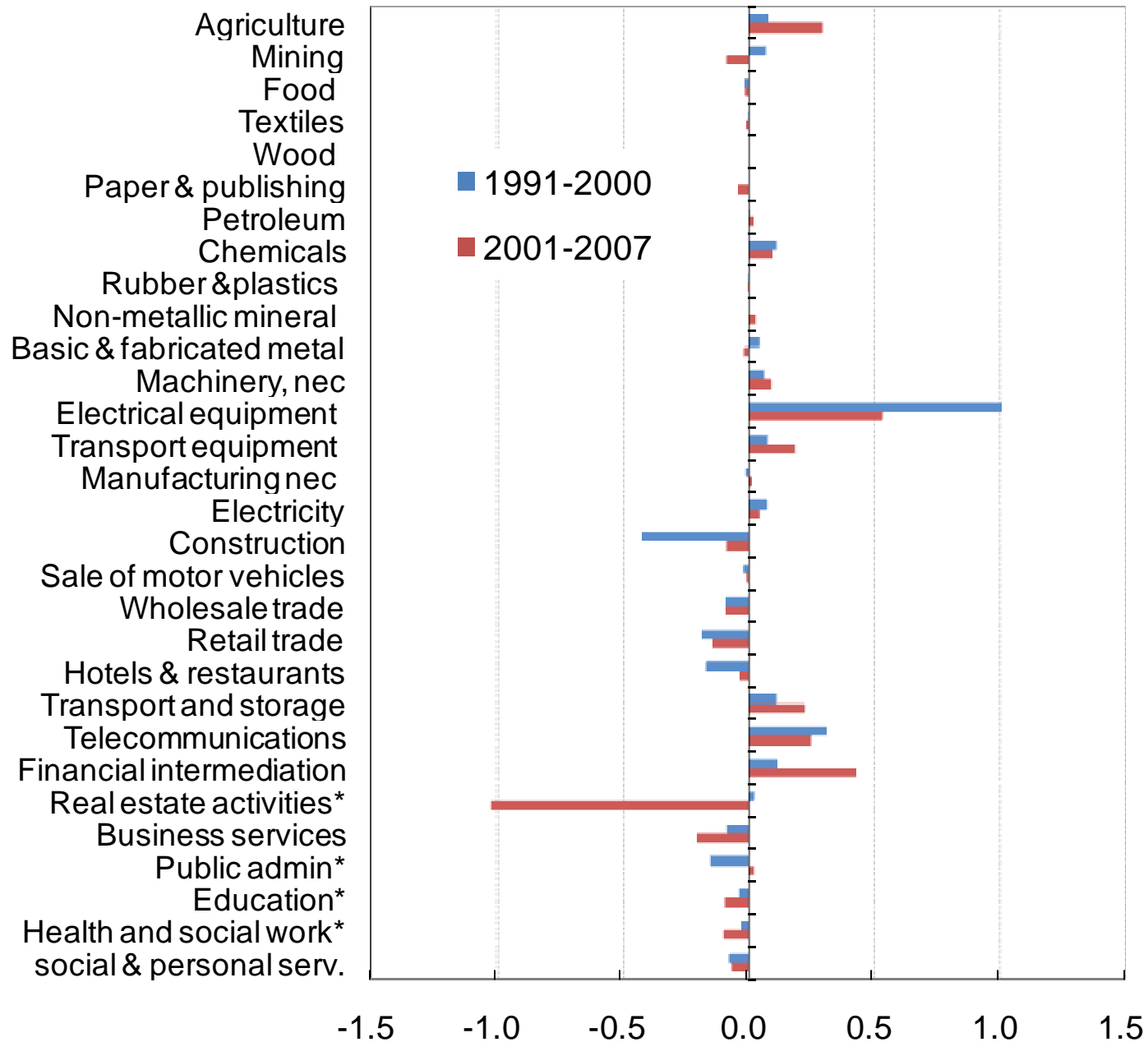
Industry Contribution to Aggregate Output and TFP Growth

- Data
 - 30 industry-level data
 - Korea, USA, Japan, EU15EX
 - 1991-2000 and 2001-2007
- Industry contribution measures
 - Both output and TFP growth contributions are weighted by industry nominal value-added

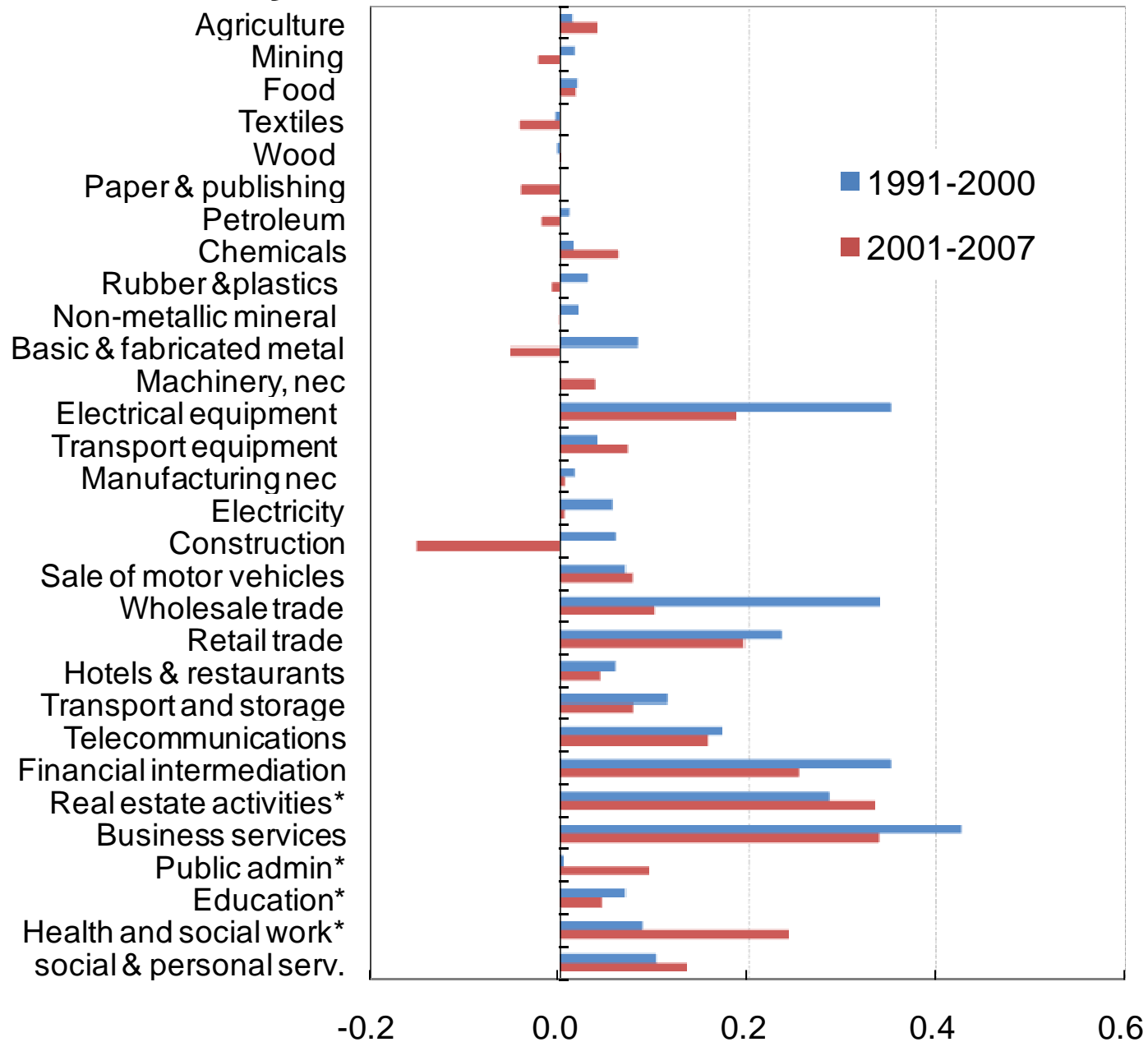
Industry Contributions to Output Growth in the Total Economy, Korea, 1991-2000 vs. 2001-2007



