

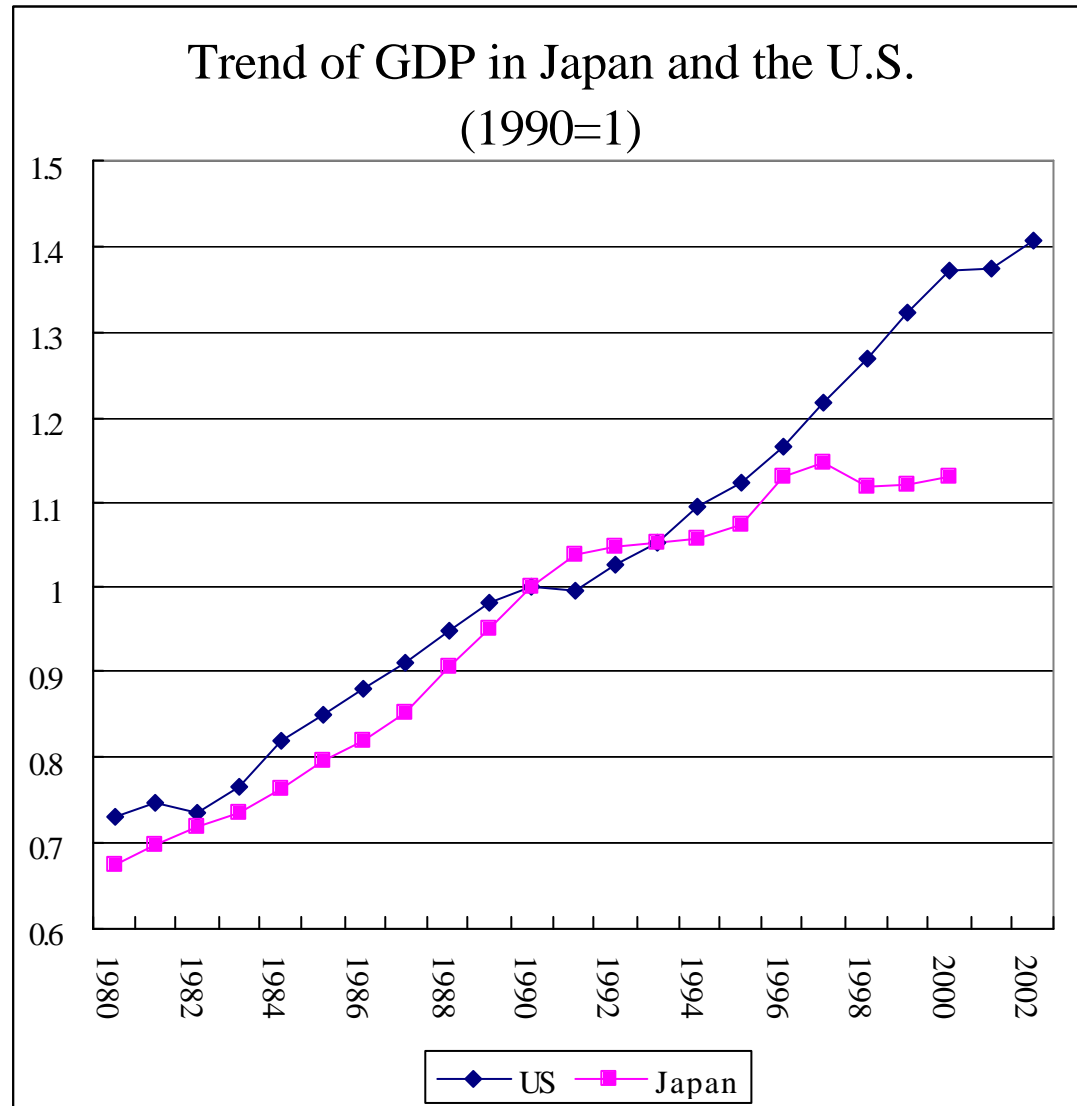


# Economic Growth in Japan and the United States in the Information Age

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# Sharp contrast of economic growth in 90's



# Economic Growth in the Information Age

- US Economic Resurgence and the role of IT
  - Strong labor productivity performance by IT capital deepening
  - Speed up of TFP growth, by ICT sector
  - Positive relationship between IT and productivity at the firm level
- Divergence of economic growth rates of OECD countries, and potential role of IT (OECD's growth projects, studies on EU countries)
- What happened in Japan?

