

Turn the Tables!

Reframing Measurement of Capital in Japanese National Accounts

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Today's Topics

Capital: Two Aspects of One Entity

- Concepts of Capital Stock
- Capital Value and Depreciation

Measurement in Japanese National Accounts

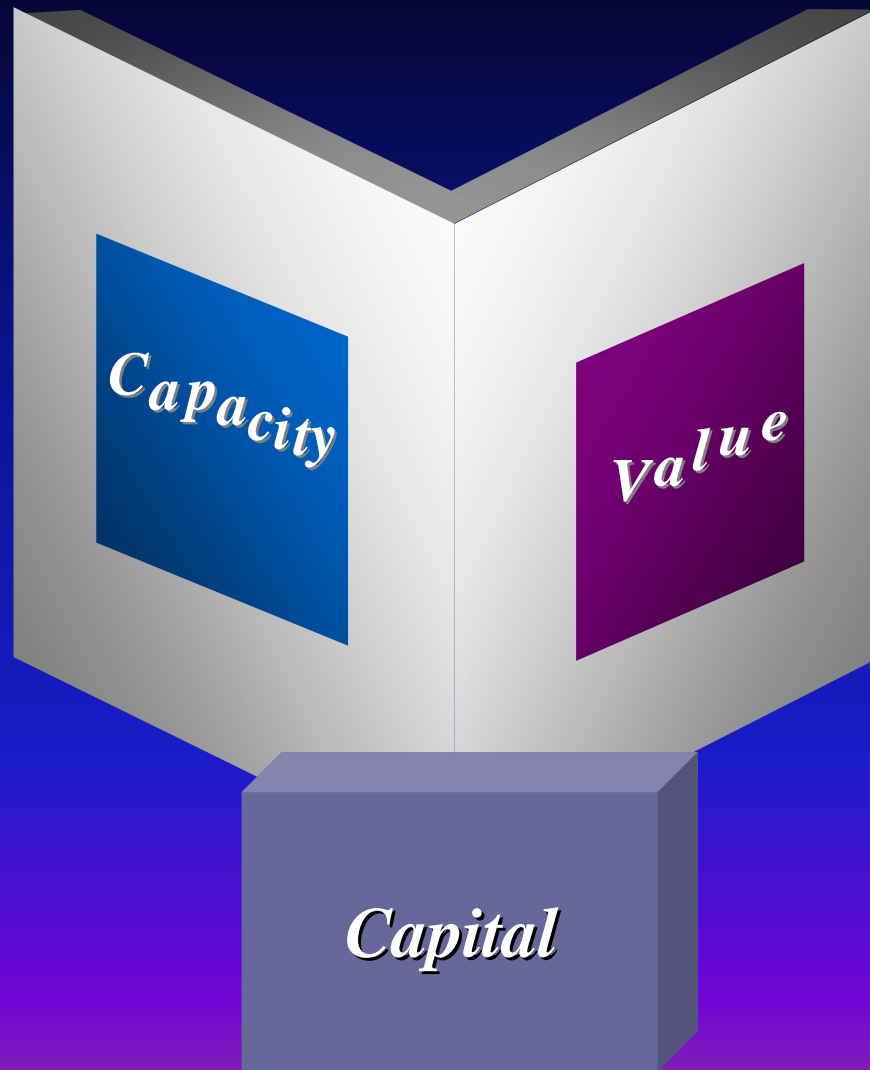
- Net, CFC, and Gross

Alternative Measurement

- Price and Quantity of Capital Service
- Aggregating Capital
- Land as a Capital
- Capitalization of Software
- IT Capital and Price Statistics
- Capital Costs for Non-Market Production