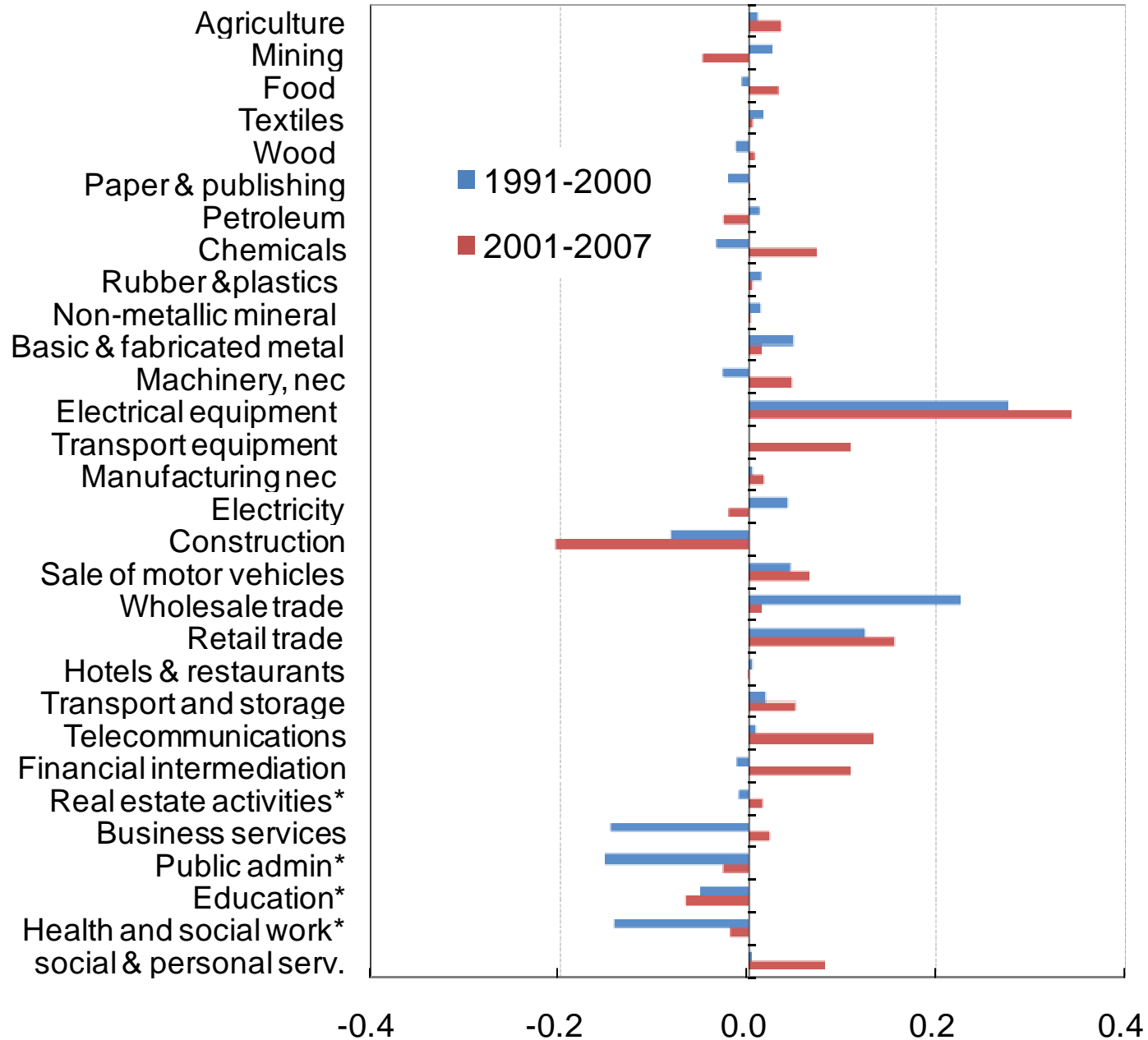
Industry Contributions to TFP Growth in the Total Economy, Korea, 1991-2000 vs. 2001-2007