# Methodology

-production possibility frontier approach-

$$\bar{w}_{I,n} \Delta \ln I_n + \bar{w}_{I,c} \Delta \ln I_c + \bar{w}_{I,s} \Delta \ln I_s + \bar{w}_{I,t} \Delta \ln I_t + \bar{w}_{c,n} \Delta \ln C_n + \bar{w}_{c,c} \Delta \ln C_c = \\ \bar{v}_{K,n} \Delta \ln K_n + \bar{v}_{K,c} \Delta \ln K_c + \bar{v}_{K,s} \Delta \ln K_s + \bar{v}_{K,t} \Delta \ln K_t + \bar{v}_L \Delta \ln L + \Delta \ln A$$

Output: Ic: Investment in computers

Is: Investment in software

It: Investment in communications equipment

Cc: Consumption of IT products

In, Cn: investment and consumption of non-IT

Input: Kc: Capital service flow from computers

Ks: Capital service flow from software

Kt: Capital service flow from communications equipment

Kn: Capital service from non-IT

L: Labor service

Total Factor Productivity: A

# Dataset for analysis (Japanese data)

	Business sector	Public sector	Household sector
Output	93SNA Official GDP + software adjustments	93SNA Official GDP + software adjustments	93SNA Official GDP + capital service from household
Capital Input	(Depreciable Assets) - Based on investment series by 62 types of asset (5 types of IT), capital stock and capital service are estimated.  (Land) - The stock of land is assumed to be constant at macro level. Capital service price is estimated from land price  (Inventory) - Use SNA base aggregated inventory stock and price to estimate capital service		Based on investment series by 20 types of asset (3 types of IT), capital stock and capital service are estimated.
Labor	KEO data for labor inputs by type of labor		•