Conclusion: Proposals for Reframing

Two Aspects of Capital



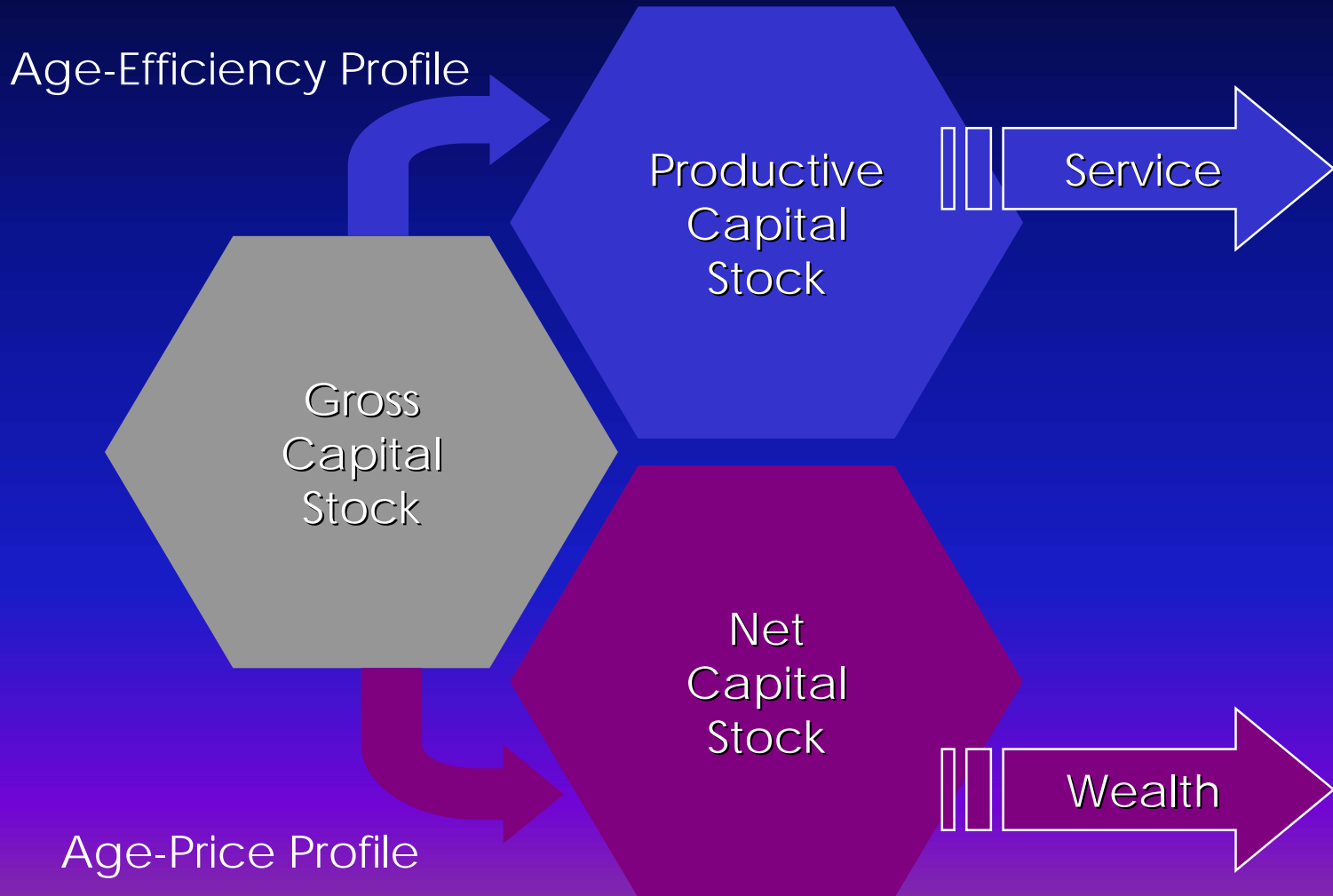
Traditional Concepts of Capital Stock



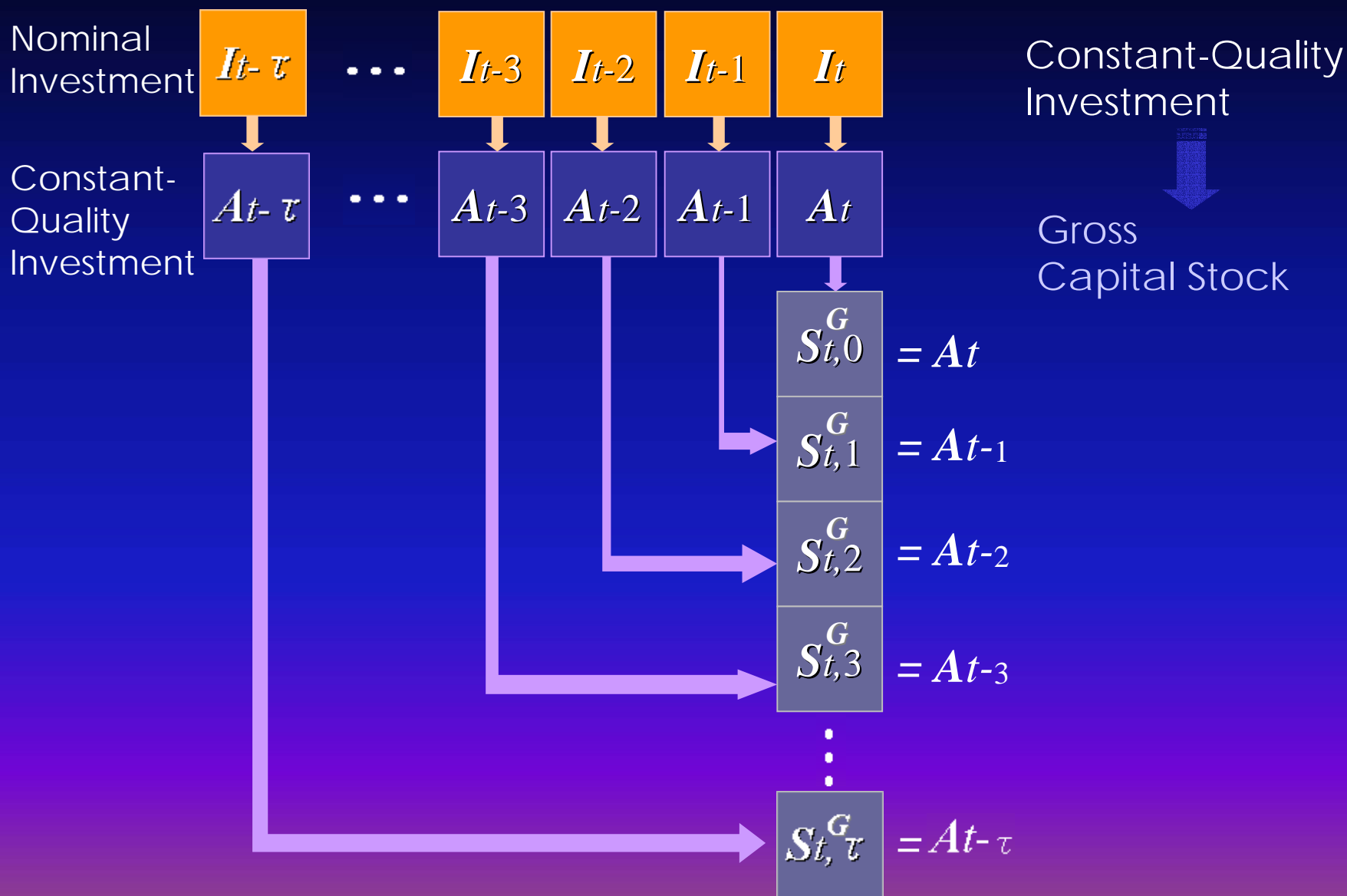
Gross
Capital
Stock

Net
Capital
Stock

Three Concepts of Capital Stock



Gross Capital Stock



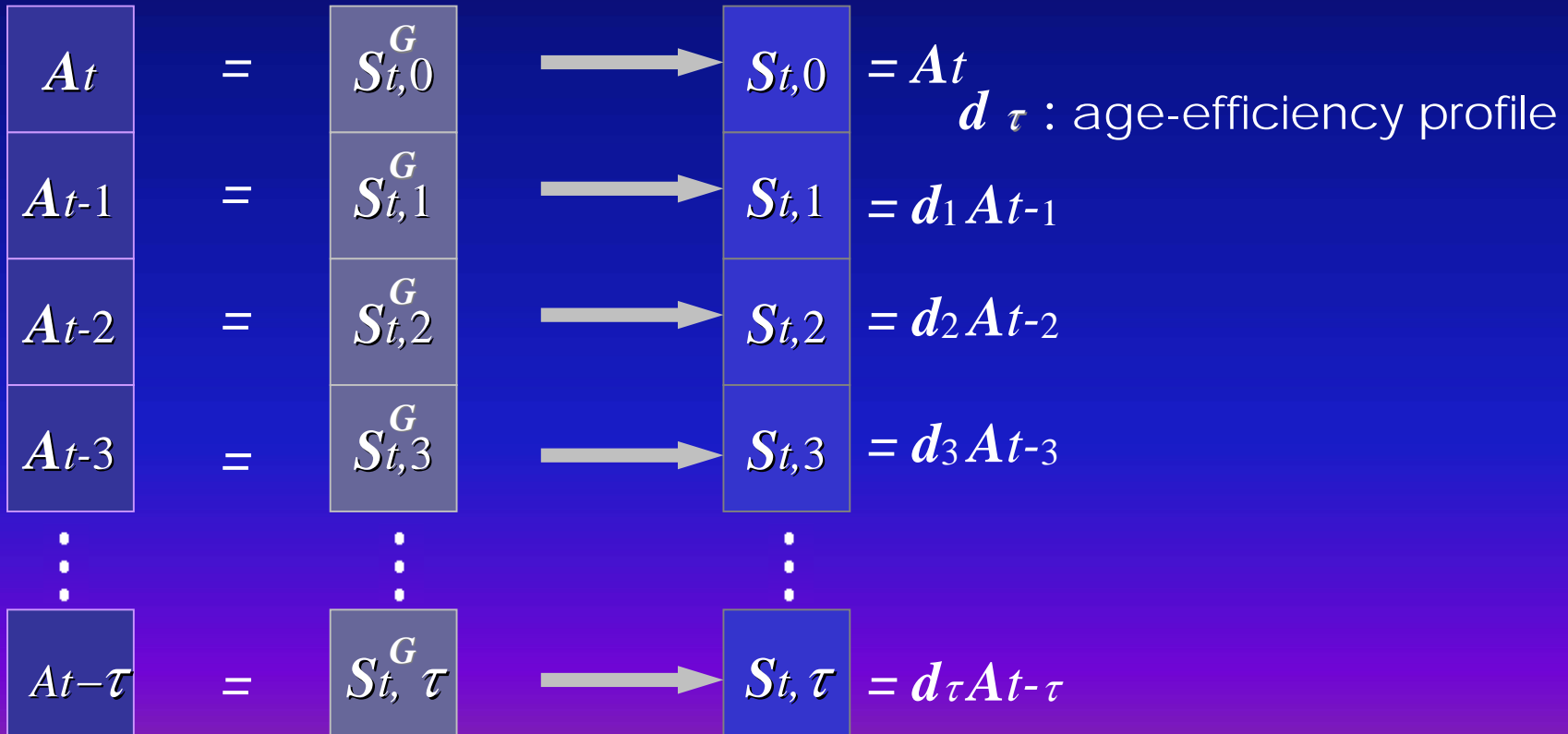
Productive Capital Stock

Constant
Quality
Investment

Gross
Capital
Stock



Productive
Capital Stock



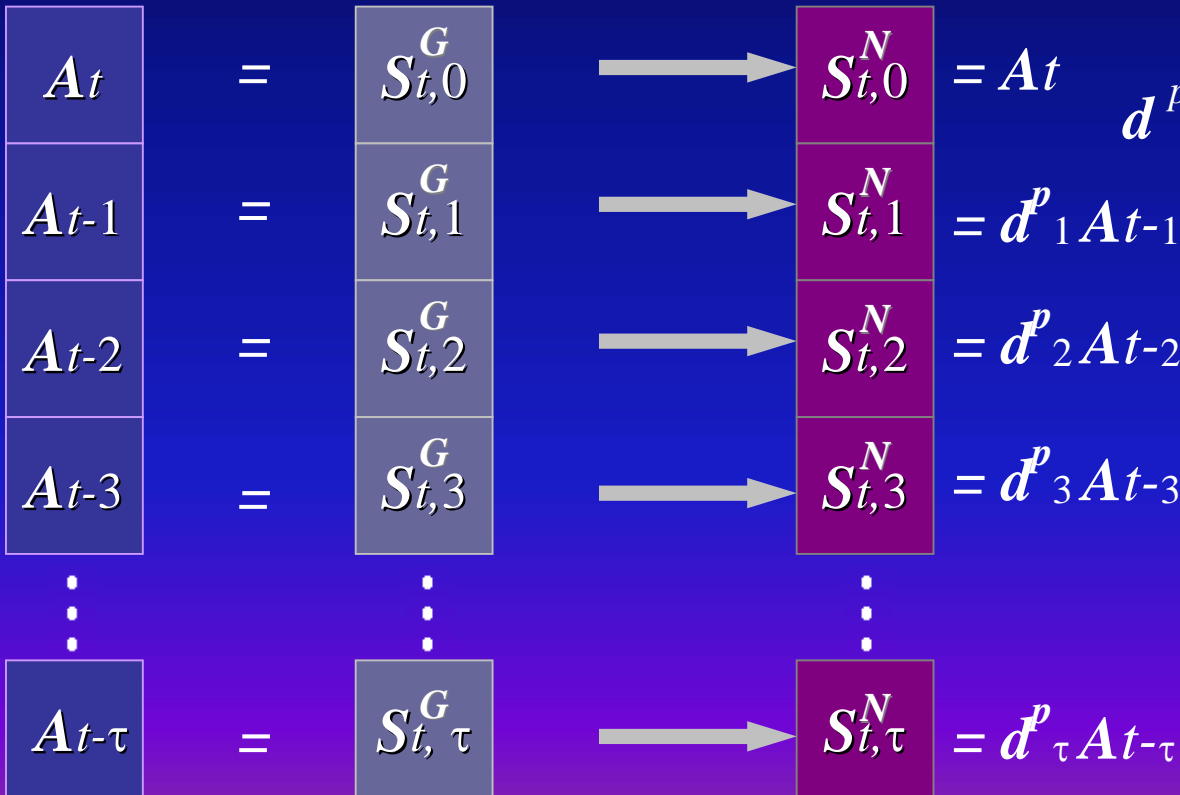
Net Capital Stock

Constant
Quality
Investment

Gross
Capital
Stock



Net
Capital Stock



d^p_τ : age-price profile

Order of Magnitudes in Three Capital Stock

$$S_t^N = S_t = S_t^G$$

under Usual AEP

$$S_t^N < S_t = S_t^G$$

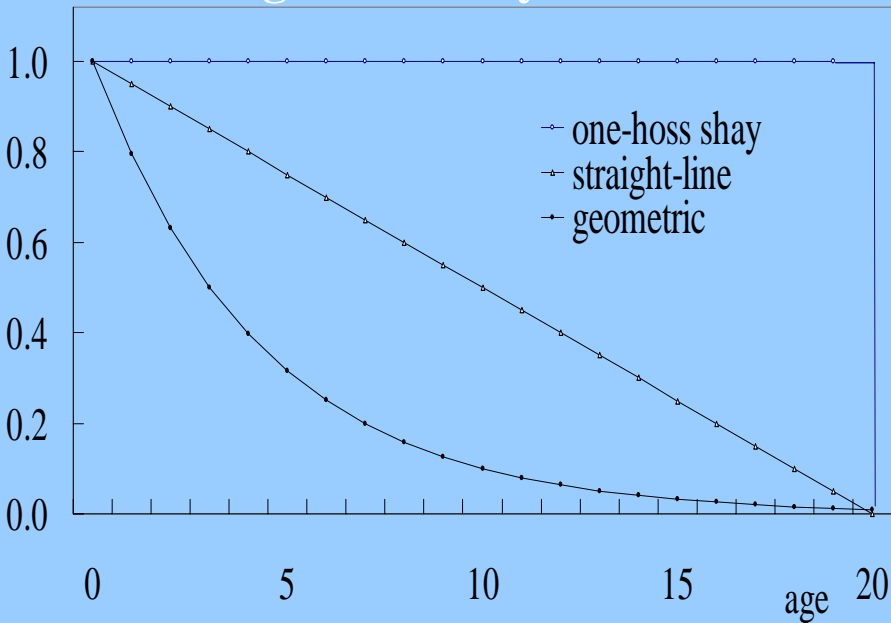
under one-hoss shay

$$S_t^N = S_t < S_t^G$$

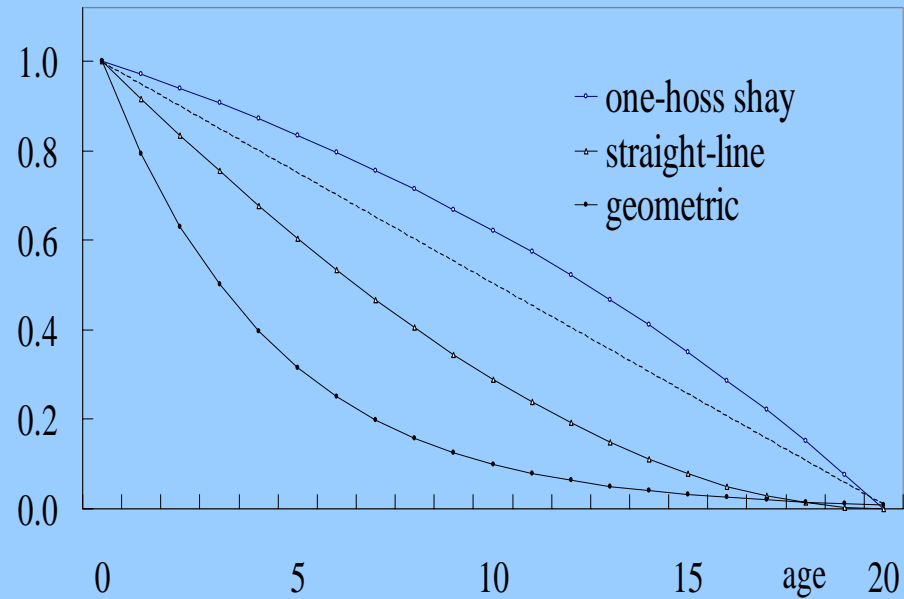
under BGA

Age-Efficiency Profile and Age-Price Profile

Age-Efficiency Profile



Age-Price Profile



Discount rate=0.05,
Average Life $T_{1\mu\epsilon}=20(\delta=0.2057)$

Geometric vs Hyperbolic

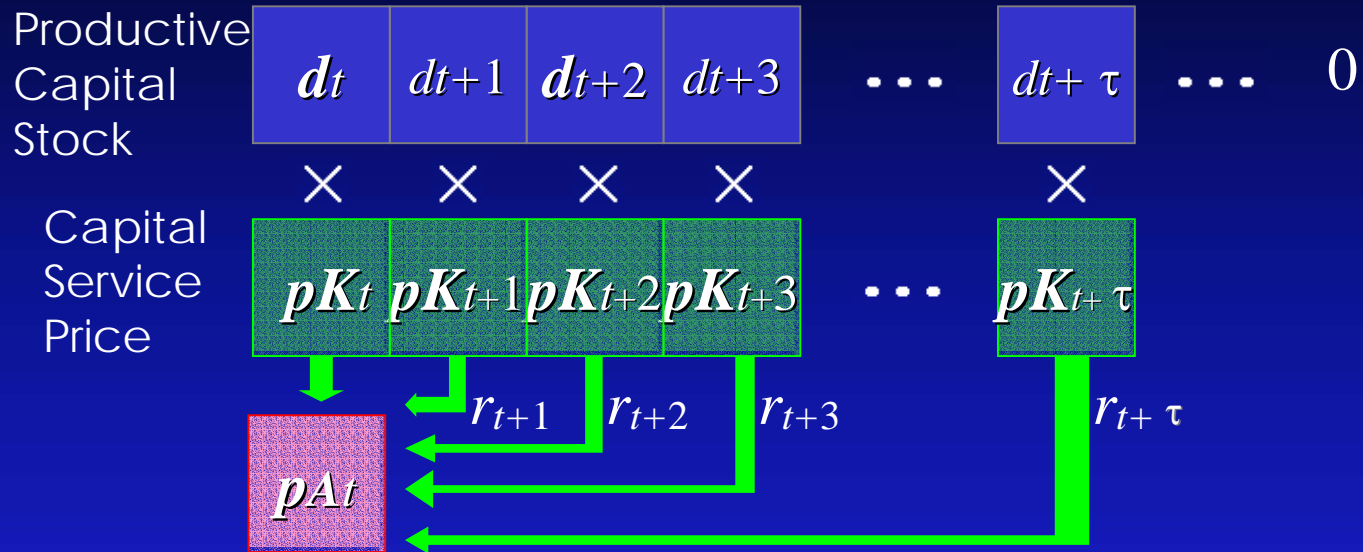
Geometric

- $d_{\tau} = (1 - \delta) \tau$
- AEP and APP are identical
- Simplify Perpetual Inventory Method
(possible to neglect the age structure for aggregating assets with different ages)
$$S_t = (1 - \delta) S_{t-1} + A_t$$
- The U.S. BEA, the Statistics Canada

Hyperbolic

- $d_{\tau} = (T - \tau) / (T - \beta \tau)$
- More Flexible
 - one-hoss shay in case of $\beta = 1$
 - concave function in case of $0 < \beta < 1$
 - straight line in case of $\beta = 0$
 - convex function in case of $\beta < 0$
- The U.S. BLS, Australian Bureau of Statistics