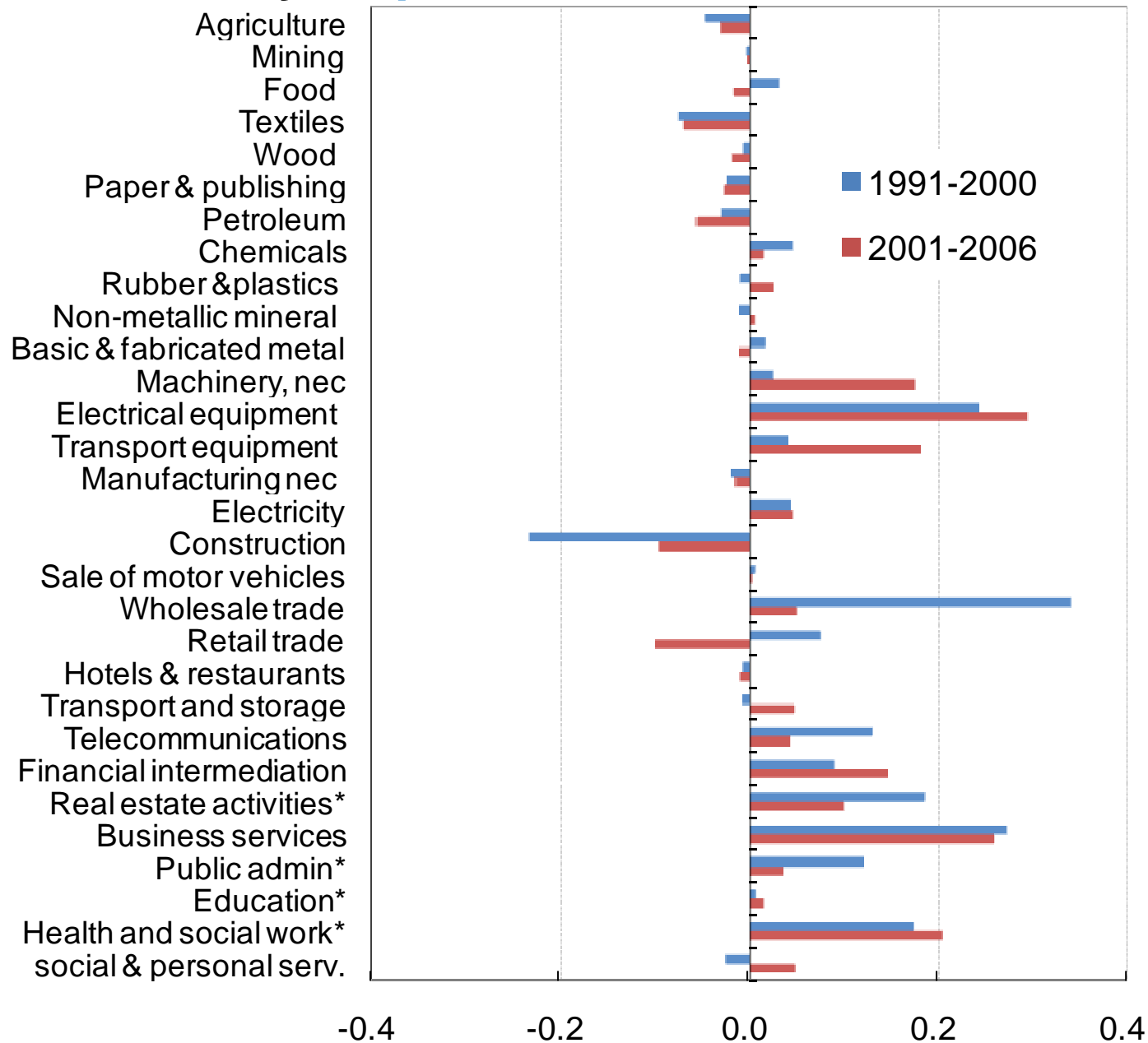
Industry Contributions to Output Growth in the Total Economy, USA, 1991-2000 vs. 2001-2007



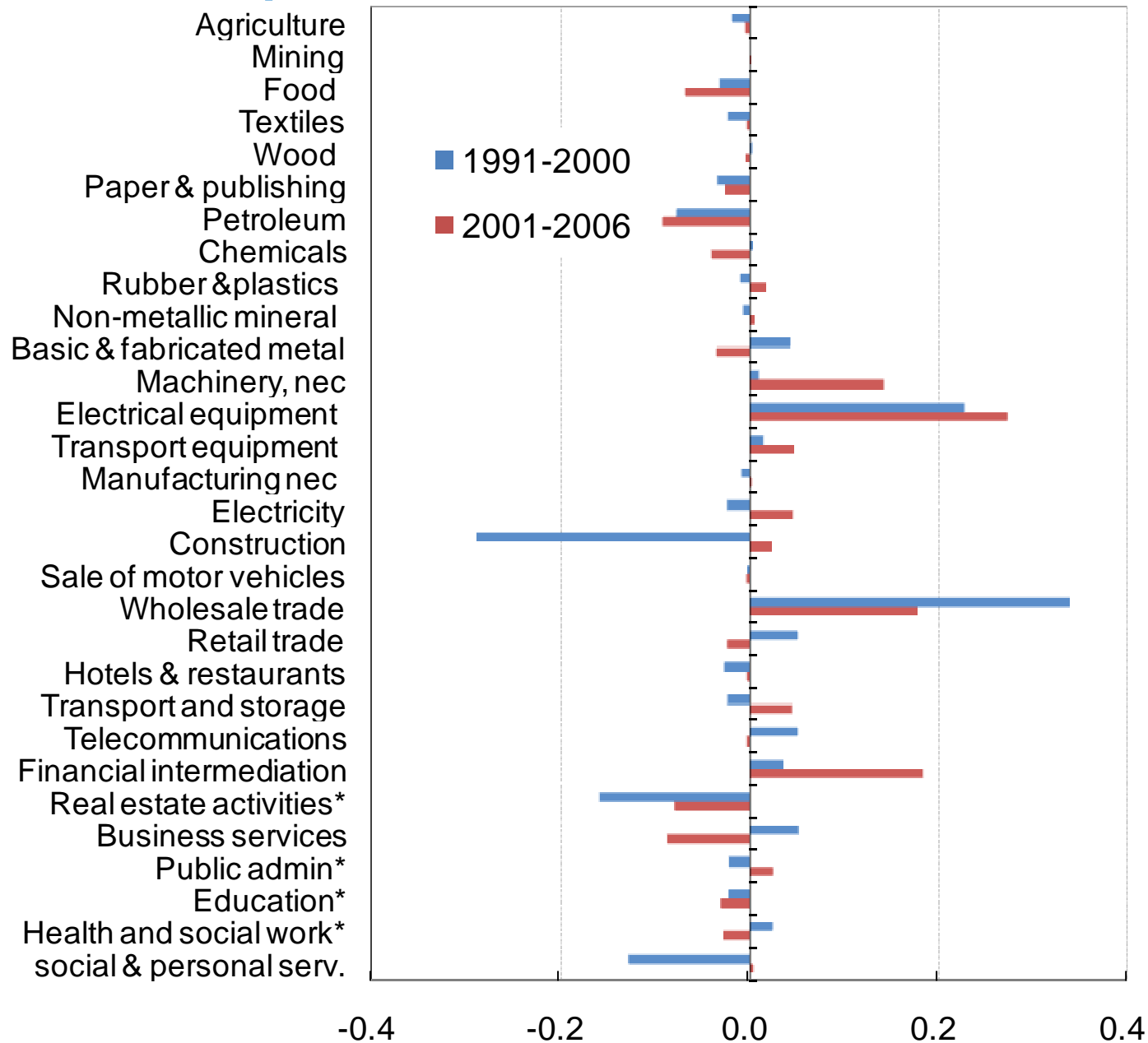
Industry Contributions to TFP Growth in the Total Economy, USA, 1991-2000 vs. 2001-2007