## Dataset Issues (1)- Output

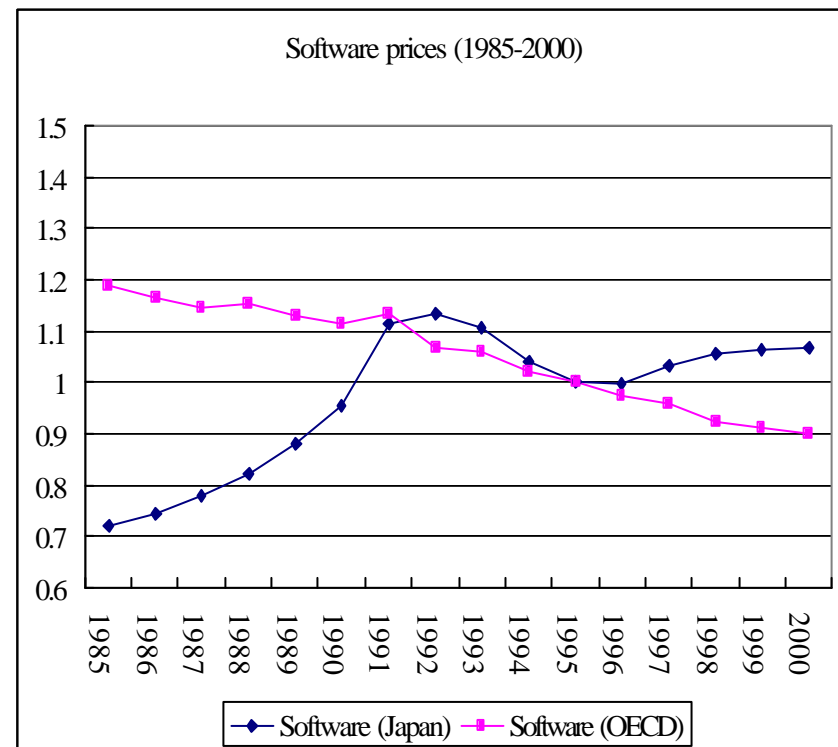
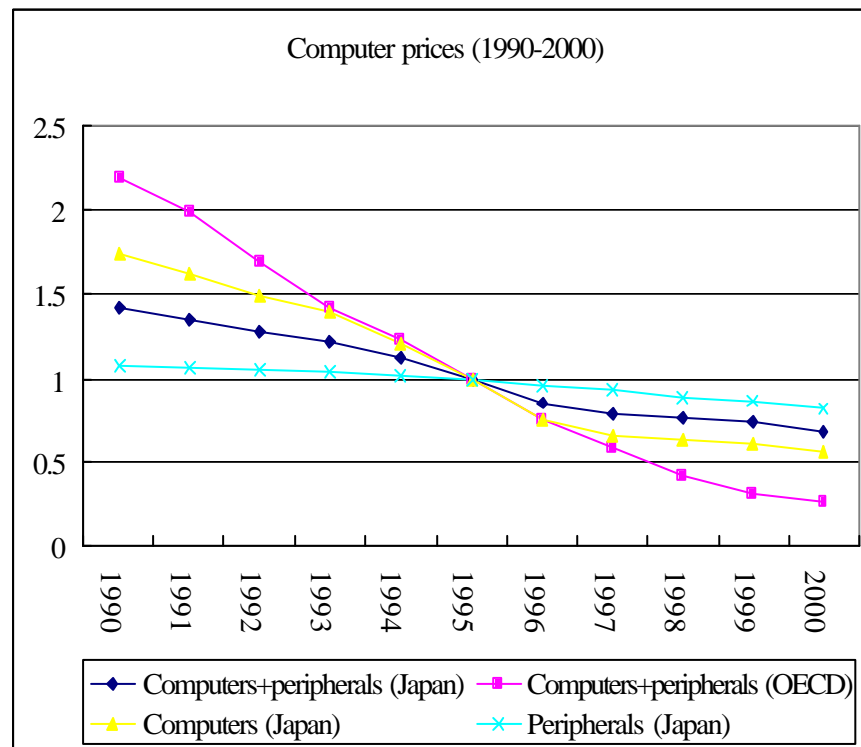
- Difference in Official GDP
  - Japanese GDP (93SNA base) only includes “custom made software in investment”, while US NIPA includes “prepackaged” and “own account software” as well.
- Addition of capital service flows from consumer durables
- Impact of these adjustments is about 20 trillion yen

	(in billion yen)
Official GDP 93SNA	513,377
+Software Adjustment	4,154
+Consumer Durables Adjustment	15,338
Adjusted Output data	532,868
Reference: Official GDP 68SNA base	490,518

## Dataset Issues (2)- IT Price (1)

- Huge J-US difference in IT price, particularly for computers
- Harmonized IT Prices a la OECD

IT Price = US IT price relative non-IT+domestic non IT price



## Dataset Issues (2)- IT Price (2)

Possible factors of slow pace of IT price drop

- Laspyres upward bias in BOJ's computer series
  - Weight change: PC vs MF=1:1 in 95, 4:1 in 2000