Capital Value and Rental Prices



pA_t = value of new asset

$pA_{t,\tau}$ = value of asset with age: τ

$d^P_{t,\tau} = \frac{pA_{t,\tau}}{pA_t}$: age-price profile

Capital Value and Depreciation

The difference of Value

$$(P_{t-1,\tau} - P_{t,\tau+1}) = (P_{t,\tau} - P_{t,\tau+1}) - (P_{t,\tau} - P_{t-1,\tau})$$

$$(P_{t-1,\tau} - P_{t,\tau+1})$$

: time-series depreciation (Hill, Diewert),
full depreciation (Oliner), economic depreciation and asset
inflation (Hulten-Wykoff)

$$(P_{t,\tau} - P_{t,\tau+1})$$

: cross-section depreciation (Hill, Diewert), partial
depreciation (Oliner), economic depreciation (Hulten-
Wykoff)

$$(P_{t,\tau} - P_{t-1,\tau})$$

: revaluation

BEA's Revision in 1997

Wealth Account

- Net Capital Stock

Survival Function + Straight-line for Decay

→ Geometric Distribution as a Default

- Gross Capital Stock

→ No Longer Produced!

Production Account

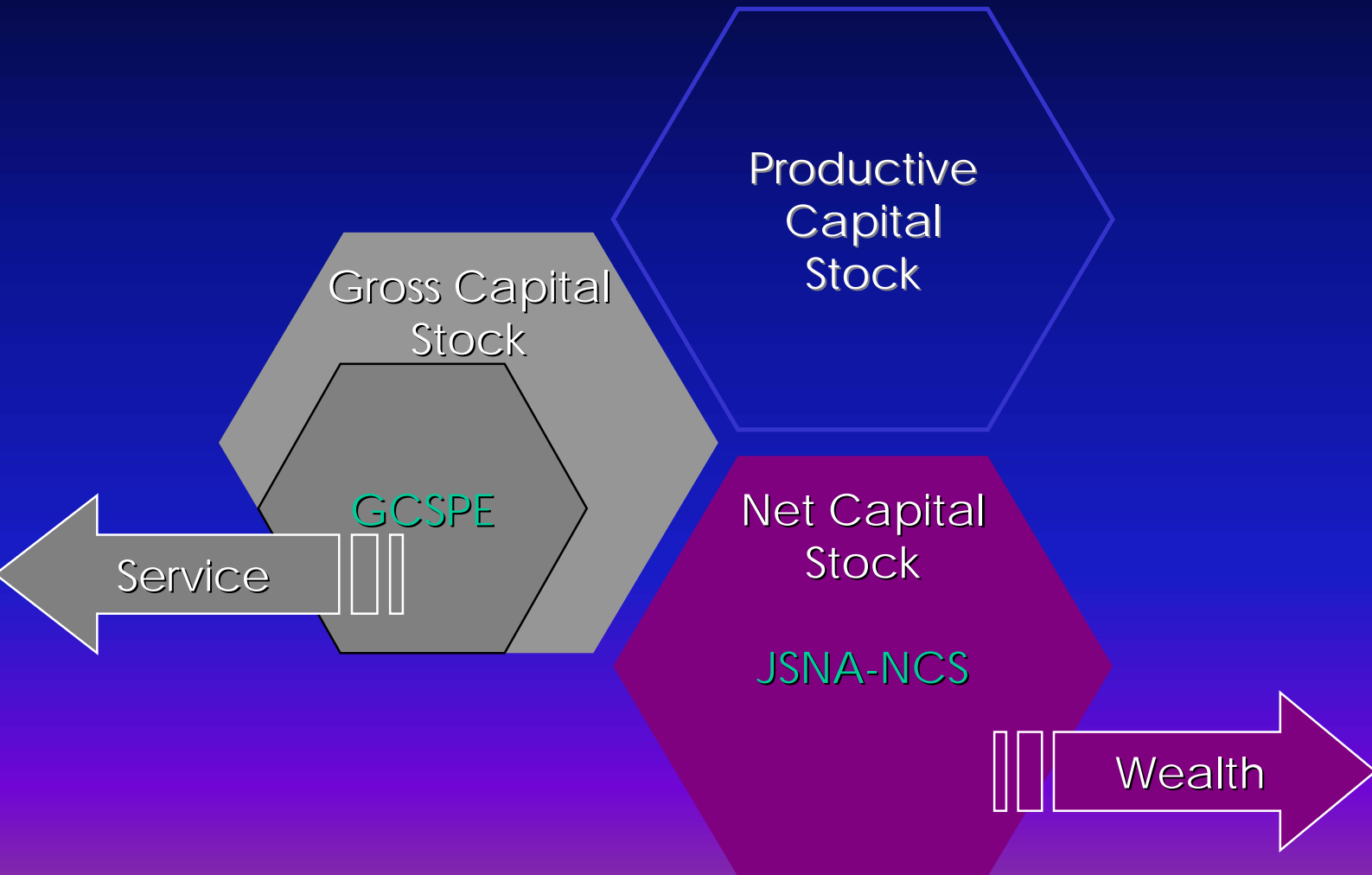
- Consumption of Fixed Capital

→ Consistent with Stock Measurement

Time-series Depreciation

→ Cross-section Depreciation

Capital Stock in the Japanese National Accounts



Net Capital Stock in the Japanese National Accounts

JSNA-NCS

- Six Tangible Assets
 - : 1) dwellings, 2) other building, 3) other structures, 4) transport equipment, 5) other machinery and equipment, 6) cultivated assets
- One Intangible Assets
 - : custom software, only
- Depreciation Distribution
 - : Straight-line for infrastructure
Geometric for other assets
- Benchmark Year
 - : 1970 National Wealth Survey
- Underestimate?
 - : 30-40 percent lower than our estimates in 2000
due to too-high depreciation rates ?