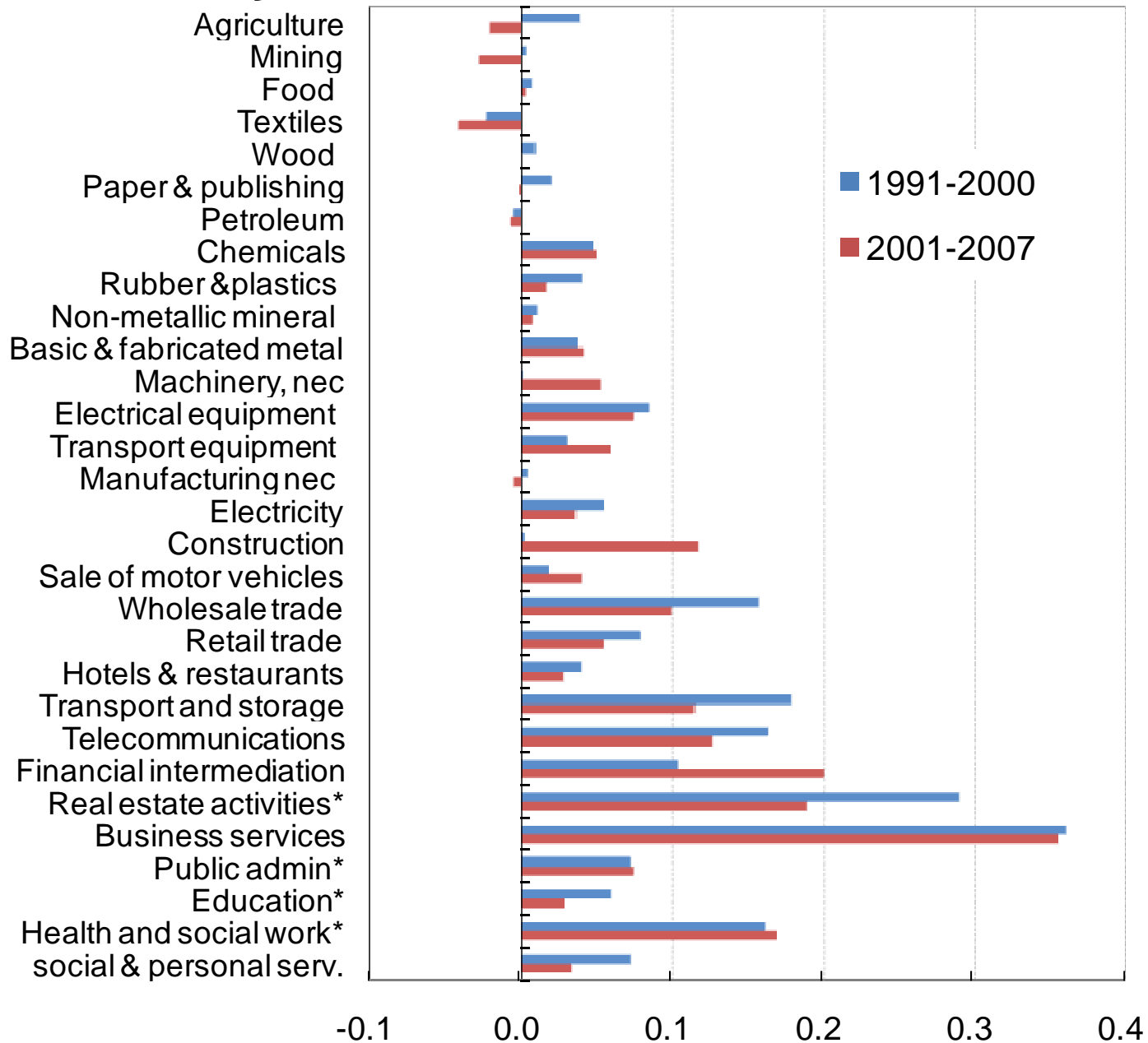
Industry Contributions to Output Growth in the Total Economy, Japan, 1991-2000 vs. 2001-2006



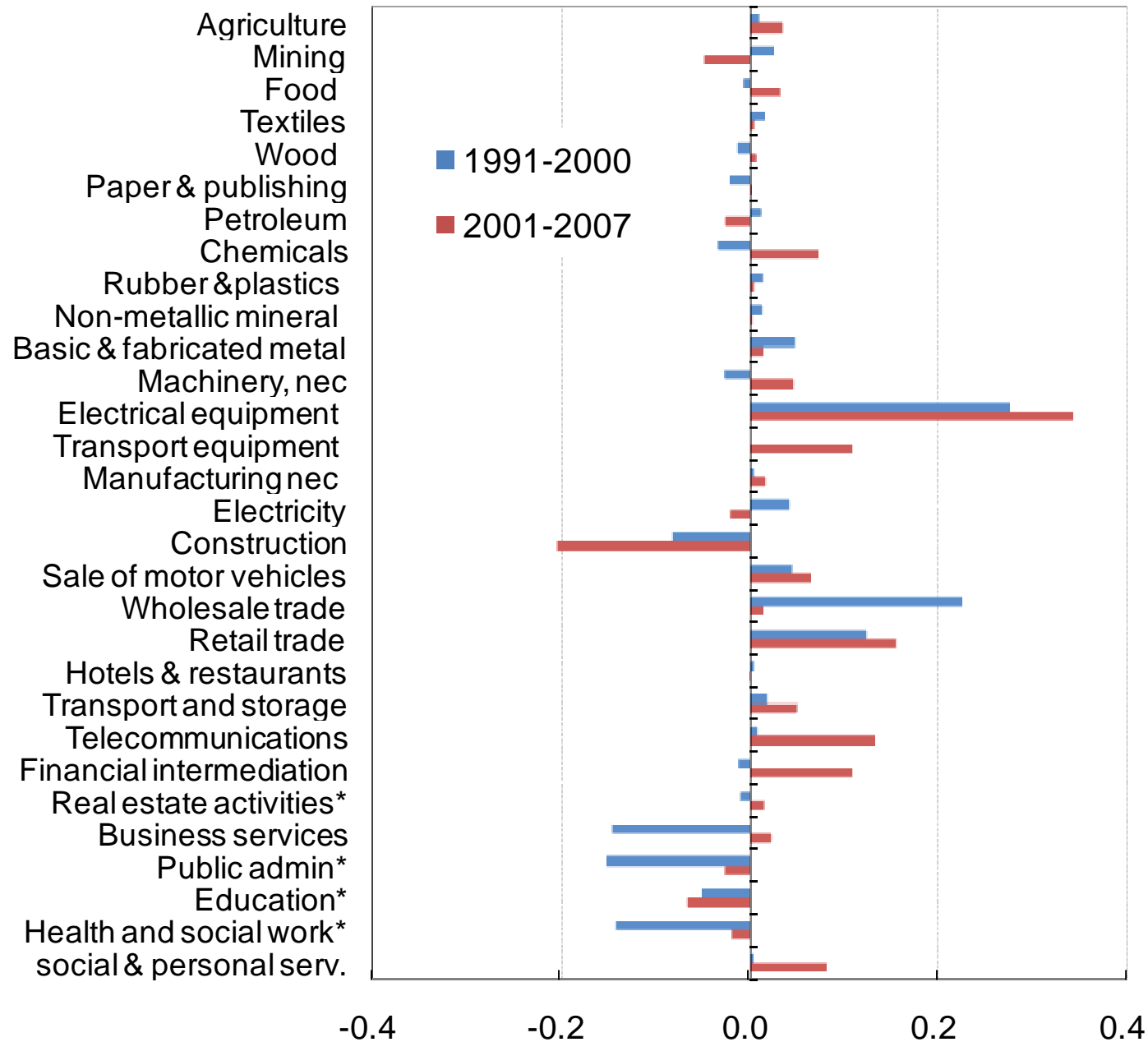
Industry Contributions to TFP Growth in the Total Economy, Japan, 1991-2000 vs. 2001-2006