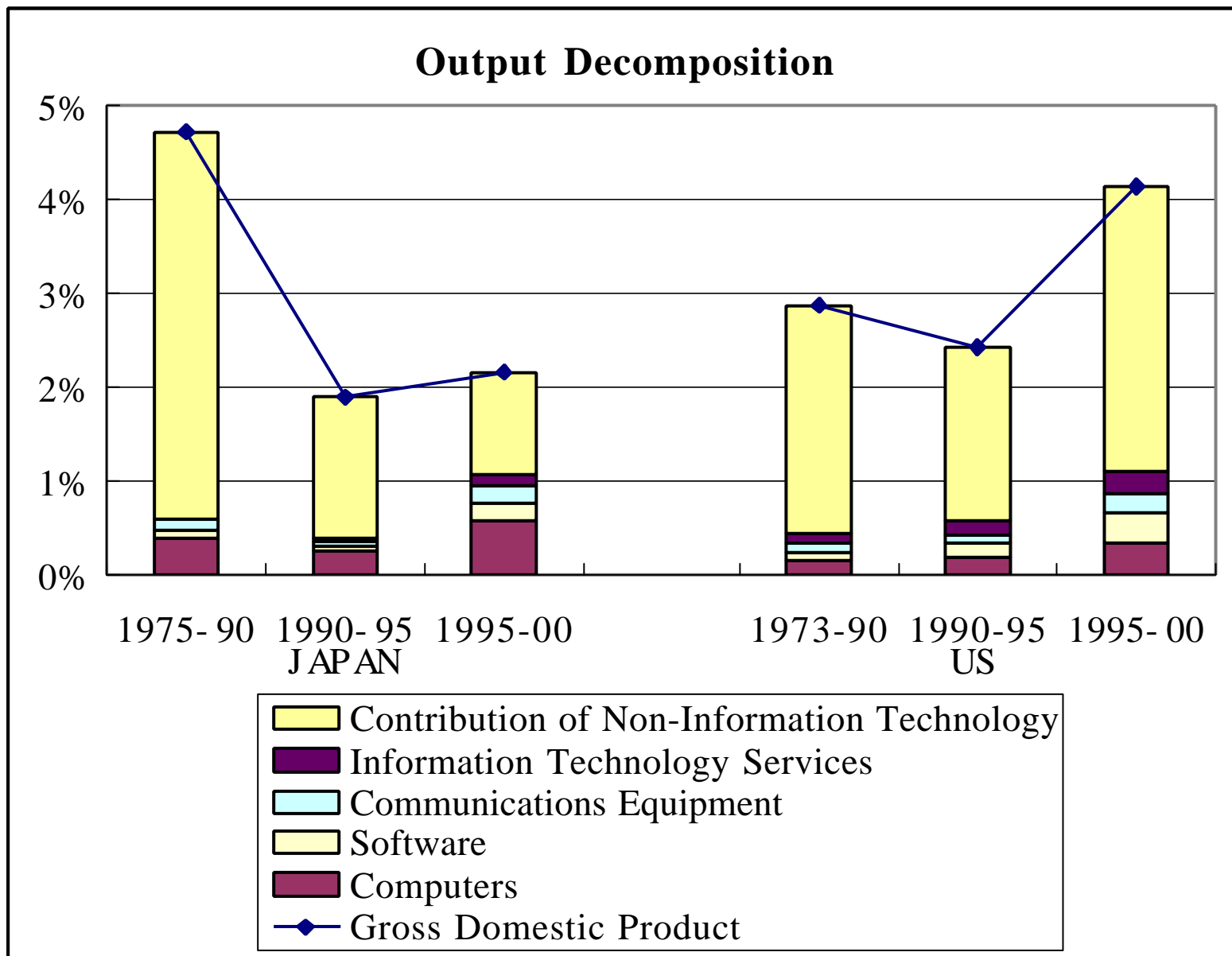
	BOJ	Paarche	Fisher	J&M
1995	1.00	1.00	1.00	1.00
1996	0.74	0.59	0.66	0.75
1997	0.65	0.44	0.53	0.58
1998	0.63	0.40	0.50	0.42
1999	0.61	0.37	0.47	0.31
2000	0.55	0.27	0.39	0.26

- Slow pace of computer downsizing, Japanese business practices for mainframe users