Consumption of Fixed Capital in the Japanese National Accounts

JSNA-CFC

- Prices

 - : Based on Historical Prices (Book-Value)

- CFC in the 1993 SNA

 - : “Its value may deviate considerably from depreciation as recorded in business accounts or as allowed for taxation purpose, especially when there is inflation” (paragraph 6.179)

Gross Capital Stock in the Japanese National Accounts

GCSPE (Gross Capital Stock of Private Enterprises)

- Coverage

 - All assets, except residential owned by company

 - Excluding Non-profit Institution

- No Assets Classification

- No Investment in Current Prices

- Overestimate as Production Capacity?

 - : 20 percent higher than our estimates in 2000

Alternative Estimates

Periods

- 1960-2000 (1955-2000 for Capital Stock)

Classification

- 102 Asset Classification by 70 Sectors

Assets: 90 Tangible Assets, 5 Intangible Assets
(3 Software, others), 3 Inventories, 4 Types
of Land

Sectors: 45 industries, Government,
Household, 23 Infrastructures

Geometric Approach

- $AEP=APP$

Price and Quantity of Capital Service

Basic Assumption

- $K_t^{kj} = \phi^{kj} S_t^{kj}$, ϕ = annualization factor (constant)

Capital Service Prices

- $P^{K,kj}_t = (r_t - \pi_t^k) P^{A,k}_{t-1} + \delta^k P^{A,k}_t$

: Capital Service Price =

Opportunity Cost of Financial Assets

- Revaluation + Cross-section Depreciation

- $V^{K,j}_t = \sum_k P^{K,kj}_{t-1} K_t^{kj}$

- Endogenous Rate of Return (after tax rate of return on equity) by Industry

- Japanese Tax Structure

Corporate income tax, business income tax, property tax, acquisition tax, capital consumption allowance, income allowance and reserves, special depreciation, capital gain tax, dividend tax

Capital Stock and Services in Japan : In Case of Fixed Assets

	Z	Z*	K		GCSPE
1960-65	9.11	7.80	13.88	<	11.55
1965-70	10.44	9.53	12.27	<	12.45
1970-75	9.56	9.25	9.96	<	10.10
1975-80	6.15	6.18	5.81	<	6.38
1980-85	4.80	4.69	5.24	<	6.72
1985-90	5.04	4.87	6.02	<	6.79
1990-95	4.42	4.40	5.08	<	5.15
95-2000	2.56	2.60	2.49	<	3.48
60-2000	6.51	6.16	7.59	<	7.83

Source: Nomura[2004a]

Capital Stock and Services in Japan : In Case of Total Assets

	Z	Z*	K		ref:GCSPE
1960-65	4.97	3.64	9.85	<<	11.55
1965-70	5.94	4.93	9.76	<<	12.45
1970-75	5.43	5.05	8.17	<<	10.10
1975-80	3.79	3.57	4.67	<<	6.38
1980-85	2.73	2.57	3.87	<<	6.72
1985-90	2.69	2.68	4.94	<<	6.79
1990-95	2.42	2.52	3.82	<<	5.15
95-2000	1.74	1.73	2.05	<<	3.48
60-2000	3.72	3.34	5.89	<<	7.83

Source: Nomura[2004a], GCSPE is defined by fixed assets only.

Land as a Capital

Share of Land to Total Capital Stock in 2000

- 23.6 percent in the U.S. (Jorgenson-Landefeld. 2005)
- 43.5 percent in Japan (Nomura, 2004)

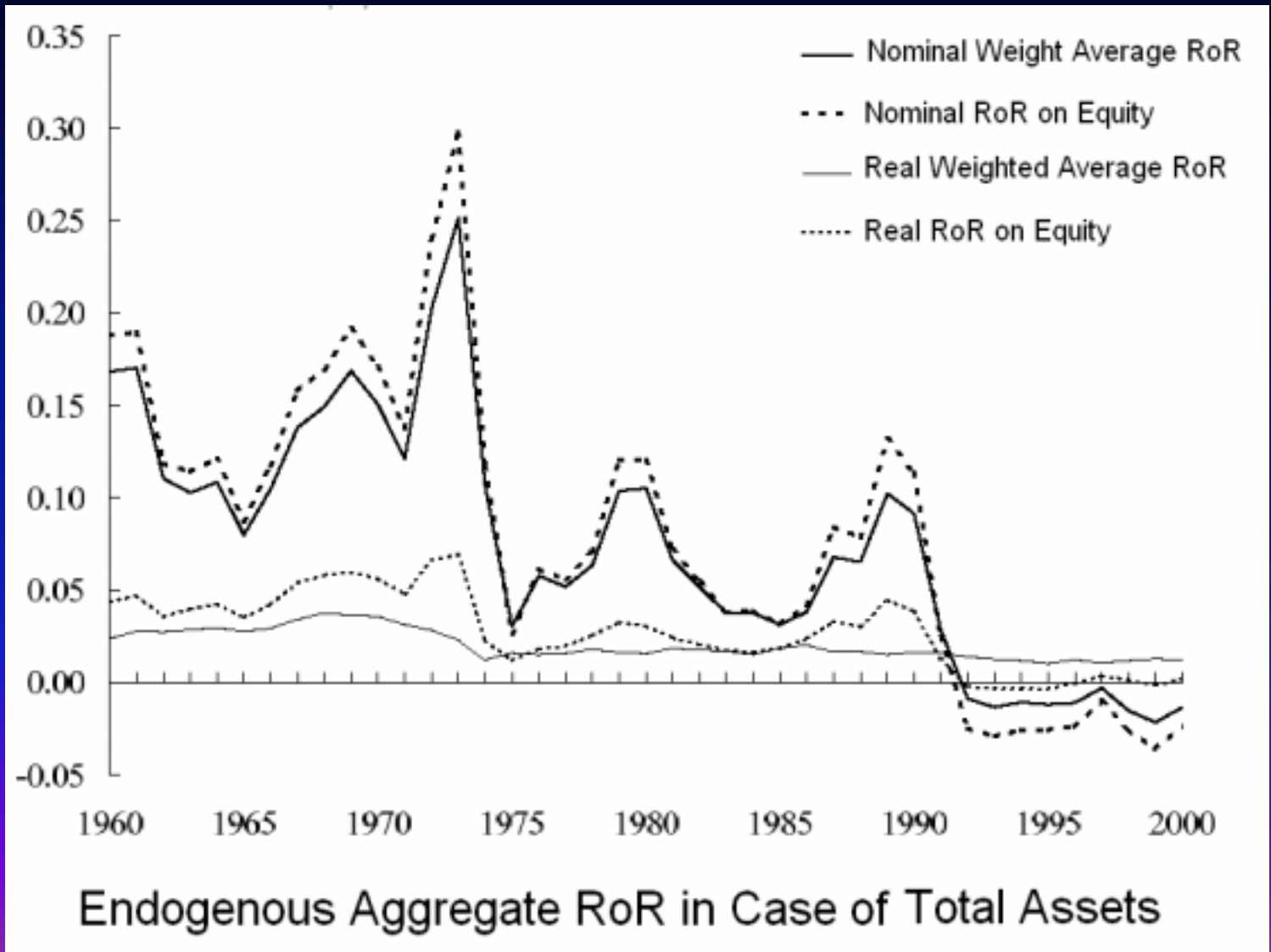
Impacts to TFP

- Canada: Neglecting of land and inventories leads to a decline in average TFP growth rates of 0.1 percent per year during 1963-96 (TFP Growth=0.5-0.6), Diewert-Lawrence (2000)
- Japan: Neglecting of land and inventories leads to a decline in average TFP growth rates of 0.7 percent per year during 1960-2000 (TFP Growth=1.5), Nomura (2004)

Impacts to Relative Prices in 1990 (Nomura, 2004)

- Relative Price of Capital Stock between the U.S. and Japan
1.31 for fixed assets → 3.05 for total assets
- Relative Price of Capital Services between the U.S. and Japan
1.36 for fixed assets → 1.70 for total assets

Endogenous Ex-Post RoR



Capitalization of Software

Japanese National Accounts

- Custom Software, only

Benchmark Input-Output Table

- 1995:
Custom Software
- 2000:
Custom Software, Prepackaged Software

Methodology to Estimate Own-Account Software

- Recommendations by the OECD Task Force on Software Measurement in the National Accounts:
- BEA Methodology by Industry: 1997, 1999, 2003

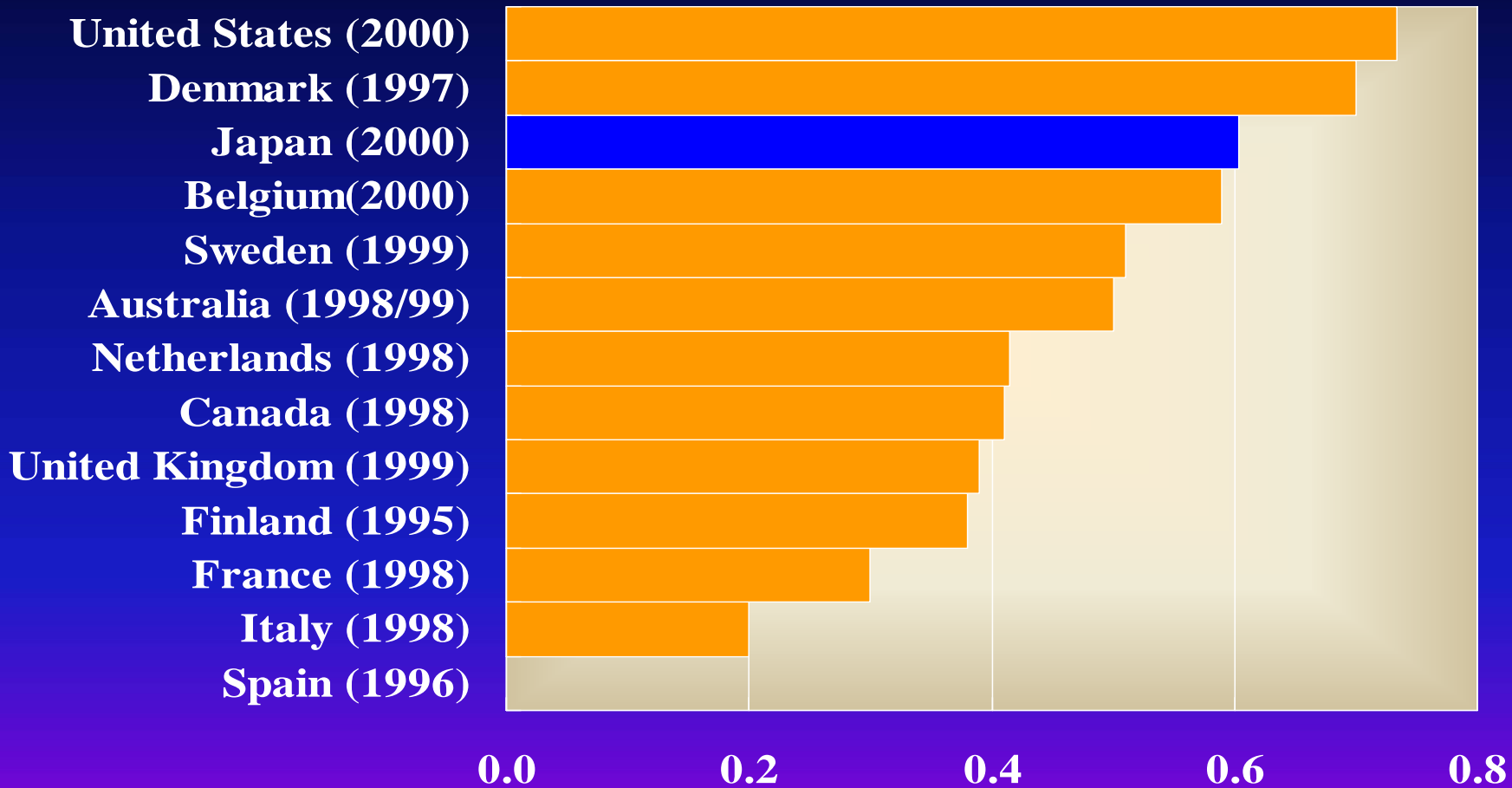
International Comparison of Software Professionals