Industry Contributions to Output Growth in the Total Economy, EU15EX, 1991-2000 vs. 2001-2007



Industry Contributions to TFP Growth in the Total Economy, EU15EX, 1991-2000 vs. 2001-2007



TFP Growth Slowdown in Korea

- Low TFP growth in the service sector
 - Especially, in the non-market service sector
- Non-market service sector
 - Measurement errors
 - Non-market (non-profit maximization) as well as low competition (regulation)
 - Other factors: R&D, firm size, and etc

V. KIP, EUKLEMS and WIOD

- KIP2010 and EUKLEMS
 - Available in December 2010 (and to be sent to EUKLEMS in the early 2011)
 - 72 industries for 1970-2008
- Intangibles
 - 27 industries (National Accounts) from the early 1980s to 2008
 - Intangible investment (following Corrado, Hulten and Sichel's definition) including R&D

World Input-Output Database (WIOD) Project

- International collaborative research project based on international Input-Output Tables
- Main purpose
 - Construction of internationally harmonized database
 - for the data between countries and between industries
 - about national production structure, international trade, socio-economic issues and environmental issues

Korea's Participation in WIOD

- WIOD's first annual consortium meeting
 - Vienna, May 26-28, 2010
 - Paper presented: "The Effect of Intangible Investment on Employment in Korea"
 - Supplied WIOD with available Korean I-O tables from 1995 to current
- Korea's Participation
 - Plans to take an active role in this kind of international research
 - Intends to provide Korean data for the construction of DB, following WIOD's 3 years(2010-2012) schedule

VI. Preliminary Estimates of Intangible Investment in Korea

- Intangible investment data as a part of WIOD project
- Definition
 - Corrado, Hulten, & Sichel (2006, 2009)
- Period: 1983-2008
- Industry
 - National Accounts Industry classification
 - 27 industries (11 MFG) (use and make tables)

Industry Classification in the National Accounts

No	Industry Name	No	Industry Name
1	Agriculture, forestry and fishing	14	Electricity, gas and water supply
2	Mining and quarrying	15	Construction
3	Food, beverages and tobacco	16	Wholesale and retail trade
4	Textiles, leather and fur products	17	Restaurants and hotels
5	Wood, paper, printing and reproduction	18	Transport and storage
6	Petroleum, coal and chemicals	19	Financial intermediation
7	Non-metallic mineral products	20	Real estate and renting
8	Metal products	21	Information and communication
9	General machinery	22	Business activities
10	Electric machinery	23	Public administration and defence
11	Precision equipment	24	Education
12	Transport equipment	25	Health and social work
13	Furniture and other manufacturing industries	26	Recreational, cultural and sporting
14	Electricity, gas and water supply	27	Other service activities

Definition of Intangibles (Corrado et al.)

- Computerized Information
 - Mainly computer software
- Innovative Property
 - Scientific R&D, Non-scientific R&D (R&D in financial industry, copyrights & license costs, and new architectural & engineering designs)
- Economic Competencies
 - Brand equity (advertising and market research)
 - Firm-specific resources (job training and consulting costs)

Data Sources

- Computerized Information
 - Computer software investment from BOK National Accounts; Industry decomposition using industry-asset investment table
- Innovative Property
 - Scientific R&D: Industry-level R&D series from the Survey of Research and Development published by the Ministry of Education, Science and Technology; Industry-level data is available

Data Sources (Continued)

- Innovative Property (continued)
 - Non-scientific R&D
 - R&D in financial industry (20% of intermediate consumption for financial intermediation industry)
 - Copyrights & license costs (20% of intermediate consumption for entertainment industry)
 - Mineral exploration from BOK NA; all for mining industry

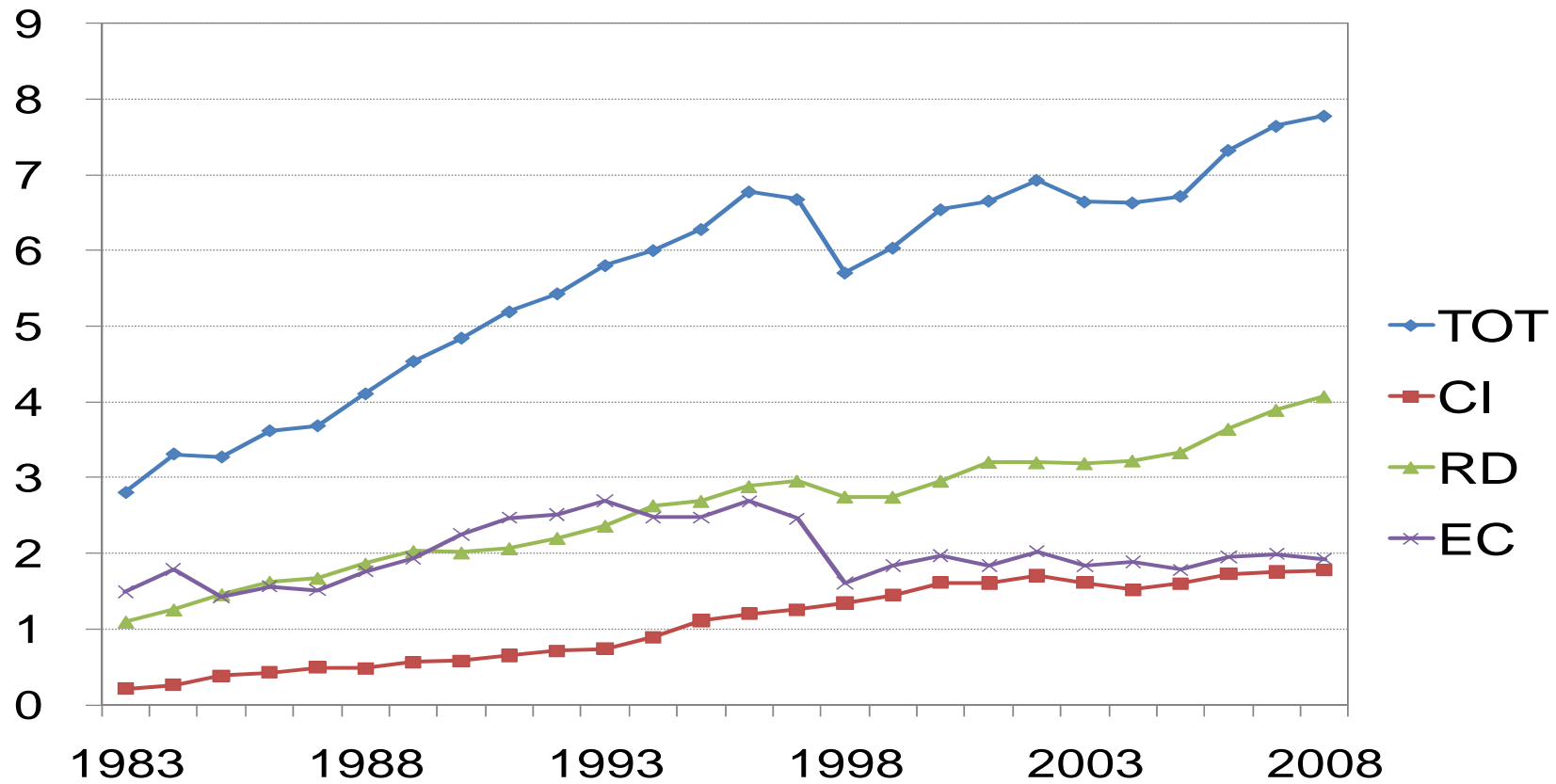
Data Sources (Continued)