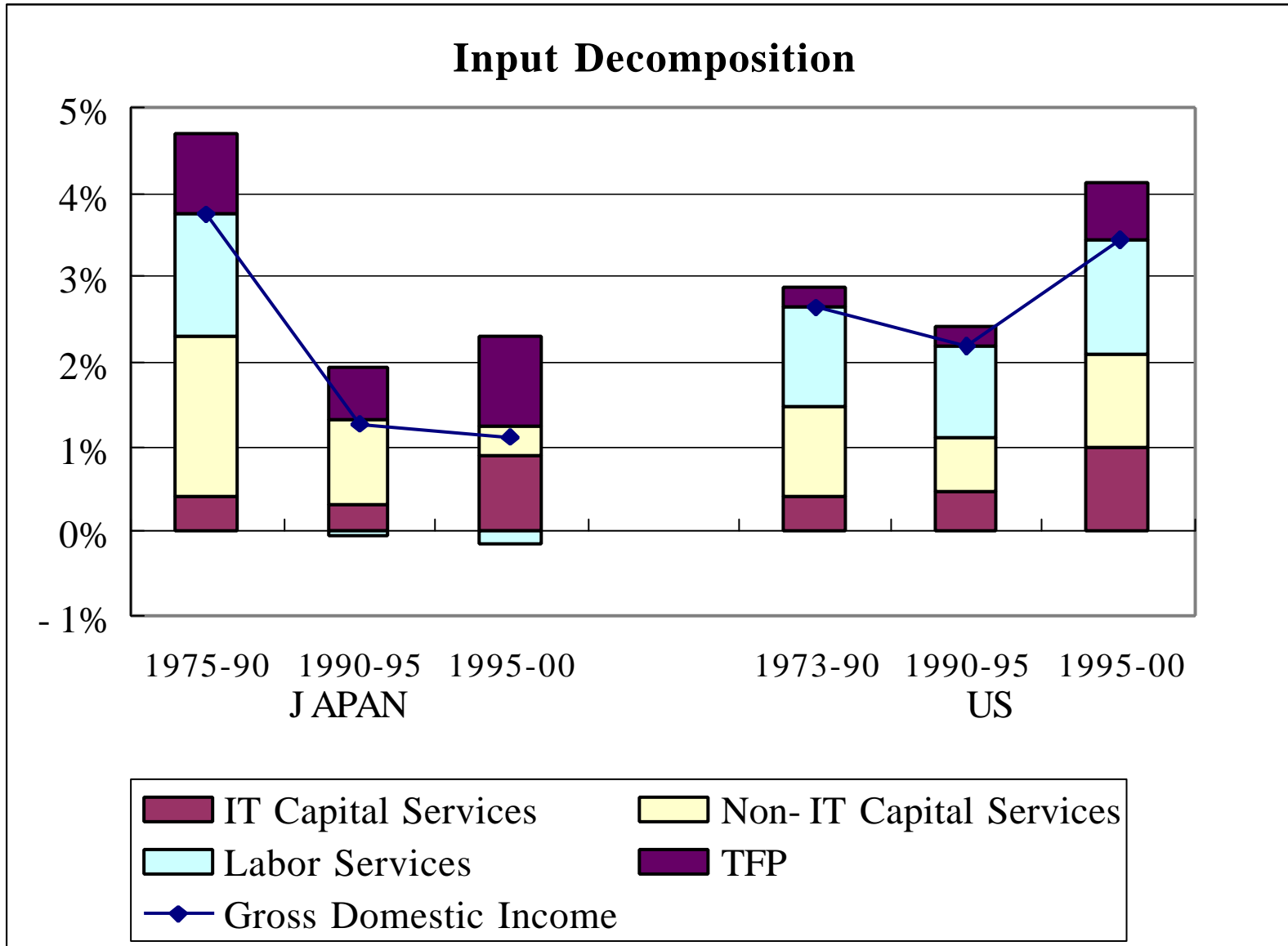
## Sensitivity to constant price output change

	<b>1975-90</b>	<b>1990-95</b>	<b>1995-00</b>
Official Statistics (93SNA)	4.19	1.49	1.39
(68SNA GDP series)	(4.13)	(1.44)	(1.02)
+Software Adjustment	0.11	-0.01	0.02
+IT consumer durables	0.01	0.02	0.06
+Non-IT consumer durables	0.24	0.17	0.10
Adjusted by national statistics	4.54	1.67	1.58
+price adjustment (Computer)	0.14	0.16	0.42
+price adjustment (Software)	0.04	0.04	0.06
+price adjustment (Comm. Equip)	-0.02	0.00	0.01
+price adjustment (IT services)	0.00	0.02	0.09
Adjusted by harmonized price	4.70	1.89	2.15