	Year	Share to total employees	ISCO-213	ISCO-312	ISCO- 213/ (213+312
Greece	1998	0.2	7444	7196	50.8
Spain	1998	0.3	44026	34107	56.3
France	1998	0.4	196705	99011	66.5
Netherlands	1998	0.9	100765	82144	55.1
U.S.	2000	1.3	1633280		
Sweden	1999	1.3	75881	24474	75.6
Japan	2000	1.4	753493	363753	67.4

Data: Employee Base, U.S.(Occupational Employment and Wages, BLS),
Japan(Population Census, MIC), Others(OECD, Ahmad [2003])

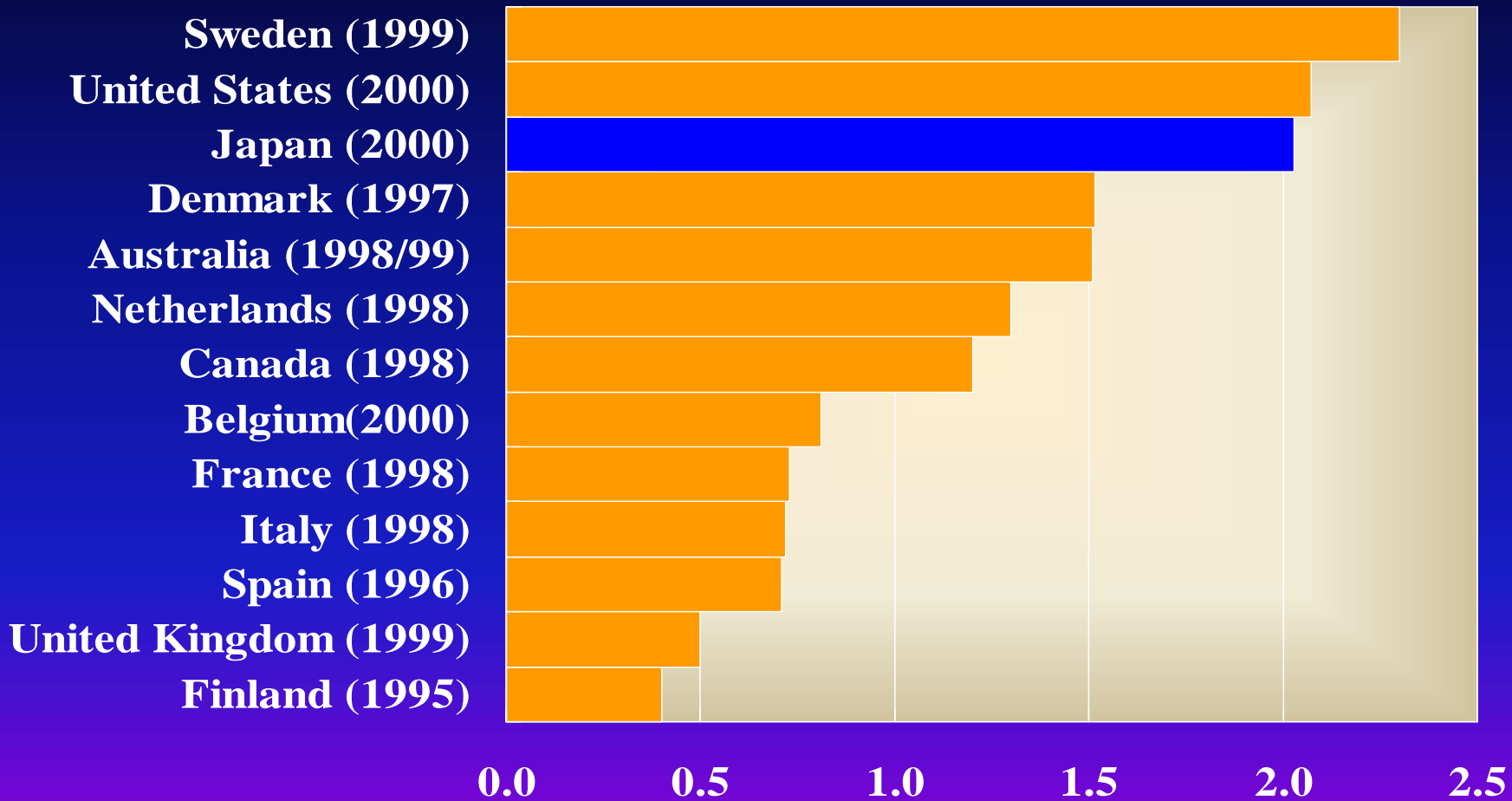
Classification: U.S. SOC-15-1020,30, 50 and JSCO-06 correspond to ISCO-213

International Comparison of Own-Account Software Investment Share to GDP



Source: Japan (Nomura, 2004), U.S. (BEA), Belgium (Hermans, 2002), others (Ahmad, 2003)

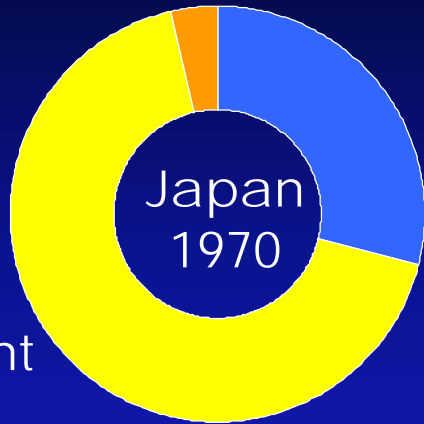
International Comparison of Total Software Investment Share to GDP



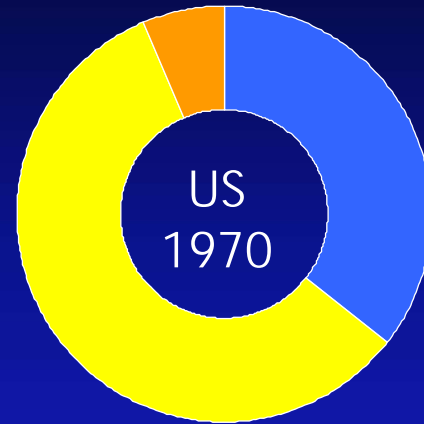
Source: Japan (Nomura, 2004), U.S. (BEA), Belgium (Hermans, 2002), others (Ahmad, 2003)

Composition of Software between the U.S. and Japan

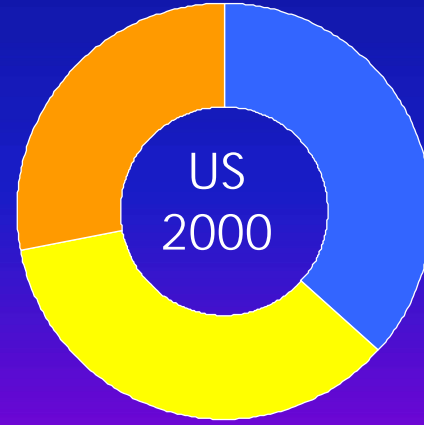
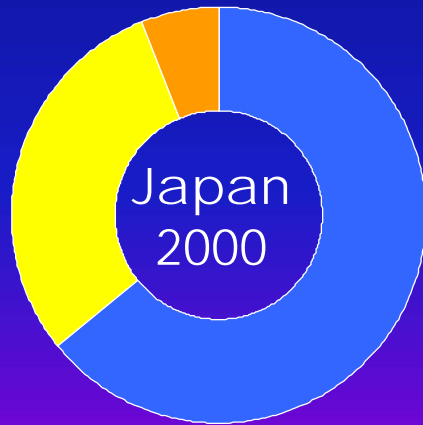
Prepackaged