- Economic Competencies
 - Brand equity
 - Advertising expenses from 60% (following CHS) of gross output of adv. Industry; industry decomposition using IO table
 - Firm-specific resources
 - Employer-provided Job training costs (plus indirect costs) from Report on Labor Cost of Enterprise Survey published by the Ministry of Labor; industry-level data is available
 - Consulting costs from BOK detail industry data; industry decomposition using IO table

Intangible Investments as share of GDP in Korea, 1983-2008

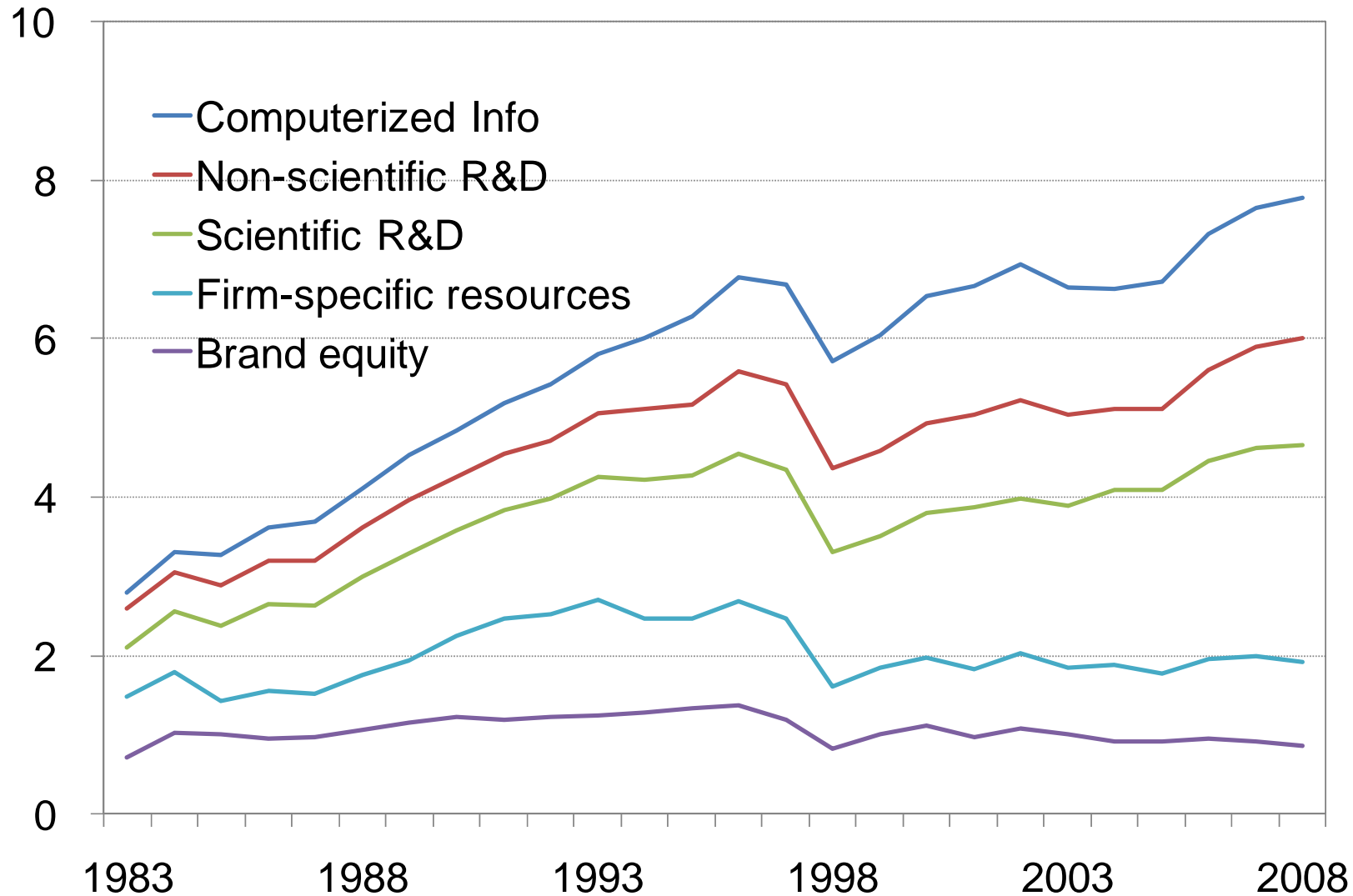
	1983-1990	1991-2000	2001-2008
Computerized information	0.4	1.1	1.7
Innovative property	1.6	2.6	3.5
(a) Scientific R&D	1.1	1.7	2.3
(b) Non-scientific R&D	0.6	0.9	1.2
Economic competencies	1.7	2.3	1.9
(a) Brand equity	1.0	1.2	1.0
(b) Firm-specific resources	0.7	1.1	1.0
Total	3.8	6.0	7.0