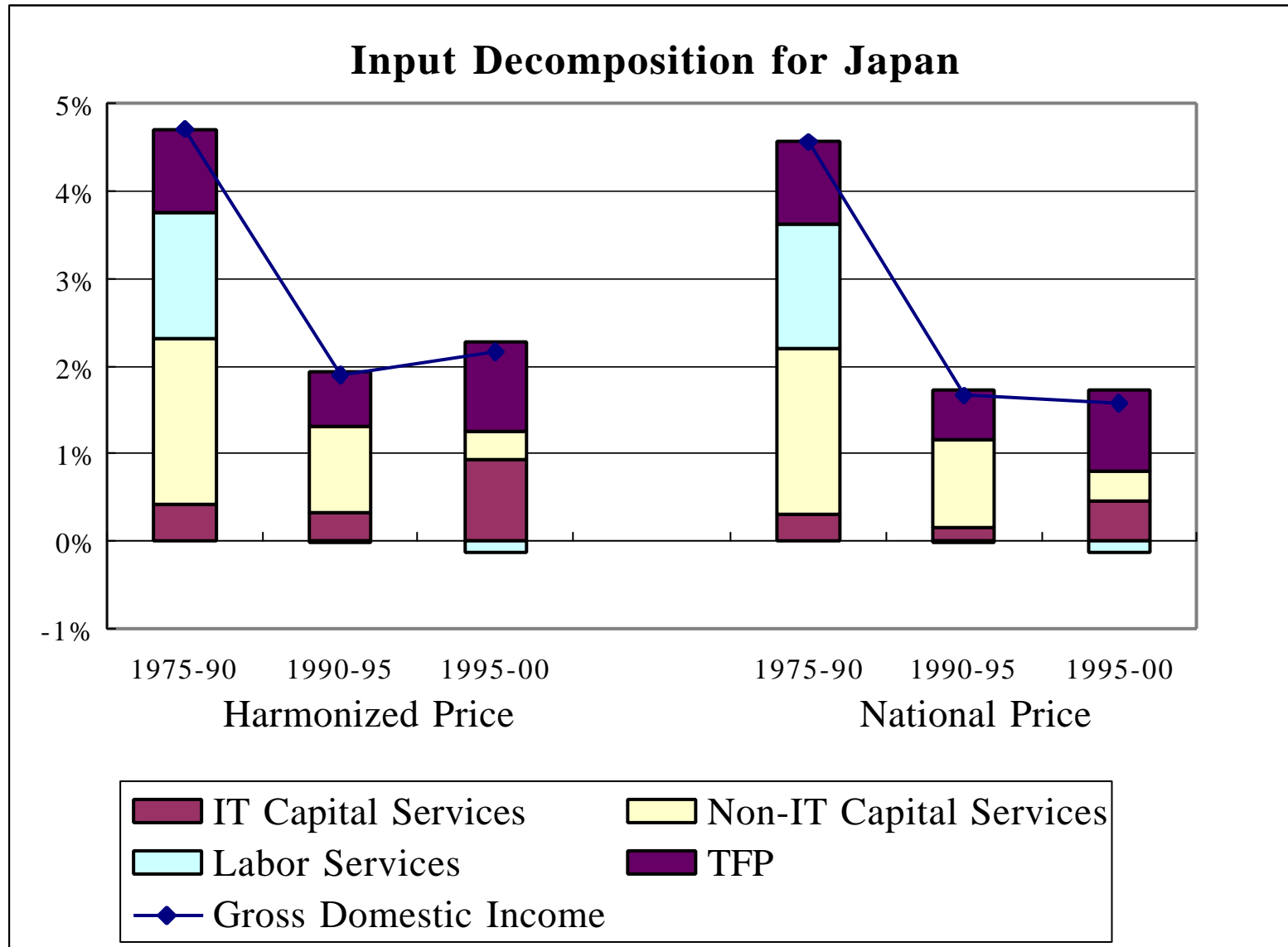
# Result (1): Output Decomposition



# Result (2): Input Decomposition



# Results (3): Input decomposition by price change



# Differences in TFP estimates in Japan

		Jorgenson & Motohashi	KEIO data (1)	Hayashi & Prescott (2)	Fukao et. al. (2)
GDP/GNP Growth	1975-1990	4.54%	4.36%	4.17%	4.23%
	1990-1995	1.67%	1.02%	1.46%	2.00%
	1995-2000	1.58%	0.87%	1.09%	0.92%(*)
Capital Contribution	1975-1990	2.22%	1.79%	1.78%	1.89%
	1990-1995	1.16%	1.57%	1.66%	1.17%
	1995-2000	0.77%	0.81%	1.13%	0.85%(*)
Labor Contribution	1975-1990	1.34%	1.32%	1.78%	2.59%
	1990-1995	-0.16%	-0.17%	-0.70%	1.07%
	1995-2000	-0.20%	-0.14%	-0.58%	0.12%(*)
TFP	1975-1990	0.98%	1.25%	1.83%	0.55%
	1990-1995	0.67%	-0.38%	0.24%	0.10%
	1995-2000	1.00%	0.19%	0.34%	-0.02%(*)
Output		93SNA	68SNA(**)	68SNA/GNP	68SNA
Industry quality control		no	yes	no	?
Input quality control		yes	yes	no	yes
Land		yes	yes(***)	no	no