Custom

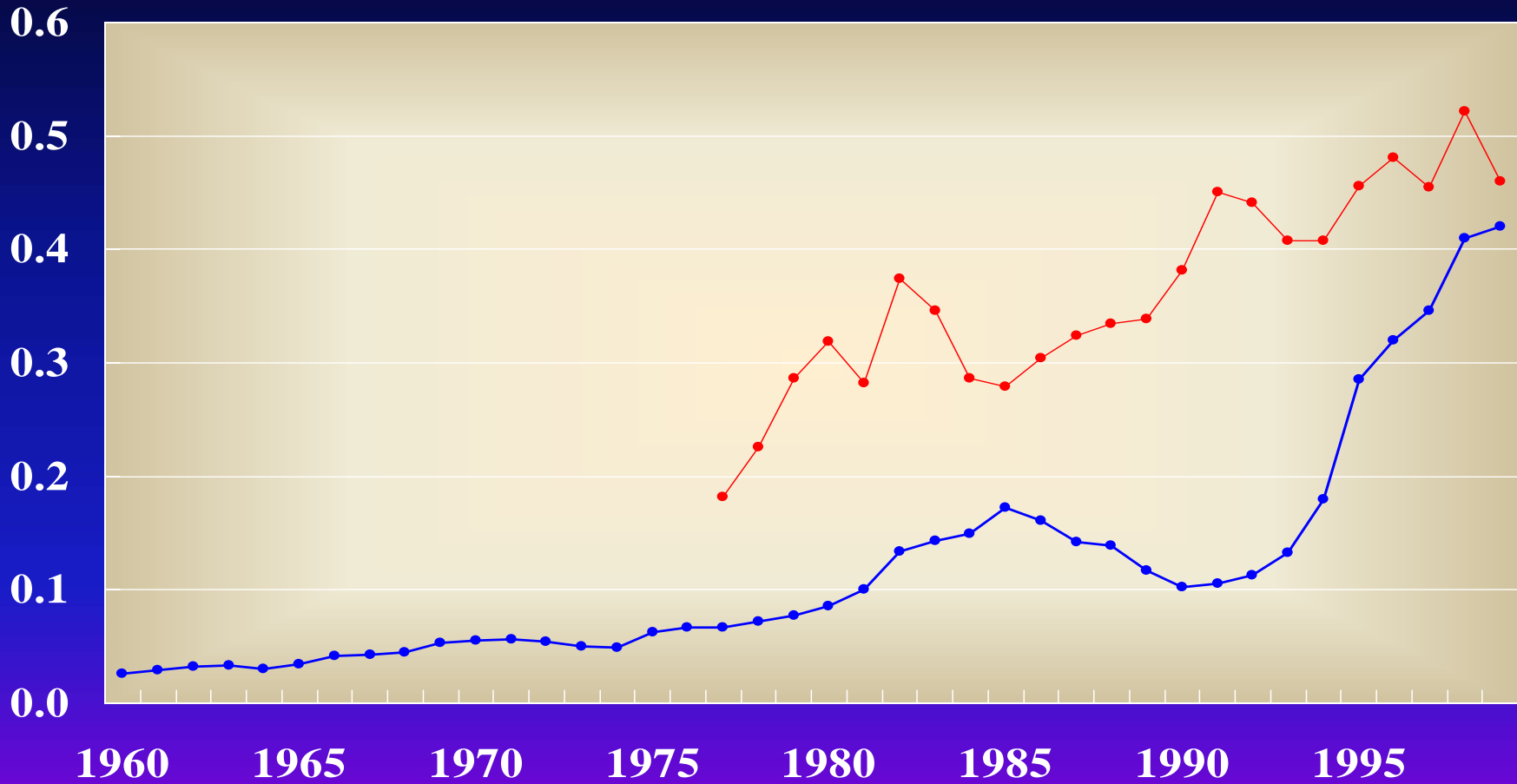


Own-Account



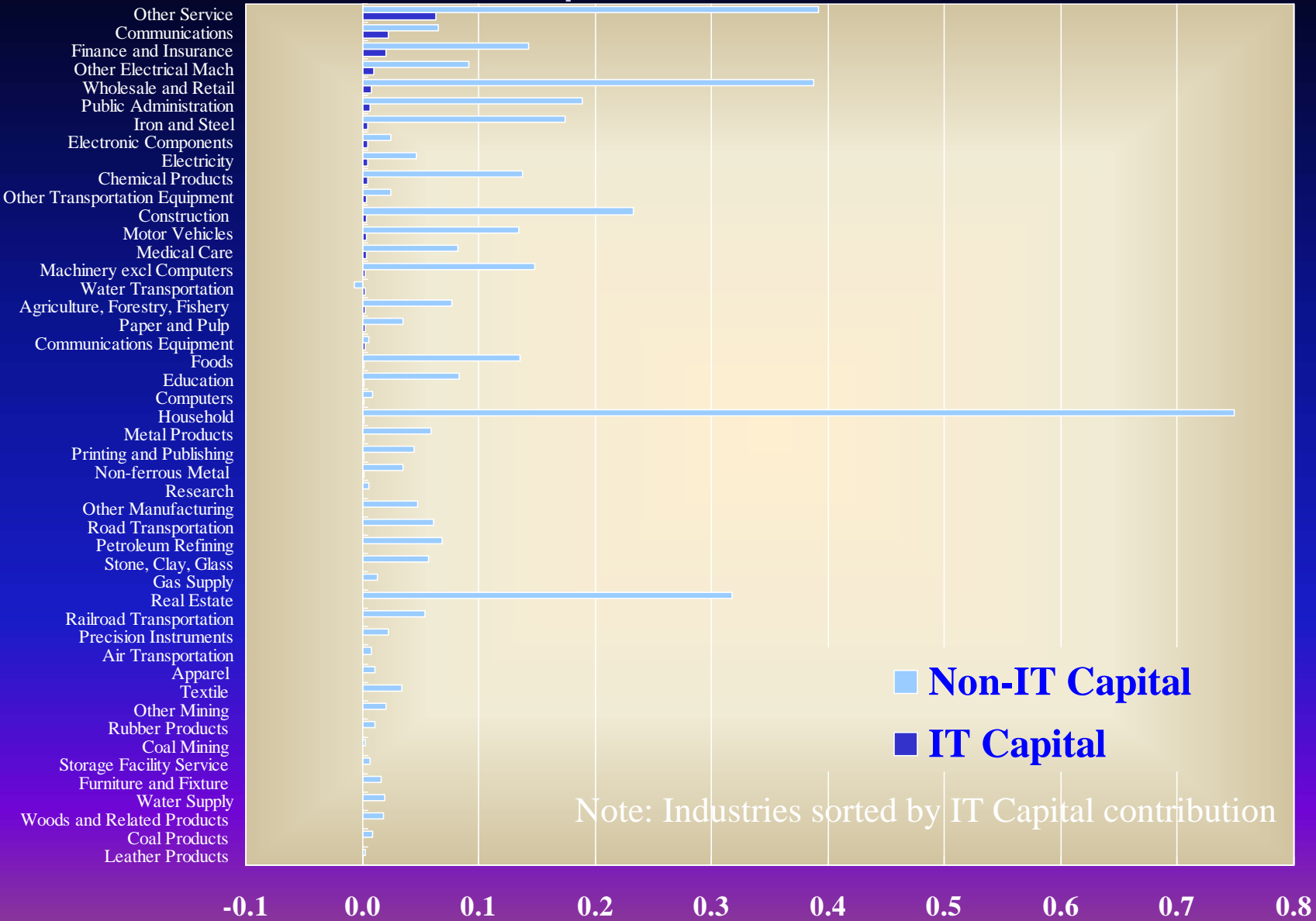
Source: Japan (Nomura,2004), U.S. (BEA)

IT Capital Contribution Share to Total Capital Service



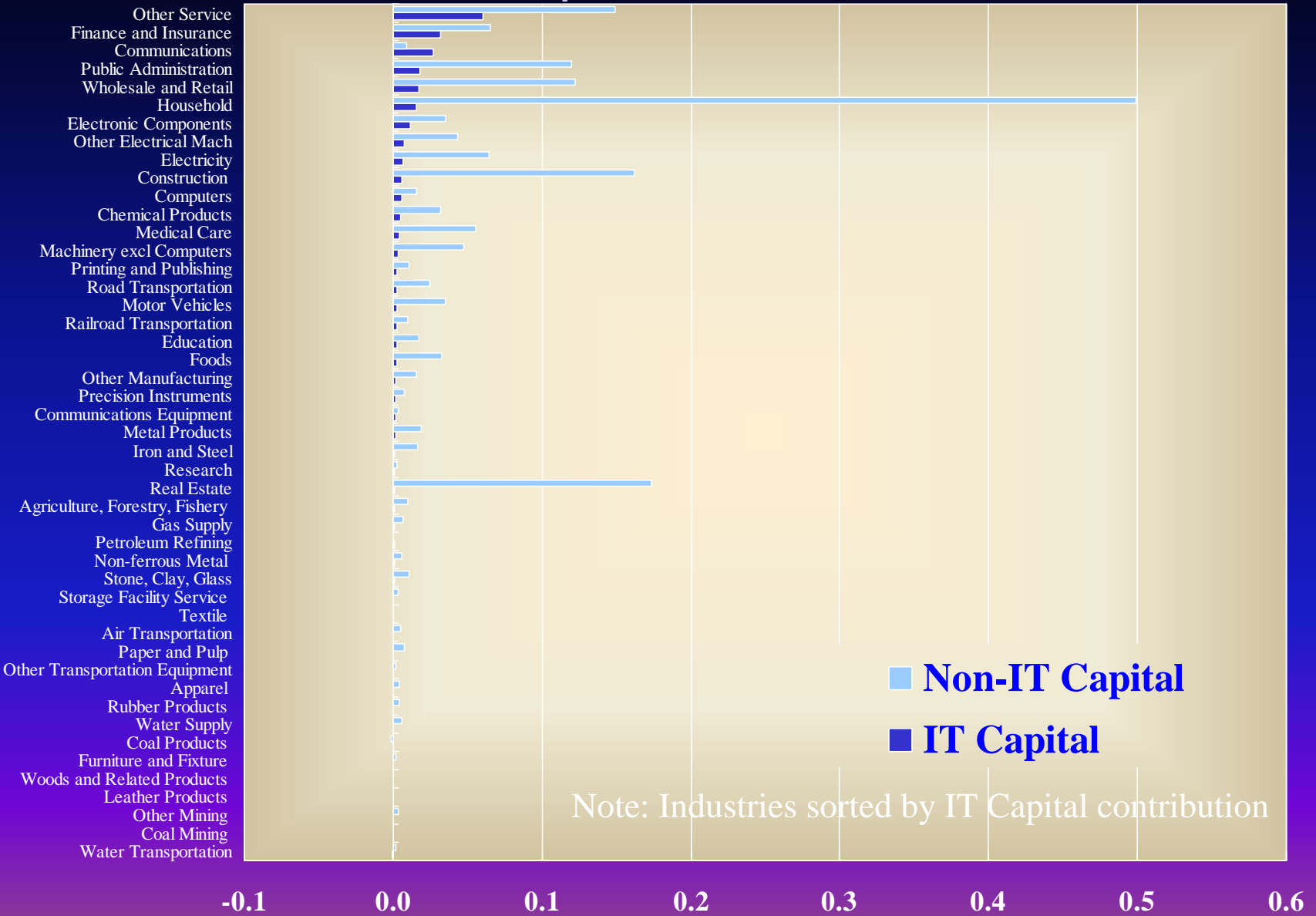
Source: U.S. (Jorgenson, Ho, Stiroh, 2005), Japan (Author's Estimate)