Intangible Investments as share of GDP in Korea, 1983-2008



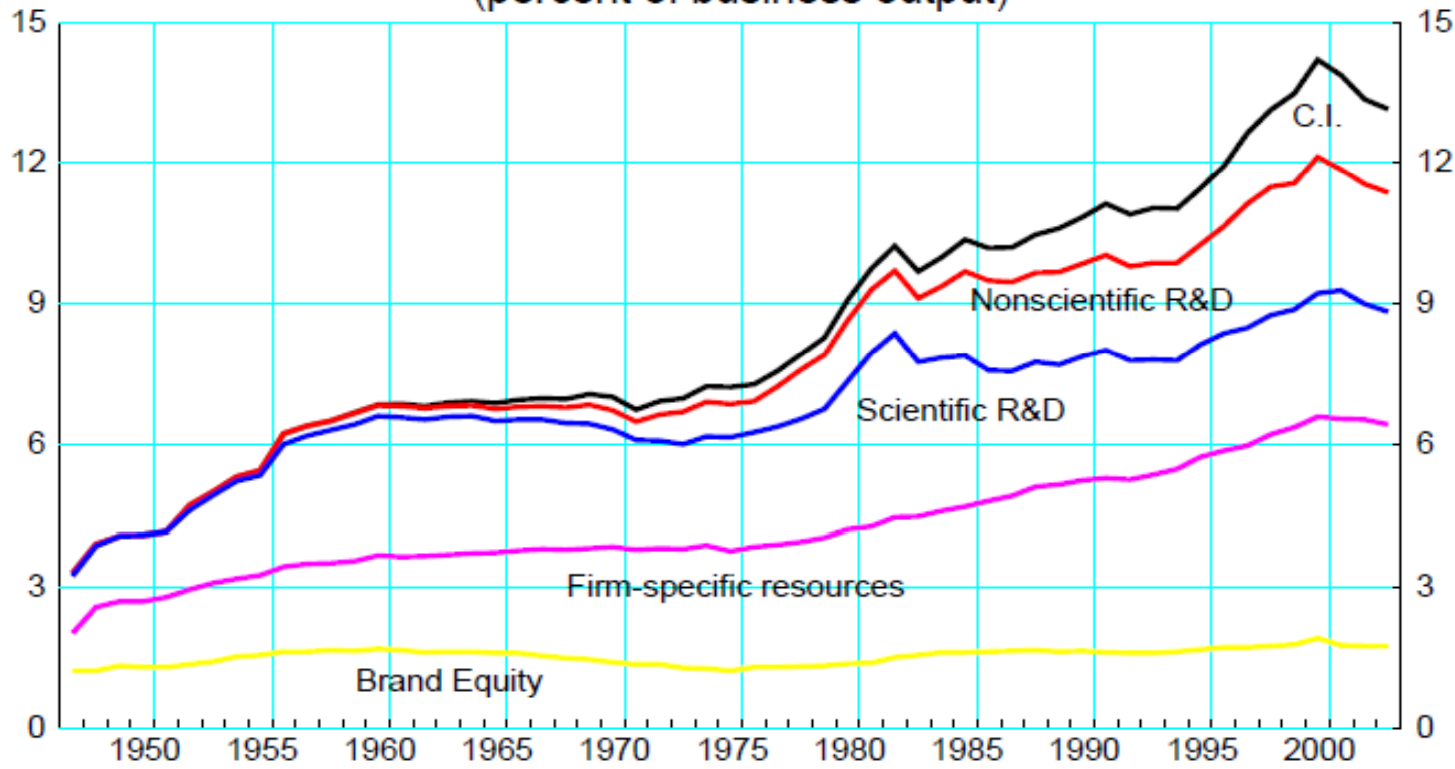
Notes: CI: Computerized Information
RD: Innovative Property
EC: Economic Competence

Intangible Investments as share of GDP in Korea, 1983-2008



Intangible Investments as share of GDP in USA, Corrado et al. (2006)

Figure 2
Intangible Investments
(percent of business output)



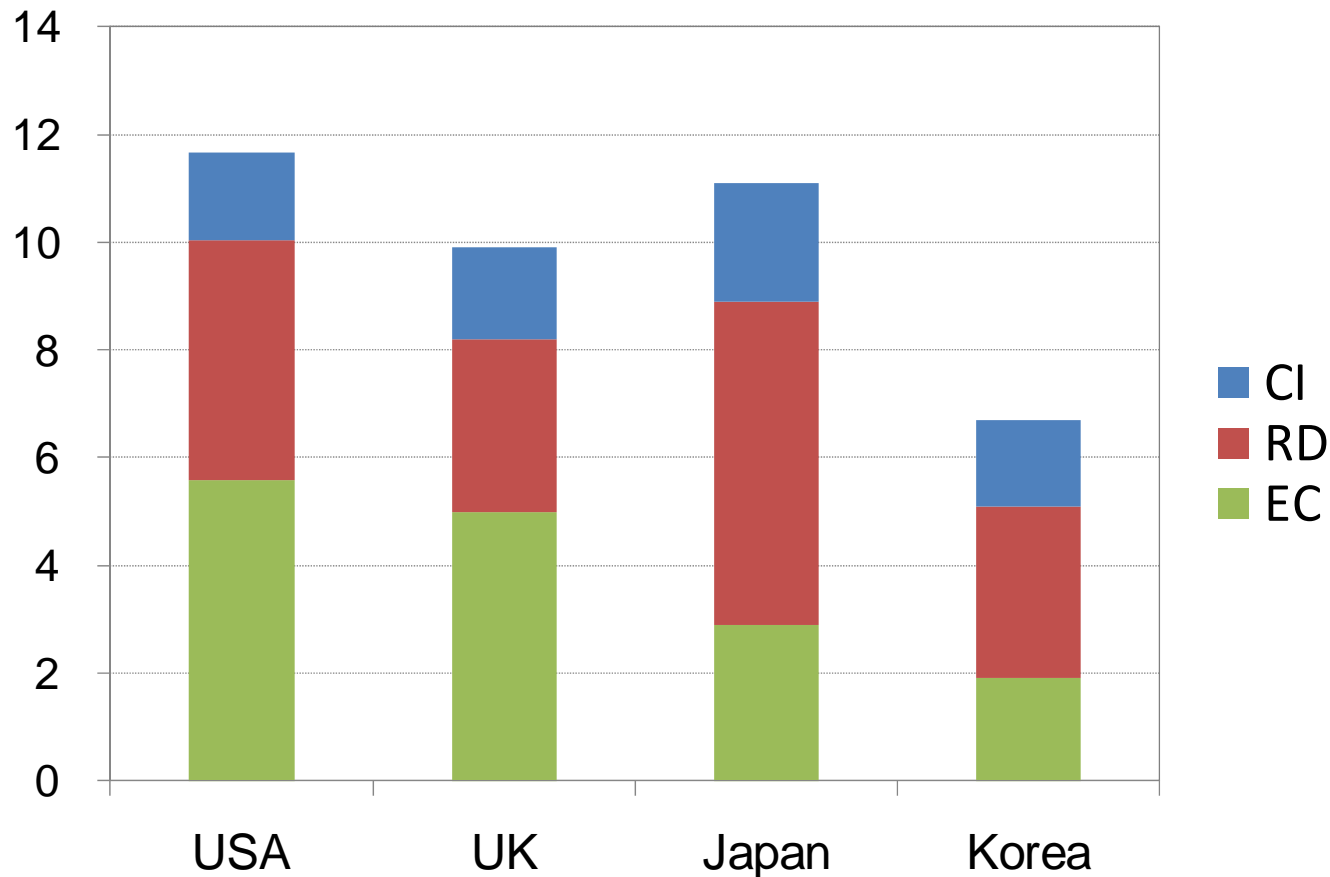
Note: C.I. = Computerized information

Share of Intangible Investment in GDP: USA, UK, Japan and Korea

	USA 2000-2003	UK 2004	Japan 2000-2005	Korea 2000-2005
Computerized information	1.6	1.7	2.2	1.6
Innovative property	4.5	3.2	6.0	3.2
(a) Scientific R&D	2.2	1.1	2.8	2.1
(b) Non-scientific R&D	2.3	2.2	3.2	1.1
Economic competencies	5.6	5.0	2.9	1.9
(a) Brand equity	1.5	1.0	1.2	1.0
(b) Firm-specific resources	4.0	4.0	1.7	0.9
Total	11.7	10.0	11.1	6.7

Sources: Corrado, Hulten, & Sichel (2009) for USA;
Marrano, Haskel & Wallis (2009) for UK;
Fukao, Miyagawa, Mukai, Shinoda, & Tonogi (2009) for Japan.