(1): Estimate by Koji Nomura, Keio University

(2): Adapted from Inui and Gwon (2004)

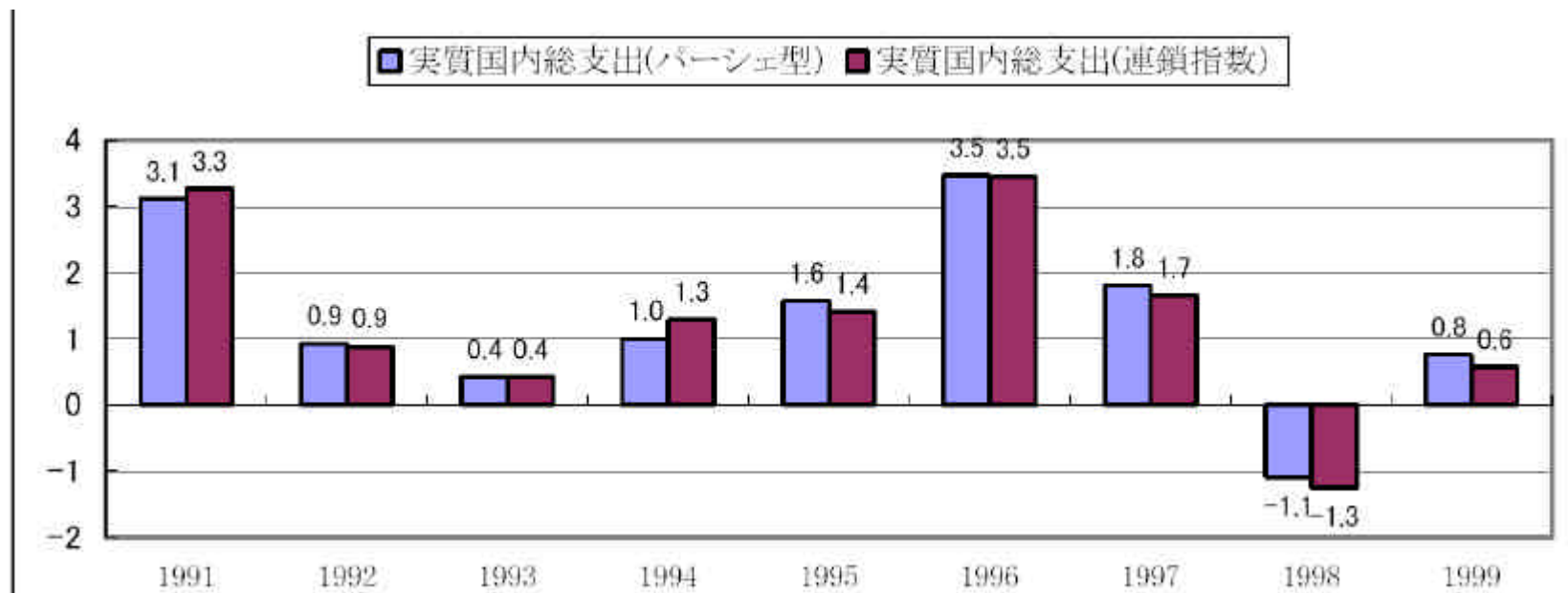
(\*): 1995-1998 instead of 1995-2000

(\*\*): Including custom made software as investment

(\*\*\*): Quality control for land as well

# Issues in output measurement

- 93 SNA or 68 SNA (software, rental services from public infrastructure)
- KLEM approach or VAKL
- Industry data (Chain weighted index) or macro data (Laspyres index)