Industry Capital Input Contributions in Japan, 1960-1977



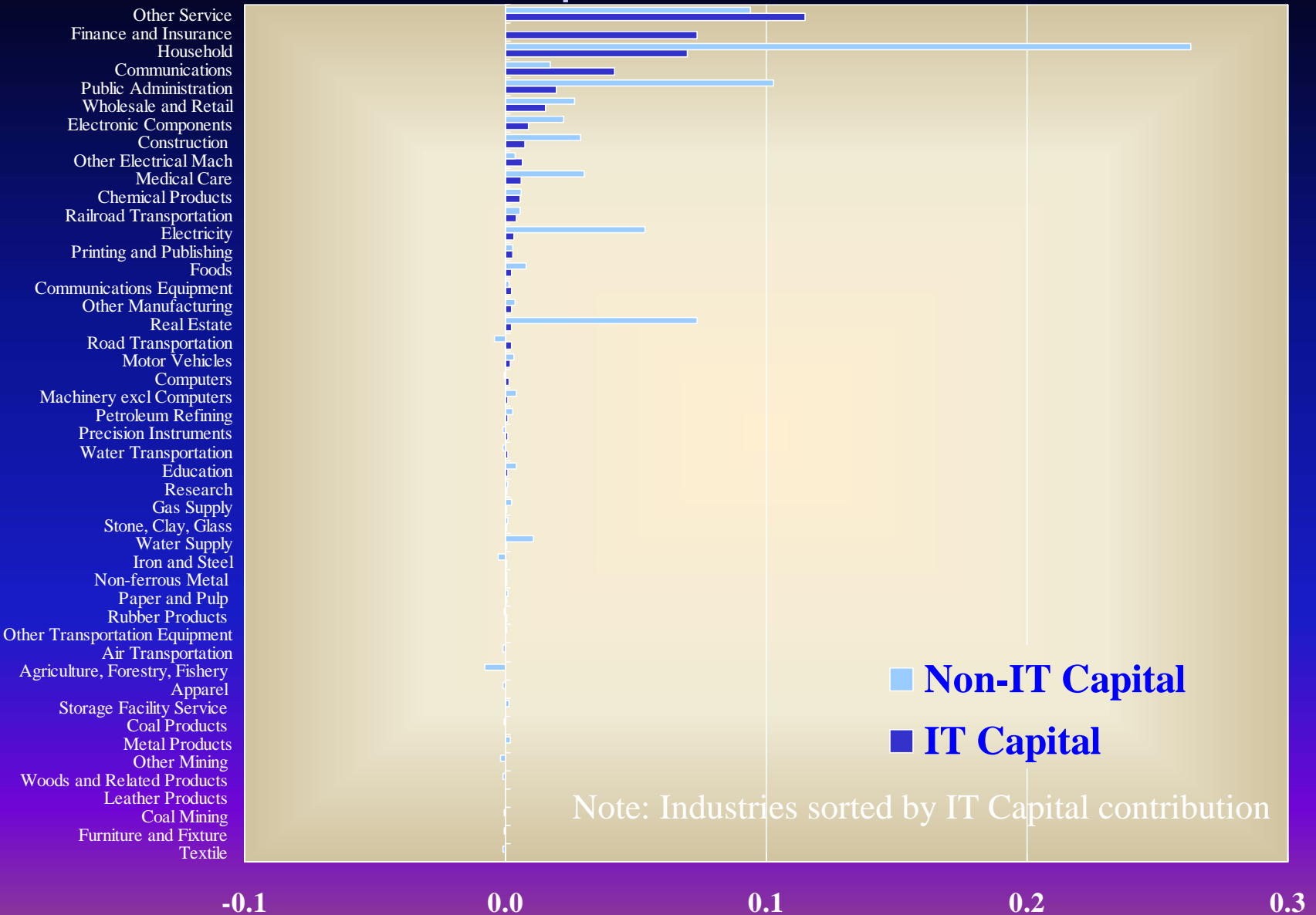
Note: Industries sorted by IT Capital contribution

Industry Capital Input Contributions in Japan, 1977-1995

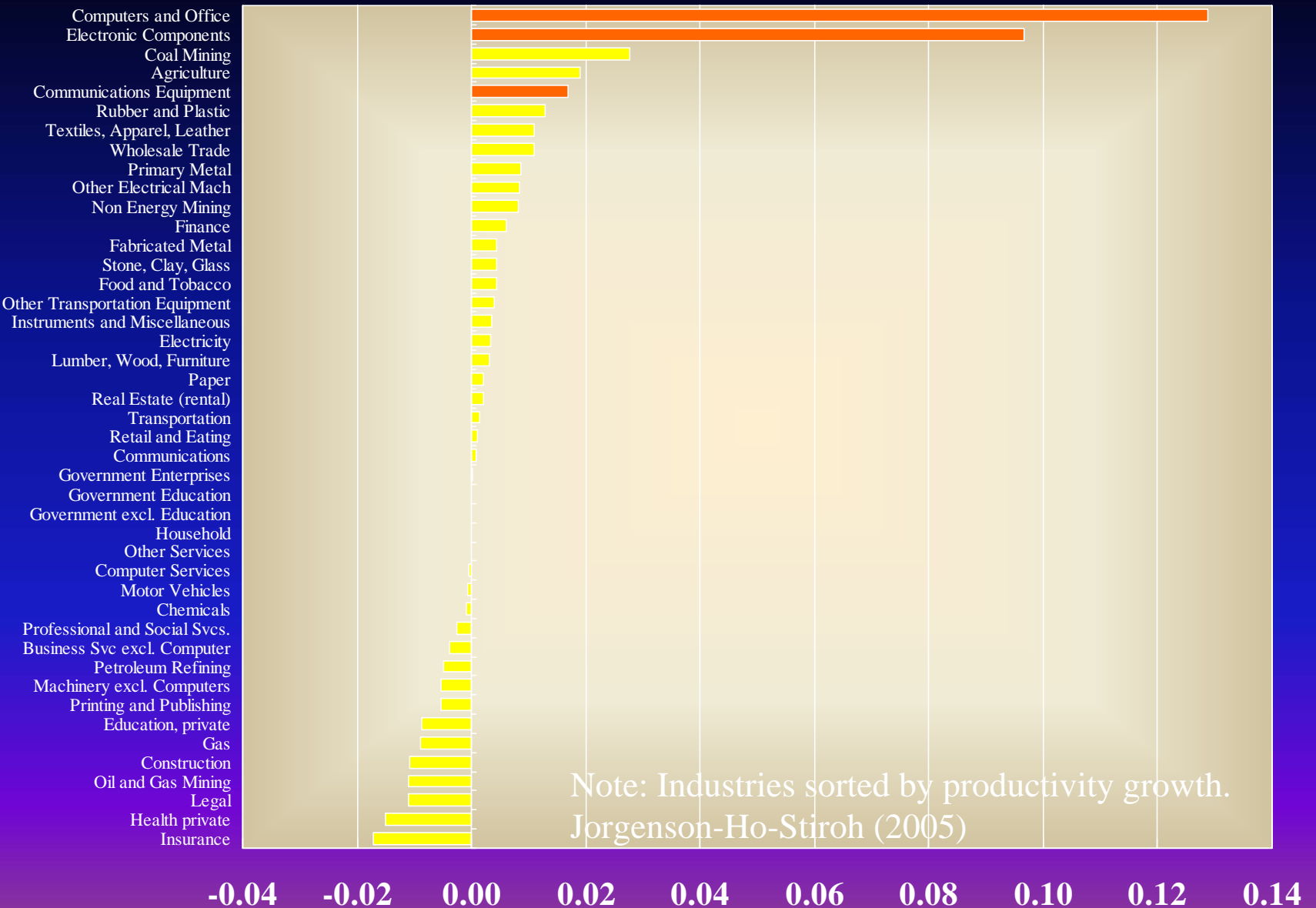


Note: Industries sorted by IT Capital contribution

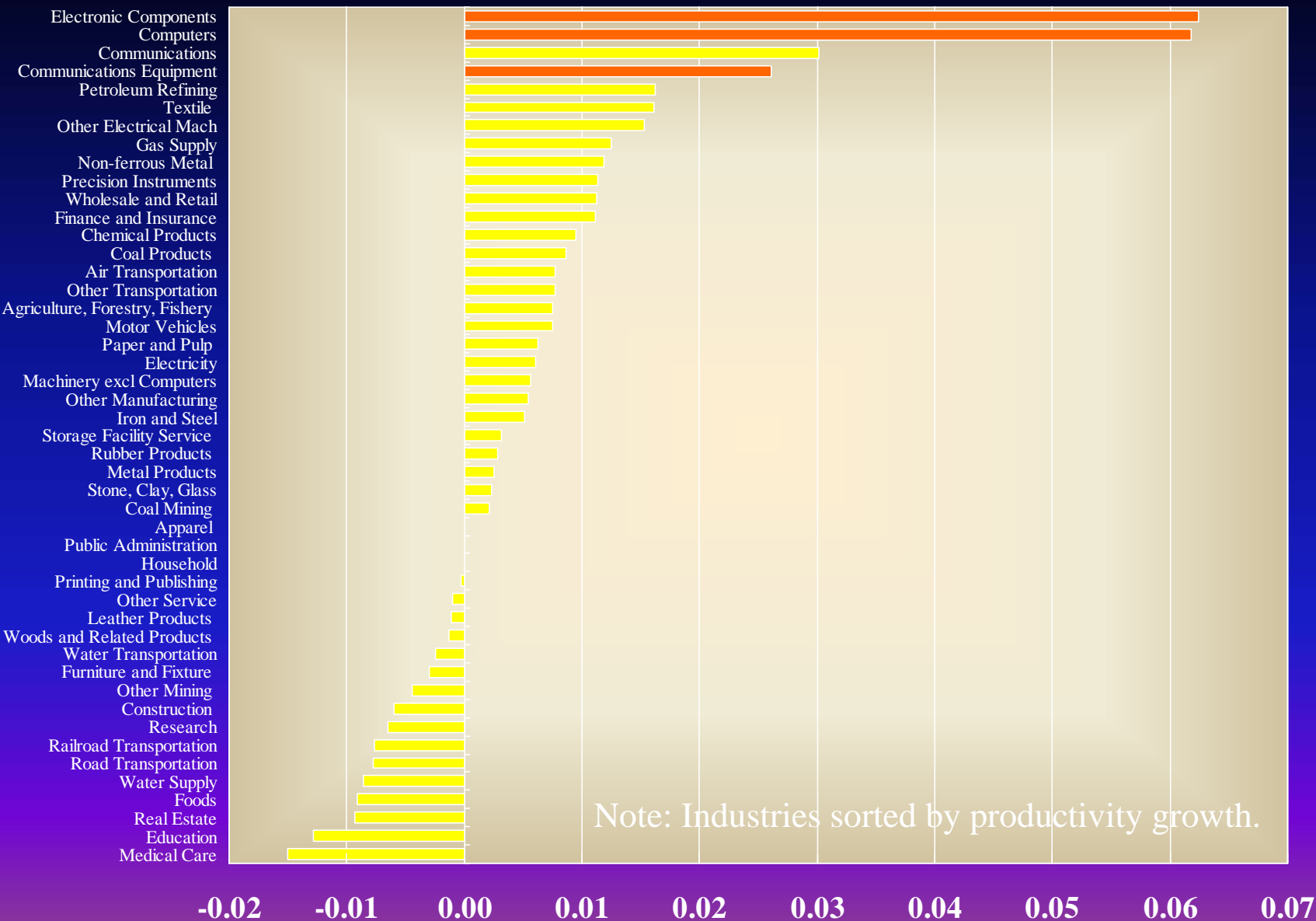
Industry Capital Input Contributions in Japan, 1995-2000