Share of Intangible Investment in GDP: USA, UK, Japan and Korea



Sources: Corrado, Hulten, & Sichel (2009) for USA;
Marrano, Haskel & Wallis (2009) for UK;
Fukao, Miyagawa, Mukai, Shinoda, & Tonogi (2009) for Japan.

Results

- Level
 - Korea's share of Intangible Investment in GDP (6.7% during 2000-2005) lags behind USA (11.7%), Japan (11.1%), UK(10.0%)
- Composition
 - Concentrated in R&D for Japan & Korea, but in EC for USA and UK

Future Work

- Output measure and income share
 - Double counting
- Real investment and capital stock
 - Deflators
 - Depreciation rates
- Ownership
 - Gov. R&D; use or financed by industries
 - Foreign R&D

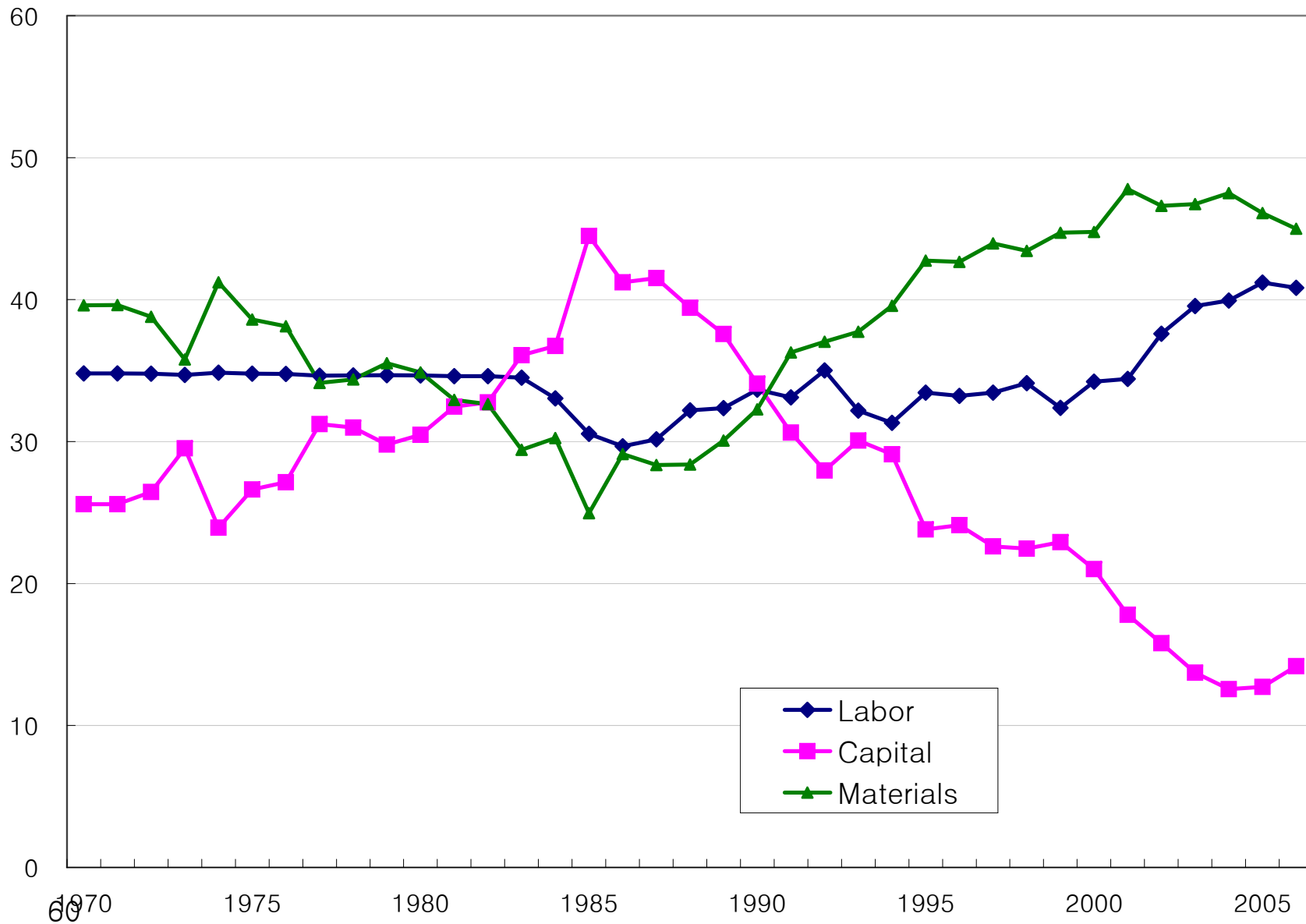
Output measure

- Framework
 - $Y=C+I$ (without intangibles)
 - $Y+N = C+I+N$ (with intangibles)
- Double-counting: An R&D Example
 - A part of R&D is included in tangible investment
 - A part of R&D is included in software investment
 - Gov. R&D is Gov. consumption

Effect on Nominal Gross Fixed Capital Formation in 2006

	Old GFCF	New GFCF	
Equipment & Structures	231.6	228.1 (=231.6-3.5)	
Intangibles	14.6	42.5	
Computer Software	14.5	14.1 (=14.5-0.4)	
Mineral Exploration	0.1	0.1	
R&D		27.3	
Total	246.3 (trillion won)	269.6 [+9.5%]	Double counting adjustment for R&D software

R&D by the Types of Expenditures (%) in Korea



Deflators

- Choice of deflators is different across studies
 - CI: software investment deflator
 - R&D: GDP deflator (or business or market economy VA deflator), input cost-based deflator
 - Brand equity and firm-specific resources: GDP deflator or adv. & private education industry deflators

Depreciation rates

- CHS's depreciation rates
 - CI (33%), R&D (20%), Brand equity (60%), Firm-specific resources (40%)
- Too high or too low depreciation rates for Korea
 - CI Dep. rate by BOK or Pyo lower than CHS' rate
 - Highly concentrated R&D in ICT sector in Korea; 20% seems too low.