# Issues in capital inputs

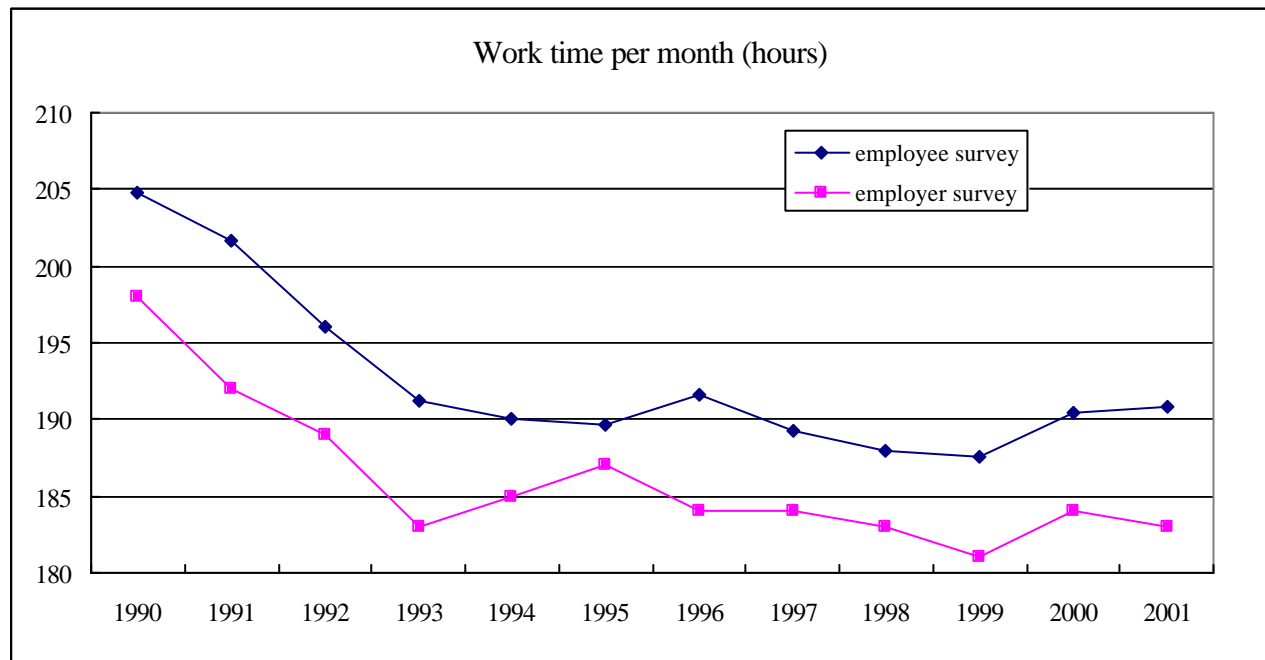
- Control for capital quality
  - J&M: estimated by 62 commodity types for private and public, 20 types for households

	Capital Service Value (a)			Capital Stock Quantity(b)			Capital Stock Quality (a-b)		
	1975-90	1990-95	95-2000	1975-95	1990-95	95-2000	1975-95	1990-95	95-2000
Total	7.81%	4.39%	4.13%	5.38%	3.97%	2.72%	2.43%	0.41%	1.41%
IT	1.35%	1.10%	3.03%	0.30%	0.33%	1.60%	1.05%	0.76%	1.42%
Non- IT	6.46%	3.29%	1.10%	5.08%	3.64%	1.12%	1.38%	- 0.35%	-0.02%

- Including land, inventory or not
- Adjustment for capital utility ratio

# Issues in labor inputs

- Control for labor quality
- Estimate of working hours
  - IT and flexible working style: invisible working time from employer side? (95-00: annually 0.4% difference between surveys)



# Conclusion

- Contribution of IT to both output and input of economic growth is about same for Japan and the U.S. in 1990's
- TFP growth rate increased in the late 90's in Japan, higher rate of growth than that of the U.S. (based on comparable data set)
- Large difference in economic growth rate can be explained by non-IT capital and labor
  - supply side story (labor institution change, IT-labor substitution) or demand side story (NPL-credit crunch-non-IT investment down, deflationary pressure-consumption down)