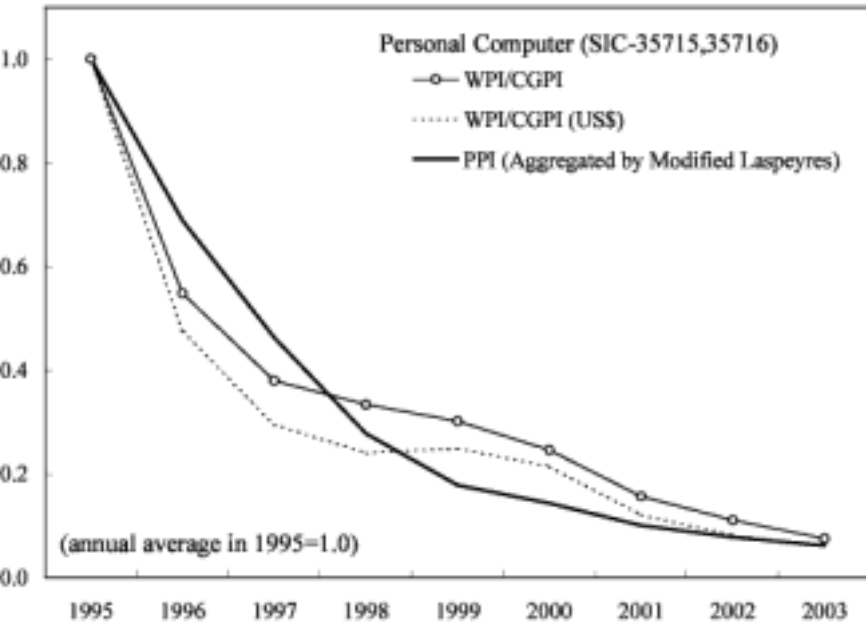
Industry Productivity Growth in the U.S., 1977-2000



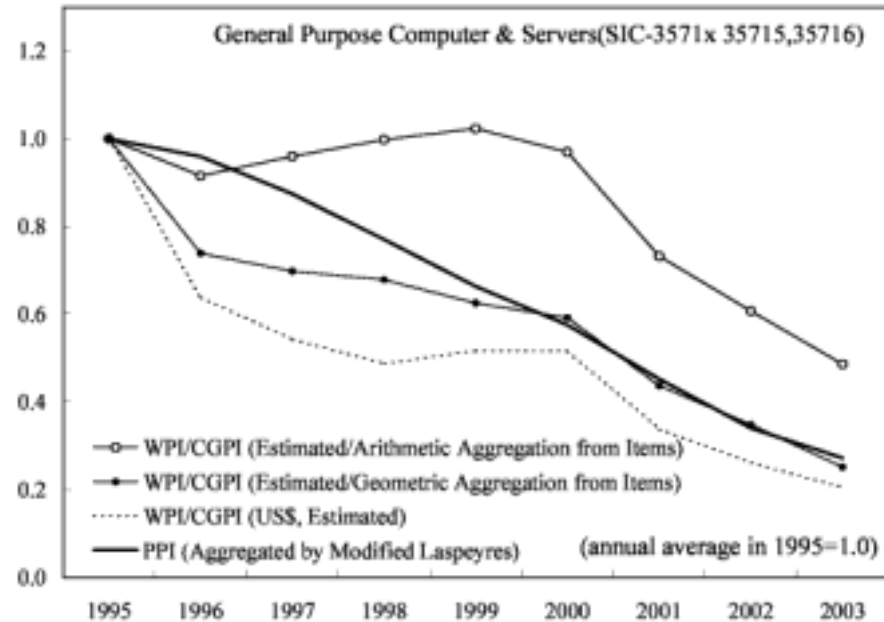
Industry Productivity Growth in Japan, 1977-2000



Comparison of Computer Price at 5-digit SIC between the U.S. and Japan



(a) Personal Computers



(b) General Purpose Computers & Servers

WPI/CGPI and PPI: 5-digit SIC

Price Aggregation at the Most Detailed Item

Price Aggregation in the Most Detailed Item

- BOJ's CGPI Laspeyres:
Defined by Carli Price Index
(Simple Arithmetic Average)
:ESRI uses CGPI Laspeyres at the Most Detailed Level
- BOJ's CGPI Chained-Las:
Defined by Jevons Price Index
(Simple Geometric Average)
- Carli Price Index has an Upward Bias
(Fisher, Diewert)

Who Extrapolate Prices Backward ?

Price Statistics

Prices for National
Accounts

U.S.

BLS-PPI

BEA-Price

Japan

BOJ-CGPI

ESRI ?

Prices for Investment as a Composite Goods

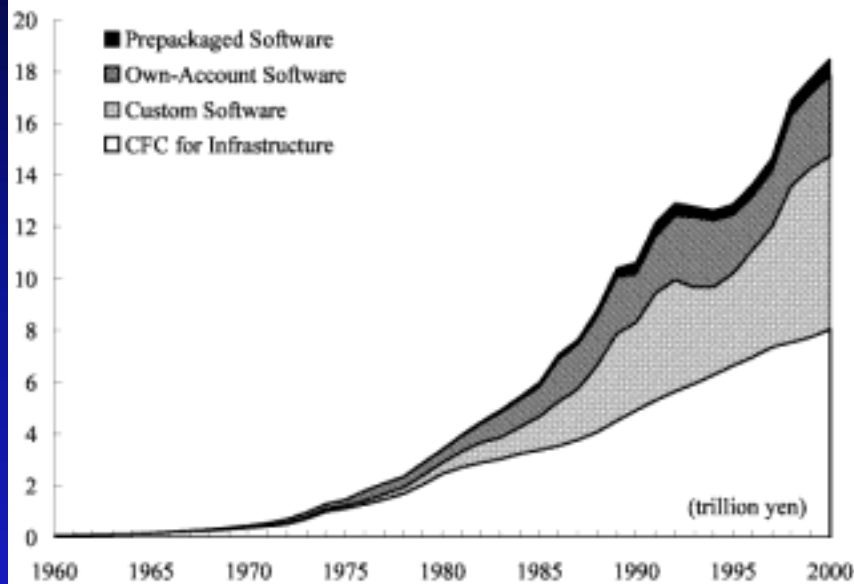
Why the Investment Price for Computer Declines
Faster than Producer's Price in BEA

- Investment Prices Should Be Defined by Purchaser's Prices

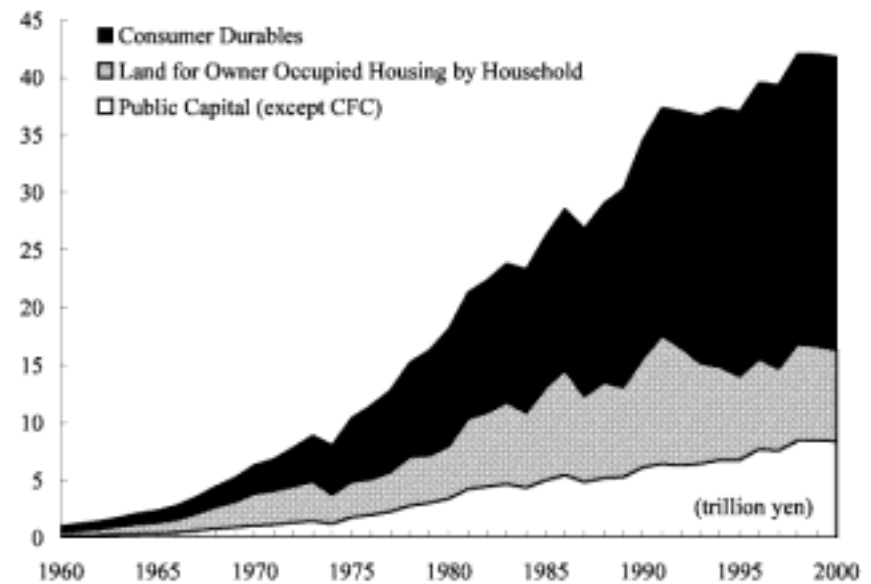
Prices Can be Estimated and Revised Separately

- Investment Goods is Defined by Final Goods
- Embodiment: Software → Computer → Office Building

Capital Service Cost for Non-Market Production



(a) for 93 SNA Concepts



(b) for Non-Market Production

Additional Capital Service Cost for Non-Market Production

Source: Author's Estimate

Conclusion: Proposals for Reframing Measurement of Capital in the Japanese National Accounts

- (i) Capitalization of Software
- (ii) Reframing Net Capital Stock and Consumption of Fixed Capital
- (iii) Gross Capital Stock to Productive Capital Stock
- (iv) Constant-Quality Prices in Japan
- (v) Empirical Studies for AEP and APP in Japan
- (vi) Measurement of Price and Quantity of Capital Services
- (vii) Land as a Capital
- (viii) Capital Service cost for Non-Market Production